



# From artificial intelligence to artificial human interaction: understand consumer acceptance of smart objects via mental representations of future interactions

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## THÈSE

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**De l'Intelligence Artificielle à l'Interaction Humaine Artificielle : Comprendre le Processus d'Acceptation des Objets Connectés par le Consommateur via les Représentations Mentales de futures interactions**

**From Artificial Intelligence to Artificial Human Interaction: Understand Consumer Acceptance of Smart Objects via Mental Representations of Future Interactions**

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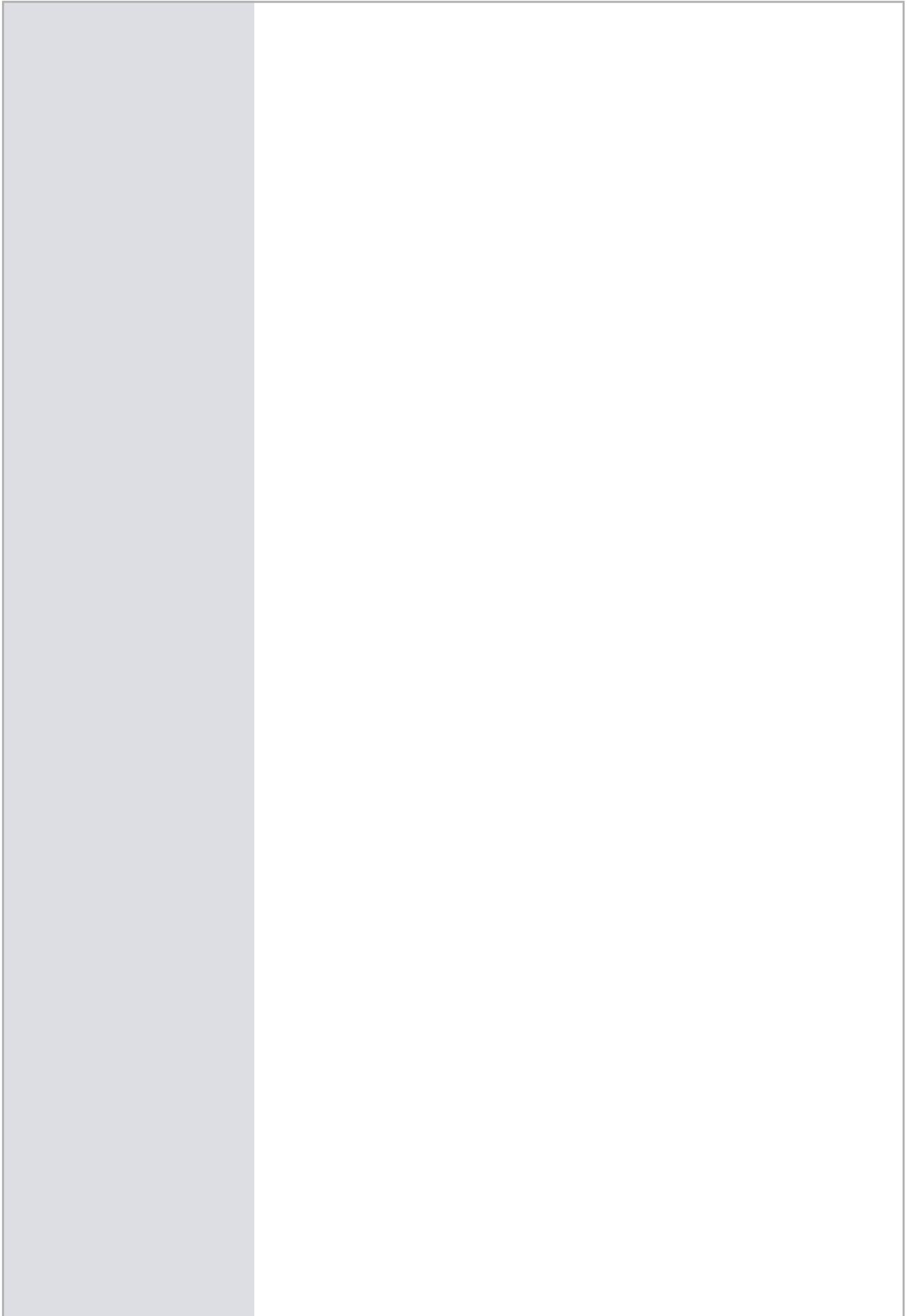
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« The most exciting phrase to hear in science, the one that heralds new discoveries, is not “Eureka!” (I found it!) but “That’s funny ...” »

Isaac Asimov (1987)



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## Introduction

# Table of Contents

Introduction .....	4
Part 1 – A theoretical approach of consumer-smart object interaction .....	29
Chapter 1 - Innovation and Technology Diffusion, an acceptance – resistance perspective	30
I- Technology diffusion and acceptance models .....	31
II- Resistance and negative attitudes toward technology .....	62
III- The struggle for domination and control.....	94
IV- Limits of the Human-oriented ontology in Human-Technology Interaction.....	108
Chapter 2 - Consumer-Smart object relationship .....	119
I- The Object-Oriented Ontology .....	120
II- Assemblage theory and smart objects .....	127
III- Consumer-Smart Objects Interpersonal Relationship Styles .....	148
IV- Consumer-Smart object simulated assemblages .....	167
Conclusion of Part 1 and propositions of investigations.....	178
Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology .....	180
Chapter 1- Epistemological positioning and Methodological implications .....	182
I- Epistemological paradigm .....	183
II- Methodology .....	187
Chapter 2 - Exploring the perception of smart object's innovative capacities from a relational perspective.....	190
I - The Album-On-Line method (AOL) .....	191
II – AOL Scenarios and Sample.....	195
III- AOL Results.....	201
IV- From the AOL to Explaining the Potential Mechanism Activation .....	215
Chapter 3 - Concretization and Conceptualization – Examine and explain how the mechanism operates.....	219
I - Hypotheses and Conceptual model.....	220
II - Measurement scales.....	235
III – Concretization design.....	244
Chapter 4 – Experimental design, results, and discussion .....	246
I – Study 1 - PLS approach .....	248
II – Study 2 – Empirical support .....	288
General discussion.....	314
Research contributions .....	316
Research limits .....	322

## Introduction

Research avenues .....	325
References .....	330
Table of contents .....	368
Appendices .....	375

## **Introduction**

Consumer relationship with technology has changed with the emergence and wide spread of artificial intelligence and the Internet of Things (IoT). The term IoT was first employed in 1999 by the Massachusetts Institute of Technology, when the internet was shifting from a computer-based usage to a broader and more inclusive set of devices (Mitew 2014). With smart homes, quantified-self devices, autonomous cars, smart assistants and connected clothes, consumers are facing new interactions and are involved in different relationships with their environment (Verhoef et al. 2017). According to Stankovic (2014), “cities and the world itself will be overlaid with sensing and actuation, many embedded in “things” creating what is referred to as a *smart world*” (p.3).

This perspective depicted by scholars and managers is a reality. The IoT market has grown significantly during the last decade. Estimations indicated that the market was supposed to reach 26 billion devices in 2020 (Gartner 2013) and would potentially represent 11% of world’s economic output before 2025 (McKinsey & Company 2015). According to the Accenture Digital Consumer Survey (2016), artificial intelligence is investing consumers’ lives and represents a major growth opportunity for companies. Concerning the French IoT market, 45% of consumers believe that smart objects are a revolution on their own and 58% have at least, a good understanding of the IoT (OpinionWay 2017). While it is true that smart objects’ users remain young adults and early adopters (TNS Sofres 2016), the IoT is spreading so fast that almost every single consumer’s segment shows interest for this technology (Accenture 2016).

A good way to start is to properly define what is often called “smart objects” and what refers to the “Internet of Things” (IoT) and “Artificial Intelligence” (AI). The concept of smart objects or object automation is not new. While most of IoT-based products have emerged after the 2000’s, the concept originated from the 1980’s, with the birth of digital personal assistants such as IBM Simon or Apple Newton in the 1990’s. These devices were aiming at assisting people in their daily tasks (Smith 2020). The technology has evolved and now integrates complex interactive capacities such as voice-control commands, allowing consumers to interact more fluently with objects (Belk and Kniazeva 2018). These properties are what differentiate smart objects from automated objects (Lopatovska and William 2018).

## Introduction

The literature offers extensive and broad definitions that encompass almost every single smart object. According to Hoffman and Novak (2015) for instance, the IoT is made of multiple devices and objects that can autonomously collect data from various interactions with their surroundings and communicate wirelessly through the Internet. Smart objects are defined as products “that interact and communicate with themselves and each other - and with humans - on an ongoing basis by sending and receiving data through the Internet that is stored and organized in a database” (Hoffman and Novak 2015, p.14). According to Rijssdijk, Hultink and Diamantopoulos (2007), smart objects are physical products equipped with sensors and connected to the internet, allowing them to collect, store and analyze data, providing valuable information. For Smith (2020), smart objects are those products which rely on artificial intelligence to provide meaningful services to users. Artificial intelligence is a concept that includes what is called machine cognition.

According to Hidalgo and colleagues (2021), artificial intelligence from a strict computer science perspective, refers to multiple levels of intelligence, and can be divided into two broad categories: strong AI, weak AI. Strong AI refers to the concept of intelligence like human's intelligence, literally “the intelligence that it is not specific to a task but rather can function in situations and contexts that are completely new” (Hidalgo et al. 2021, p.15). On the other hand, weak AI refers to task-specific intelligence, such as smart plugs or smart thermostats, which corresponds to the AI operating today. Despite the appellation “weak AI”, smart objects express a form of intelligence called “product intelligence”, conceptualized through their autonomy, ability to learn and to cooperate, reactivity, humanlike interaction, and personality (Rijssdijk et al. 2007). All these dimensions determine the extent to which these objects interact autonomously and are perceived “intelligent” (Rijssdijk and Hultink 2009). According to Duffy (2003), weak AI only mimics human-like intelligence, for specific tasks, which is sufficient to provide the illusion of “a projective intelligence” (p.179), not real but still perceived and processed by users.

We can also define smart objects as physical products holding capacities of communication, computation, which are able to detect any stimuli and react according to their surroundings, with a direct effect in the physical world (Hsu and Lin 2016, Mani and Chouk 2017). Smart objects are not only operating through the Internet to analyze data and interact, but they can also operate offline, through a local server to store and organize collected information. Following Porter and Heppelmann (2014) definition, smart objects are made of two distinct parts. They are smart (expressing a form of intelligence through their sensors and

## Introduction

actuators) and connected (they can interact alone, with one or numerous users/objects, or be part of a large network of objects). Consequently, the IoT and smart objects must be differentiated. The IoT integrates both smart objects and the Internet, allowing the physical world to interact with digital entities (Porter and Heppelmann 2014).

From a technical perspective, smart objects possess three different elements (sensors, actuators, and connections) allowing them to express different capacities (Hoffman and Novak 2015). These devices possess the ability of detection, which refers to the ability to detect different events using their sensors. They also have the capacity of reaction, or the ability to react through actuators according to specific scenarios. Finally, they possess the feature of connectivity, which refers to their unique capacities to communicate online or locally using different communication protocols such as Wi-Fi, Bluetooth, etc. (Hoffman and Novak 2015, Mani and Chouk 2017).

*Table 1 - Smart objects capacities (Detection/Reaction/Connectivity)*

Smart object	Detection	Reaction	Connectivity
Smart light bulb	Can adapt the luminosity based on its light sensors.	Can turn on / off with hand clapping, or when triggered by a smartphone	Connected wirelessly to other devices such as a smart speaker, or a smartphone, and can be accessed online or locally.
Smart car	Can detect driving lines and traffic signs.	The car can autonomously correct the direction, or the speed based on the situation.	The car can be connected wirelessly to other devices such as the smartphone, or the automatic garage door for instance.
Smart watch	Can detect the number of steps, the heart rate, and the blood oxygenation.	The smart watch can send notifications based on the collected information (such as reminders to do more physical activity, or feedbacks regarding your performance).	The smart watch can operate locally by being wirelessly connected to a smartphone. It can also provide information regarding the position when equipped with the GPS.

## Introduction

Smart objects operate in almost every industry. The IoT market has many segments (health, mobility, smart home, wearables) and involve heterogeneous market players, from multinationals to small start-ups. According to the McKinsey Global Institute (2015) smart objects' operating areas can be sorted into nine different segments: humans, homes, cities, worksites, offices, factories, vehicles, retail environments, outdoors.

*Table 2 - Smart objects' operating areas (McKinsey Global Institute 2015)*

Areas	Description
<b>Humans</b>	Devices enabled by the human body, such as health devices or monitoring devices, bringing opportunities for welfare and productivity improvements. These devices can monitor people in their daily routines sending information continuously. They collect and analyze data for decision making purposes.
<b>Homes</b>	Devices that are integrated to consumers' home environment. Smart plugs, thermostats, locks, and lightbulbs are bringing unique opportunities to monitor and manage energy consumption, automation, and security.
<b>Cities</b>	Devices used in networks for large scale usage. Smart devices can help shaping innovative smart cities with improvements in transportation, security, energy, and resource management. These devices bring unique opportunities for reducing and managing the traffic or monitoring and reducing pollution.
<b>Worksites</b>	Devices integrated on worksites. With the adoption of smart devices, companies can rely on sensors and actuators to perform complex or risky operations reducing cost and improving safety for their employees.
<b>Offices</b>	Devices for improving security and resource management of offices. Using smart security cameras and sensors to monitor an entire office building, reducing the need for human intervention.
<b>Factories</b>	Devices used in the production process. These devices bring opportunities to enhance productivity, energy savings, and process optimization. They can also improve employees' safety and welfare.
<b>Vehicles</b>	Devices used in cars and transportation. These devices can be relied on for autonomous driving but also for monitoring and improvements of performance for public transportation.
<b>Retail environments</b>	Devices integrated to retail environments. These devices aim at enhancing the consumer experience, improving the consumer journey within a retail environment, including lights, personalized elements in the surroundings of a store.
<b>Outdoors</b>	All the devices that are not included in previous segments but for which interaction occurs outside.

## Introduction

Smart objects can be categorized based on their functions, in four different segments (Hoffman and Novak 2015, Ardelet et al. 2017): wearables (such as smartwatches or fitness trackers), health devices (relied upon for measuring specific information related to one's health, such as a smart glucometer), smart home devices (smart bulbs or smart plugs), and smart mobility devices (autonomous vehicles, GPS etc.). We can also sort smart objects regarding their capacities. According to Cila and colleagues (2017), four types of smart objects can be identified: (1) objects that interact with users, providing information about their status and responding to orders, (2) objects that improve and become smarter by interacting with users, (3) objects that interact only with other objects and (4) objects that don't communicate through the internet but still possess the capacity to act autonomously.

Due to their capacities to collect, analyze data and interact with their surroundings, smart objects are considered as disruptive innovations, or radical innovations compared to traditional objects (Mani and Chouk 2018, Ram 1987). Indeed, they are perceived by consumers as innovative products (OpinionWay 2017). An innovation is defined as any “idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers 1995, p.11). Accordingly, smart objects are perceived as innovative products (Ardelet et al. 2017), due to their unprecedent capacities to “affect every aspect of all our lives” (Stankovic 2014, p.4).

In line with their innovativeness, smart objects offer to companies, new opportunities to develop and enhance their performance allowing most of the authors to consider the Internet of Things as the next stage of the new industrial revolution (Ostrom et al. 2015, Porter and Heppelman 2014, Hoffman and Novak 2015, Mani and Chouk 2017, O’Brien 2016). According to Porter and Heppelmann (2014), the new industrial revolution began in the 1960s when the productivity of activities increased due to the automation of each activity within the value chain. It then totally changed with the spread of the Internet between 1980s and 1990s, allowing the integration and coordination of each individual activity with the entire value chain. Even though these two waves provided huge growth opportunities for companies, affecting the value chain, products remained unchanged. The current IoT revolution brings to the physical world, brand new opportunities. Smart objects “bring the intelligence of the Internet to physical products with the potential for something new to emerge” (Hoffman and Novak 2015, p.126).

## Introduction

Consequently, products have evolved and now integrate Internet-based functionalities through sensors and actuators, providing unprecedent improvements and opportunities for companies and society at large. The technology and the internet embedded inside smart objects allow for tremendous opportunities of market segmentation and unique opportunities to provide personalized products and services (Ostrom et al. 2015).

Benefits for companies and firms are mainly twofold. The first affects the value offer provided to consumers. Smart objects with their capacities to collect and process data, communicating and interacting with autonomy with consumers can potentially enhance consumer's performance (Bayart et al. 2017). Smart objects possess intrinsic properties that can expand the range of what people can do (Hoffman and Novak 2015). The second benefit refers to the opportunities for better understanding the consumer behavior. Using the capacity of smart objects to enhance the consumer experience represents a unique opportunity for personalization and segmentation. The IoT can provide means for improving the offer both in terms of product's functionalities and experience offered to consumers. Hence, smart objects represent a radical innovation that brings new opportunities to the fore such as smart services, literally the capacity of smart devices to provide autonomously meaningful services (Wunderlich et al. 2015). Many companies and organizations have already adapted to this revolution and now integrate IoT-based solutions in their offer.

The *Weber company* for instance, the world's leading barbecue grill brand, has invested the smart cooking market by launching in 2020 the *Smart Grilling Hub* (Weber 2020). As part of their strategy, they first launched a device that was able to transform any barbecue grill to a "connected barbecue". Basically, this device offers to any barbecue the opportunity to become "smart" by collecting data with sensors and sending notifications to a smartphone. A year after, they introduced native smart grills integrating their own Weber Connect Technology (Weber 2021).

In 2016, Leicester City Football Club have won against all odds the English Premier League with the lowest rate of injured players over the season, thanks to their massif investment in wearable technology for tracking and analyzing players' performance (Smith 2016).

The IoT has invested our environment and is no longer a chimera but a tangible reality. Another emerging market is the self-driving cars segment. Regardless of their capacity to drive autonomously, these cars are also capable of sending information directly to insurers providing driving history information in case of car accident (Mani and Chouk 2018). Smart objects are

## Introduction

now operating at both small and large scales and several industries have been invested by IoT technology from homes, workplaces, cars, clothes, factories, transports, and cities, providing innovative products and services.

Smart objects' innovativeness often refers to three main dimensions (Porter and Heppelmann 2014, Mani and Chouk 2018): intelligence, connectivity, and ubiquity.

*Table 3 - Dimensions of smart objects' innovativeness*

Dimension	Definition
<b>Intelligence</b>	Intelligence is related to the degree of autonomy expressed by the smart object. Smart objects possess the capacity to affect and to be affected. Depending on this capacity, they can interact autonomously, or even authoritatively (Hoffman and Novak 2018).
<b>Connectivity</b>	Connectivity refers to the smart object's capacity to communicate with objects and consumers. This powerful capacity allows common products to integrate networks of components, called assemblages (DeLanda 2016, Hoffman and Novak 2018) under which both objects and consumers experience ongoing interactions.
<b>Ubiquity</b>	Ubiquity derives from the unique opportunity brought by Connectivity. It refers to the flexibility of access, giving the possibility to access smart objects anywhere, anytime and through multiple devices (smartphones, voice-controlled assistant...).

These distinctive features are the main reasons why smart objects differ from traditional objects. The expression of these three features allows the smart object to completely redefine and reshape the relationship between consumers and objects (Hoffman and Novak 2018).

Indeed, smart objects have “changed the way people communicate, interact and take advantage of the Internet, allowing them to access the Web whenever they want and wherever they are” (Pagani and Malacarne 2017, p.133). People can order around their smart objects for their need or let them operate autonomously regarding the context (Kang and Kim 2020). These characteristics allow smart objects to perform specific task, giving them the ability to interact with their surrounding by collecting data with sensors and reacting to given stimuli with autonomy. The emerging capacities of smart objects is reshaping the way consumers interact with inanimate objects (Belk 2014). Consequently, the IoT represents meaningful opportunities for companies that engage in this digital revolution. Yet, despite the wide spread of smart objects and the increasing interest of the industry for IoT products, barriers to adoption remain and consumer resistance to smart objects must be tackled.

## Introduction

Regardless of estimations of adoption and the overwhelming development of technology and innovation, the penetration rate for smart objects remains relatively insufficient (Hoffman and Novak 2015). Despite the expectations of research institutes, we are still below 20 billion devices, including mobile phones representing around 33% of connected devices worldwide (Kemp 2021). According to the OpinionWay survey (2017), more than half of the French consumers remain absolute non-users of smart devices (apart smartphones). In 2014, an Ifop survey has shown that 88% of French consumers were not willing to adopt smart objects. This can perhaps be attributed to the lack of knowledge regarding smart objects. Almost 41% of French consumers declare having a lack of understanding for IoT products, with 43% that consider they are not disruptive innovations, and 11% that they are only a short-term trend (OpinionWay 2017). Yet, both users and non-users tend to feel curious (41%) but also anxious (33%) as regard Internet based products (TNS Sofres 2016), indicating that the lack of knowledge might not be sufficient to explain resistance toward smart objects.

We can illustrate consumer's resistance by checking penetration rates of widespread smart objects, such as smart speakers. Smart speakers are interesting to analyse as they express, through voice-controlled functionalities, unique capacities to interact with consumers (Schweitzer et al. 2019). Smart speakers represent one of the most iconic smart home devices, providing voice interactions, tasks management, weather, traffic and many more information and functions (Smith 2020). Relying on artificial intelligence, they can also control other objects, becoming a hub of interactive smart objects (Hoffman and Novak 2018).

However, "The slow pace of consumer adoption of new technologies is a major disappointment for the IoT industry" (Mani and Chouk 2017, p.77). Indeed, focusing on penetration rates, the global penetration rate for these smart home devices is about 10% (Kemp 2021). If we focus on the French smart speakers' market, the penetration rate falls below 10% (Credoc 2019). These penetration rates remain relatively low considering that these products have been released almost ten years ago. Indeed, Apple's Siri for instance, has been released in 2010 and integrated in iPhones in 2011. Thus, Siri has been adapted and integrated in various kinds of products (iPad, Apple TV, Apple HomePod, Macs...). Similarly, Amazon released in 2014 its virtual assistant called Alexa, embedded in a large set of physical products (Amazon Echo, Echo Plus and Spot, Amazon Dot...) and Google provided its Google Assistant in 2016 embedded in Android smartphones and its Google Home devices (Smith 2020).

## Introduction

Evidence regarding barriers preventing consumers to adopt smart objects can be provided. We can illustrate the resistance toward IoT products acceptance with the difficulty encountered by tech-companies to achieve market success with smart products. Such as the recent market failure of Pepper the robot, produced by the SoftBank company.

First made in 2014 by the French start-up Alderaban, the robot “Pepper” had been very popular at the beginning. So popular that the Japanese giant SoftBank bought the start-up to market this robot all around the world. Pepper the robot was an ambitious humanoid aiming at serving as a hosting agent and robot companion, providing information and guidance for people in hotels, banking agencies, restaurants etc. This robot was equipped with sensors allowing for the recognition of different emotions expressed by people. In 2021, the SoftBank company decided to stop the production of Pepper, considering it was a market failure after 7 years of activity. This reluctance to adopt innovative products and smart things represents the main threat for tech-companies in achieving market success. That is because “at a high level of product newness, understanding and managing uncertainty are critical to adoption” (Castaño et al. 2008, p.321).



Figure 1 - Pepper Robot - <https://www.softbankrobotics.com/emea/fr/pepper>

Innovation always implies a dialectic between adoption and resistance (Ram 1987). IoT devices are a source of innovative services (Wunderlich et al. 2015), yet companies are facing new challenges and threats (Hsu and Lin 2016). Smart objects, as disruptive innovations, elicit both opportunities for companies and resistance from consumers (Mani and Chouk 2017). Consequently, as more smart objects are getting developed, more resistance will emerge from consumers. Focusing on autonomous cars for instance, most consumers tend to express

## Introduction

reluctance toward their adoption regardless of the potential benefit they represent (Meyer-Waarden and Cloarec 2021).

Resistance to innovation is defined as a negative reaction or attitude toward a new product or service, that will upset the current status quo (Ram and Sheth 1989). Within the context of smart objects' resistance, scholars identify three different types of resistance: rejection, postponement, and opposition (Mani and Chouk 2017).

*Table 4 - The different types of resistance (Mani and Chouk 2017)*

<b>Resistance nature</b>	<b>Definition</b>
<b>Rejection</b>	Consumers are rejecting the smart object due to individual factors (price issues, self-efficacy...).
<b>Postponement</b>	Consumers are differing the smart object adoption based on the circumstances.
<b>Opposition</b>	Consumers perceive the smart object as a threat and express a form of resistance to adoption.

Current literature on smart objects adoption has neglected the barriers responsible for the emergence of resistance (Claudy et al. 2015). Consumer resistance must be considered as it can result in negative outcomes not only for consumers but also for companies and brands (Fournier and Alvarez 2013). Taking care of consumer resistance will reduce the risk for innovation failure (Ram 1989), allowing companies to better design their smart products, improving de facto the adoption rate (Mani and Chouk 2017, Ram 1987, Talke and Heidenreich 2014).

This is even more crucial with consumers getting increasingly connected and empowered through social medias and online communities, allowing them to share their apprehension and resistance online (Mani and Chouk 2018, Hsu and Lin 2016). Google for instance have launched a smart-home solution through its subsidiary company called 'Nest'. The Nest Guard alarm system was designed for smart home security purposes and consists of a box with a keypad, connected to different smart objects (cameras, sensors...). In 2019, Google revealed the existence of a hidden microphone inside the Nest Guard supposed to be inactivated, which was not mentioned within product's characteristics. Users felt displeased to learn that they might have been spied damaging both the user experience and the brand image. This also negatively influenced the resistance felt by non-users, raising privacy concerns and damaging trust they might attribute to Google services.

## Introduction

These empowered consumers that express their resistance and apprehension online represent a unique source of information for researchers and managers that operate within IoT markets. In September 2021, Amazon announced the future release of their robot companion called “Amazon Astro”. This robot is supposed to perform different tasks to improve the daily life of users, providing meaningful services as a domestic assistant. We thought that it could be interesting to observe the reactions of potential consumers online. Accordingly, we relied upon the methodology of text mining provided by the Research Unit of Lyon 2 and Lyon 1 Universities ([http://eric.univ-lyon2.fr/~ricco/tanagra/fichiers/fr\\_Tanagra\\_tweets\\_analysis.pdf](http://eric.univ-lyon2.fr/~ricco/tanagra/fichiers/fr_Tanagra_tweets_analysis.pdf)) to analyse the tweets that were posted online the same week of the announcement which incorporate the terms “Amazon” and “Astro”.



Figure 2 - Amazon Astro Robot - <https://www.minimachines.net/actu/amazon-astro-102602>

Based on the R package “twitteR”, we performed the text mining procedure on RStudio. About 1000 different tweets were processed. The result is a convenient word cloud that shows the 32 main terms associated with the tweets in which “Amazon” and “Astro” were mentioned. Size of words corresponds to the frequency of occurrence of the same word, in different tweets.

## Introduction



Figure 3 - Amazon Astro Word Cloud generated by text mining with *twitteR* and *RStudio*

Most words associated with “Amazon Astro” appear to be negative reactions regarding the release of this product. This illustrates the resistance expressed by consumers as regard the robot companion. People seem to be worried about the product, showing apprehension and anxiety about a potential interaction with it. Similar patterns in the literature appear continuously regarding consumer’s reaction toward smart objects and IoT products (Shank et al. 2019, Monsurrò et al. 2020). Hence, we first tried to investigate this phenomenon relying on the technology acceptance-resistance literature.

To understand the consumer resistance toward smart objects, the literature provides different factors of resistance toward smart objects, ranging from product characteristics (or functional barriers) to consumers characteristics (or psychological barriers). Product characteristics refer to functional barriers that will prevent new product adoption, whereas consumer characteristics refer to psychological barriers that will trigger apprehension regarding innovation acceptance (Ram and Sheth 1989). Accordingly, relying on such approach seems to be, at first, enough to understand the consumer resistance toward smart objects and IoT products.

However, the acceptance-resistance literature falls short in explaining some complex reactions and other aspects of the emerging resistance toward smart objects (Monsurrò et al.

## Introduction

2020). According to Mani and Chouk (2018) technology raises new challenges especially regarding resistance to IoT products. Current literature suffers from two main issues. First, they lack in providing an explanation regarding the ambivalence experienced by consumers. Consumers can potentially develop both positive and negative attitudes regarding smart objects (Lopatovska et al. 2019). According to Ardelet and colleagues (2017), this state of ambivalence toward smart objects stresses the need for models of technology acceptance and resistance to adapt to these new products.

Additionally, the conventional approach of technology acceptance-resistance models remains anchored in theories such as the Theory of Reasoned Action (TRA – Fishbein and Ajzen 1975), focusing mainly on rational antecedents of behavioral intention, without considering irrational motives behind the consumer resistance. Yet, according to Chouk and Mani (2016) more than half of the justifications provided by consumers regarding their resistance to adopt smart objects are based on irrational motives instead of rational reasoning.

Although different antecedents of consumer's resistance to innovation (Ram 1989, Ram and Sheth 1989, Laukkanen et al. 2007), and to smart objects (Mani and Chouk 2017-2018, Laukkanen 2016) have been identified, they remain focused on functional and psychological barriers. Consequently, they don't consider smart objects' emerging capacities to affect and to be affected, as well as the irrational meanings attributed to smart objects, as a potential barrier to adoption (Monsurrò et al. 2020). Regardless of the development of computer science and technological products, we still face trouble in explaining "how our perceptions affect how we treat them or accept them" (Hidalgo et al. 2021, p.3). Accordingly, the evolutions brought by smart objects' capacities and the way people understand such capacities must be considered when assessing human-object interactions.

## Research context

Consumer-object relationships have been a thrilling research topic across various disciplines and literatures (Fournier and Alvarez 2012, Fournier 1998). The literature already emphasizes the existence of meaningful relationships between consumers and inanimate objects (Belk 1988, Fournier 1998). Consumers can get emotionally attached to brands, showing loyalty and commitments but also enmities and struggles while interacting with them (Fournier and Alvarez 2014). Regarding IoT products, consumers can experience both positive and

## Introduction

negative emotions while interacting with smart objects, from amusement and happiness to unease and displeasure (Shank et al. 2019). The extended-self and digital-self theories (Belk 1988, 2013, 2014) have provided a good understanding about how we tend to incorporate possessions as portions of ourselves. These theories posit that consumers can attribute meanings and feel emotions regarding artefacts. Indeed, brands for instance can be associated with complex and profound meanings by consumers, creating affection and eliciting emotions (Fournier 1998).

However, these theories often consider inanimate objects as mere possessions, contributing to the construction of the self, but limited to a human-oriented perspective (Belk 2014). Yet, recent findings suggest that the relationship between consumers and inanimate objects such as IoT products can sometimes be assimilated to social or interpersonal relationships (Belk 2014, Novak and Hoffman 2019, Schweitzer et al. 2019). Smart objects possess unique capacities to affect and to be affected by their surroundings (Hoffman and Novak 2015). Such advanced capacities and their implications cannot be fully grasp by considering inanimate objects as mere possessions (Verhoef et al. 2017). Despite the different attempts to understand human-technology interaction, “the emergence of the Internet of Things calls for a new paradigm to help understand how users interact with and respond to everyday objects with agentic capacities” (Kang and Him 2020, p.52).

Thus, consumers-smart objects relationships must integrate a broader conceptualization of human-object interaction by considering objects on their own (Schweitzer et al. 2019). “As machines become more humanlike, it becomes increasingly important for us to understand how our interactions with them shape both machine and human behavior” (Hidalgo et al. 2021, p.3).

Human characteristics are no longer attributed to smart objects through physical resemblance. Instead, they are perceived by consumers based on the object’s capacities to interact (agency), stressing the frontier between objects and social entities to the point they can be seen as partners engaged in interpersonal relationships with consumers (Novak and Hoffman 2019). Hence, one solution consists of considering smart objects as interactive entities instead of mere possessions (Schweitzer et al. 2019).

According to Hoffman and Novak (2015), the IoT environment is characterized by components (objects, consumers) that interact directly or indirectly, forming networks called assemblages. This approach considers smart objects and humans as equal entities in terms of

## Introduction

ontology. They are both entities expressing a form of agency, with the ability to affect and to be affected (Hoffman and Novak 2018). From that perspective, different relationship styles can emerge in real-life interactions, based on the expression of each component's capacities. The dynamic structuring the consumer-smart object interaction becomes interpersonal (Novak and Hoffman 2019).

Interpersonal relationships with smart objects can be seen as an emerging approach to assess the interaction between humans and objects, which is not structured as conventional human-object interactions. Instead, it relies on both consumers and smart objects capacities to affect other entities and the assemblage (Novak and Hoffman 2019, Belk and Kniazeva 2018, Schweitzer et al. 2019).

However, little evidence exists about how smart objects' capacities to affect and to be affected influence consumer's behavior before purchase (Rijsdijk et al. 2017). Yet, Monsurrò and colleagues (2020) have highlighted the potential influence of smart objects social role over the emergence of resistance. They have shown that fear and resistance toward smart objects might originate from the apprehension of a potential intimate relationship with the smart objects. The anticipation of future interaction with the smart object can potentially raise a barrier to adoption, prior to any real-life interaction. This supposition is also supported by the literature. Indeed, the features that structure smart objects' innovativeness (intelligence, connectivity, and ubiquity) can also represent a potential source of resistance, such as the feeling of losing control or being dependent (Mani and Chouk 2017).

Not considering these emerging aspects of the relationship with smart objects, can lead to a lack of understanding regarding consumers resistance and adoption of IoT products. That is the reason why the conventional approaches to assess technology acceptance and resistance may not be sufficient to understand consumers' reactions toward smart objects (Ardelet et al. 2017).

Consequently, we have decided to tackle the consumer resistance toward smart objects by considering the emerging capacities expressed by IoT products and the irrational meanings attributed to them, as the main antecedents preventing consumers to adopt smart objects.

This choice was driven by the emergent literature on consumer-smart object interaction (Hoffman and Novak 2018, Novak and Hoffman 2019, Schweitzer et al. 2019, Monsurrò et al.

## Introduction

2020). This research digs into the mental simulation of anticipated experiences between people and smart objects, and the consequences of potential relational outcomes over the acceptance and resistance toward IoT products. “One important future research direction is to investigate consumer perceptions of intelligent products in pre-purchase situations. Such research could provide more insight into the factors that determine consumers’ willingness to purchase intelligent products” (Rijsdijk et al. 2007, p.354).

We decided to anchor this research into the direction proposed by Rijsdijk and colleagues (2007). As we are dealing with pre-purchase situations, our aim is to explore how consumers anticipate the interaction with smart objects. Indeed, “no one, however prescient, can see into the future, people use the imagination for this task. By imagining how things are likely to be or, alternatively, how one wants them to be, one achieves some ability to comprehend what the future will be like” (Taylor et al. 1998, p.429). Accordingly, the research object of this thesis is to explore the effect of smart object’s capacities over acceptance and resistance, and their potential influence over the formation of negative attitudes toward it, as imagined by consumers prior to purchase and real-life interaction.

This thesis is dedicated to the exploration of anticipated consumer-smart object relationships. More specifically, we aim at exploring the impact of smart objects’ agency (capacities to affect and to be affected) over the emergence of resistance toward it, prior to real-life interaction. Not only this IoT revolution will provide opportunities for managers, but it will also change the way consumers interact with technology, giving rise to thrilling research topics for researchers (Verhoef et al. 2017). Hence, understanding the anticipated relationship between consumers and smart objects appears to be crucial at both theoretical and managerial levels.

In line with recent findings suggesting an influence of smart objects’ social roles over resistance (Monsurro et al. 2020), we investigate the emerging field of resistance to engage in a relationship with smart objects and posit that smart objects’ agentic capacities influence the emergence of resistance and can mitigate their adoption.

Based on this research topic, different questions emerged such as:

- **How consumers perceive smart objects’ agentic capacities? And what kind of meanings do they attribute to such agentic expression?**

According to Rijsdijk and colleagues (2007), very few studies have focused on the consumer perception of smart object’s emerging capacities prior to purchase. Consumers can

## Introduction

infer objects with meanings, which are attributed based on their understanding of the object's nature and their interaction with it (Belk 1988). Thus, it is important to reflect about the meanings attributed to smart objects' capacities, to better understand how they assess the interaction with them (Verhoef et al. 2017).

### ➤ **How to conceptualize the consumer-smart object anticipated interaction?**

Both users and non-users seem to develop resistance or negative attitude toward smart objects (Ardelet et al. 2017). This suggests that the apprehension regarding future interaction with smart objects is not necessarily bound with real-life interaction but is instead anticipated. Accordingly, a conceptualization of consumer-smart object anticipated interaction is essential to understand the implication of such experiences (Shank et al. 2019).

### ➤ **Do smart objects' emerging capacities enhance or impede their diffusion?**

The implication of smart object's agency over the consumer acceptance or resistance is a neglected research topic (Monsurrò et al. 2020). Yet, it is perhaps one of the most important questions regarding the consumer-smart object future interactions (Rijssdijk and Hultink 2009). The consequences of smart object's capacities over the consumer behavior remain to be explored, making this question a thrilling research topic on its own (Bartneck et al. 2009).

### ➤ **Can irrational motives potentially influence consumers resistance toward smart objects?**

The antecedents of technology acceptance and resistance remain anchored in rationality (Sharp 2007). However, studies have shown the extent to which irrational motives were relied upon by consumers to justify their resistance toward smart objects (Chouk and Mani 2016). Accordingly, the potential influence of irrational motives over resistance and their implications regarding the consumer-smart object relationship must be explored.

The aim of this research is to bring more insights and knowledge regarding the perception of smart object's emerging capacities (or agency), by providing a model and an explanation that can capture and help to understand the implications of smart objects' agency over the consumer acceptance of IoT products.

## Introduction

### Research question and objectives

This research aims at exploring the consumer-smart object relationship and the main antecedents structuring technology acceptance and resistance from a relational perspective. The objective is to build from traditional approaches of technology acceptance-resistance, a new perspective for assessing the consumer-technology interaction. Accordingly, the literature review first focuses on traditional approaches and theories of technology acceptance-resistance, to identify core concepts and the main limits of these established approaches. Then, the literature review incorporates additional concepts and theories to assess the consumer-technology from a relational and social perspective. Finally, we build on our literature review an exploratory study to investigate the potential existence of consumer-smart object anticipated relationship. Our first research objective is therefore related to this exploratory phase:

#### **Research objective n°1: “Explore the structure of the consumer-smart object anticipated relationship”.**

From our literature review and the exploratory study, we examine the different implications of smart objects' agency over the consumer behavior. We build on the exploration of consumer-smart object anticipated relationship, different inferences and assumptions regarding the potential mechanism that trigger the resistance toward smart objects. This approach is anchored in the research direction proposed by Rijssdijk and colleagues (2007) regarding the implications of smart objects' perceived intelligence in pre-purchase situations. Accordingly, it is fundamental to reflect about the impact of smart objects' agency over the consumer reaction before purchase. Our second main objective is then articulated as follow:

#### **Research objective n°2 “Study the influence of smart-object's capacities over the consumer behavior from a relational and interpersonal perspective”:**

It follows, from this research objective n°2, different implications, and questions. Because of smart-objects' capacities to affect and to be affected (Hoffman and Novak 2015), the consumer-smart object relationship has become interpersonal and social (Novak and Novak 2019). Consumers are now able to perceive the smart object as either a real partner, a servant, or a master of the relationship (Schweitzer et al. 2019). Not only consumers perceive the social role of smart objects, but they also tend to feel dominated or mastering the relationship based on its capacities (Monsurrò et al. 2020). Such perception often leads consumer to develop

## Introduction

positive or negative attitudes toward smart objects based on their perceived or expected role within the relationship (Shank et al. 2019).

Consequently, studying the influence of smart-object's capacities over the consumer behavior from a relational and interpersonal perspective implies different sub-objectives.

First, there is a need to study the influence of smart object's capacities over the consumer expected role. If the relationship between people and smart objects has indeed become interpersonal, then the role endorsed by consumers during the interaction will depend on the object's expressive role (Horowitz et al. 2006). Additionally, the emotional response regarding smart objects' agency, and more specifically negative emotions induced by such capacities, might play a role in the emergence of resistance toward smart objects (Bartneck et al. 2009).

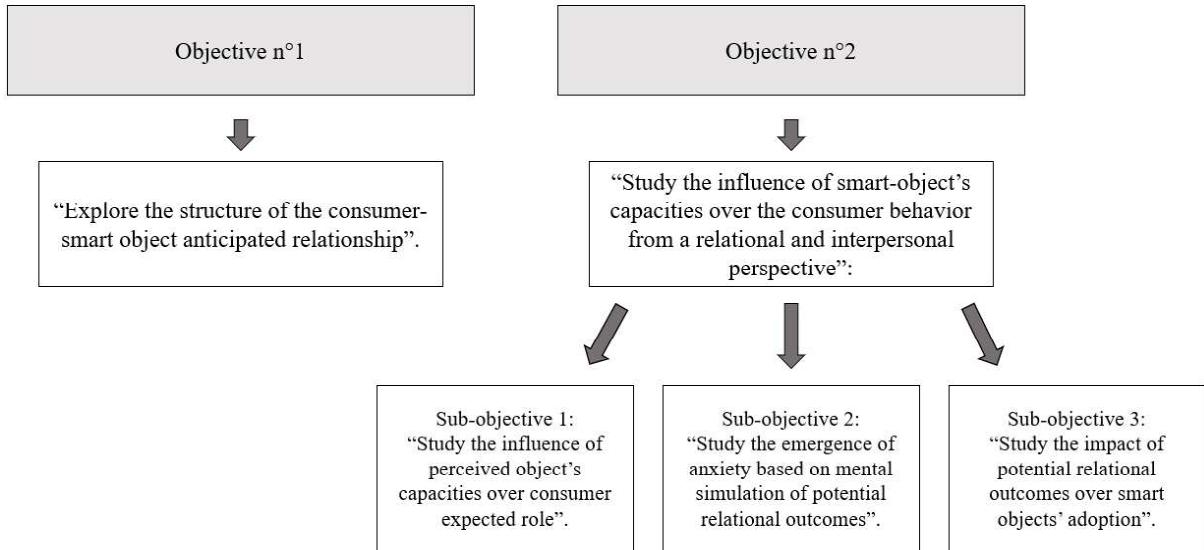
Last, the relational outcome induced by smart objects' capacities to affect the relationship can also impede the consumer willingness to engage in the relationship, if it results in negative outcomes (Monsurrò et al. 2020).

Consequently, three different sub-objectives directly stem from the objective n°2:

- **Sub-objective 1:** “Study the influence of perceived object's capacities over consumer expected role”.
- **Sub-objective 2:** “Study the emergence of anxiety based on mental simulation of potential relational outcomes”.
- **Sub-objective 3:** “Study the impact of potential relational outcomes over smart objects' adoption”.

The following figure summarizes our research objectives.

## Introduction



*Figure 4 - Research objectives and sub-objectives*

This research project aims at providing an explanation about how the capacities expressed by smart objects are perceived and processed by consumers, prior to any real-life interaction. Accordingly, this doctoral dissertation will focus on providing a theoretical grounding for conceptualizing anticipated interaction between consumers and smart objects, in order to provide a model to assess the implications in terms of relational outcomes. We investigate the complex and ever-changing relationship between consumers and smart objects by considering the interpersonal and social nature of their interaction. Hence, we rely upon our observations, assumptions, and conceptualization to study the influence of smart objects' emerging capacities (agency) over the consumer behavior (acceptance-resistance), ending to the following research question:

To what extent smart objects' agency and anticipated interactions influence the emergence of resistance toward IoT products? An interpersonal relationship approach of consumer resistance toward smart objects.

## Introduction

### Research implications

This research aims at contributing to the research fields of consumer-smart object relationship and technology acceptance. More particularly, our objectives are to provide a valuable knowledge for both researchers from related fields and managers that operate within IoT related markets, to better assess the consumer-smart object relationship.

From a theoretical perspective, we aim at providing insights and filling the theoretical gap of anticipated experiences that emerge from mental simulated interactions between consumers and smart objects (Monsurrò et al. 2020). We want to investigate the impact of smart objects' capacities over the consumer behavior as proposed Rijssdijk and his colleagues (2007) and highlight the potential existence of a relational barrier to adoption, that emerge prior to purchase and real-life interaction.

To do so, our research provides a theoretical grounding, but also empirical evidence as regard the existence of simulated assemblages under which consumers apprehend the future interaction with smart objects. This research suggests that negative and positive anticipated experiences can emerge prior to real-life interaction between the consumer and smart objects, based on smart objects' perceived capacities.

From a methodological perspective, we rely upon the projective technique called Album-Online (Vernette 2007) and its enhanced version provided by Kessous and Valette-Florence (2019), to provide a mapping of consumers' evocations regarding anticipated interaction with smart objects.

Additionally, this research is the first to our knowledge that empirically contributes to the understanding of the complex interaction that can occur between consumers and smart objects prior to purchase (Rijssdijk et al. 2007). We draw on Hoffman and Novak conceptualization of consumer-smart object relationship (2018-2019) and the interpersonal circumplex model literature, an operationalization of interpersonal relationship patterns to explain the anticipated interaction between consumers and smart objects, prior to real-life interaction. Hence, this research proposes a way to assess and map consumer's expected role, based on their expression of agentic and communal motives (Horowitz et al. 2006, Novak and Hoffman 2019).

This work explores the influence of smart objects' perceived agency over consumer's feeling of being dominated and reduced, but also over attitudes and the intention to use the

## Introduction

object. It highlights the existence of a link between smart objects' agency and negative attitudes toward future usage, providing strong support for reconsidering the approach of consumer's acceptance and resistance toward smart objects.

From a managerial perspective, this research project aims at providing valuable information to managers operating within IoT markets, to reduce the risk of innovation failure (Ram 1989). We propose to managers, to understand and consider the consumer behavioral response regarding smart objects' characteristics in order to enhance their acceptance (Talke and Heidenreich 2014). Thus, one of our objectives is to explain how to better design smart objects in terms of agency, to reduce the potential resistance that emerge prior to purchase.

Indeed, a major issue of tech-companies operating in IoT markets is to reduce resistance to avoid failure (Mani and Chouk 2018). About 47% of French people declare that smart objects are not designed in line with consumers' needs (OpinionWay 2017). Accordingly, we provide different recommendations regarding how to efficiently design smart objects. Managers must understand that there is no need to design smart objects for making them the most intelligent, but they should instead focus on designing smart objects for making them the most valuable for consumers. Managers should "exploit people's expectations of behaviours rather than necessarily trying to force people to believe that the robot has human reasoning capabilities" (Duffy 2003, p.181). Consequently, this work contributes for a better match between consumers' needs and managerial practices.

## Research design

This research is divided in two distinctive parts. First, we provide an extensive literature review of the main concepts associated with our research topic. The objectives of this literature review are threefold.

First, to provide an overview of the evolution of both models of technology acceptance and resistance. We focused on theories and models that will serve as the grounding for our approach. Accordingly, we present and analyse the evolution of technology diffusion and acceptance theories, and more importantly, the literature regarding resistance toward innovation and technology. We performed this literature review to highlight the actual limits of those models for evaluating the emerging interpersonal relationship between people and smart objects. Limits of considering smart objects from a human-oriented perspective and the need

## Introduction

for a more inclusive approach are exposed. This section will provide insights on how to overcome current limits of technology acceptance models and the need for considering smart objects' capacities as a factor that influences acceptance, apprehending the mechanisms of acceptance and resistance from an object-oriented ontology.

Additionally, we delve into the literature of consumer-object interaction and anxiety toward technology to better understand the actual relationship between consumers and smart objects. Smart objects depart from traditional devices in terms of capacities (agency), but also in terms of relationship they are engaged with people. Emerging theories based on the object-oriented ontology are relied upon to adopt a broader vision of consumer-object interactions and their consequences.

Last part of this literature review will focus on the mental simulation literature. It will provide enough insights on how simulated assemblages could emerge (before actual usage) and the extent to which those simulated assemblages can positively or negatively influence the intention to adopt (or reject) smart objects. This part will expose how interpersonal relationship styles (Novak and Hoffman 2019) can be relied upon to better understand user's acceptance and resistance toward smart objects before usage.

The first part aims at providing a sufficient theoretical support for our assumptions made regarding the resistance toward smart objects, that will allow us to explore the anticipated relationship between consumers and smart objects (Objective n°1).

The second part of this research is dedicated to our exploratory and confirmatory empirical work and will directly focus on our research objectives. We relied upon a mixed-method approach to investigate the potential mechanism identified in the first part. A section will first expose our epistemological paradigm (Critical Realism) and its implications in terms of methodology.

Then, a chapter will be dedicated to the exploratory qualitative research performed, relying on the Album-On-Line projective technique (Vernette 2007, Kessous and Valette-Florence 2019). This qualitative approach is relied upon to make assumptions and hypotheses regarding the mechanism that triggers the resistance toward smart objects.

Finally, we will expose our conceptual model and the hypotheses that will be assessed in two different quantitative studies. The aim of these empirical studies is to investigate how

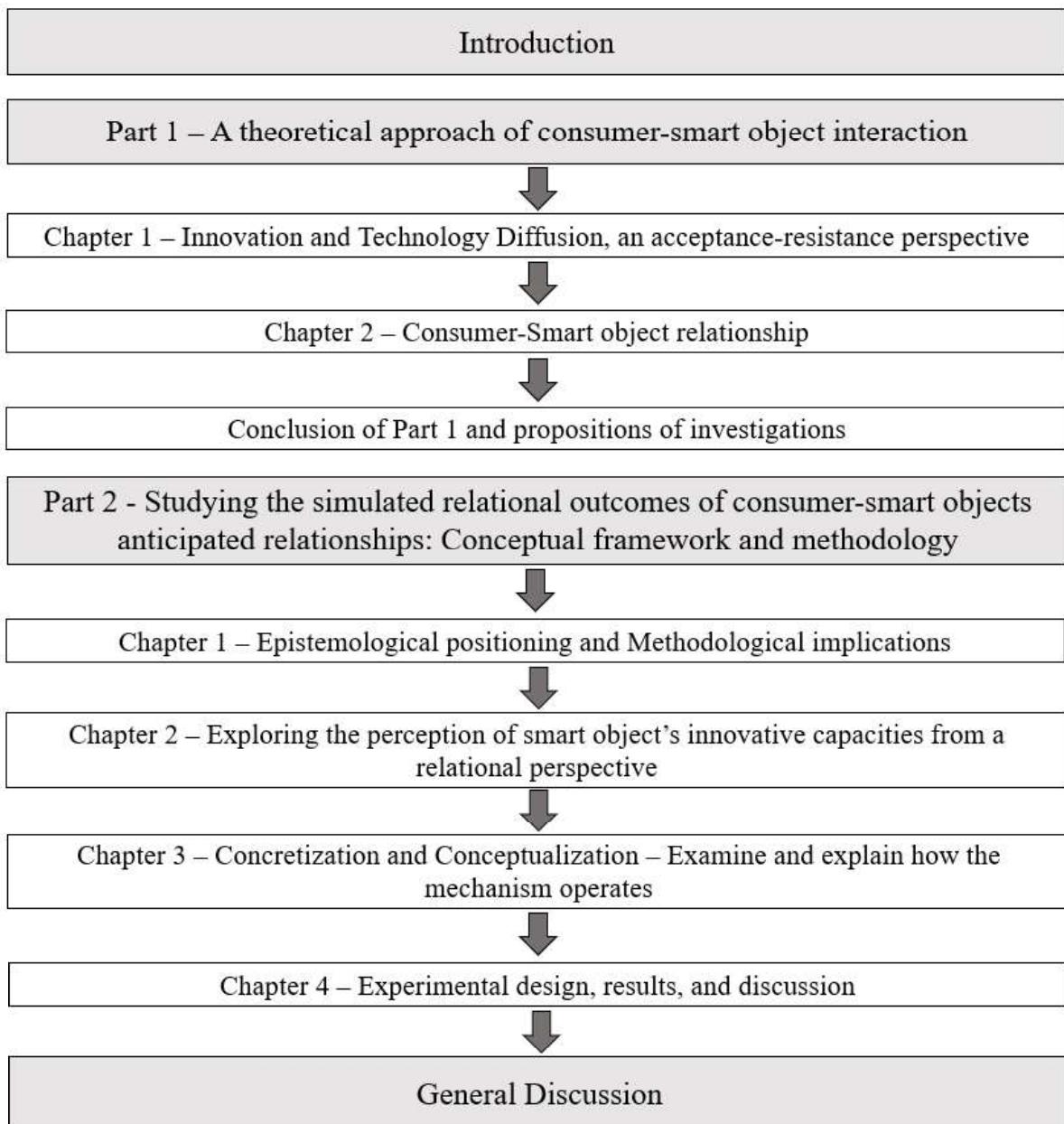
## Introduction

the smart object's agency influences and structures the consumer-smart object anticipated interactions. We relied upon a PLS path modeling approach (on XLSTAT) to evaluate the relations between all identified concepts and our hypotheses.

At the end of this second part, a general discussion will summarize our findings and expose our explanation regarding the influence of smart objects' agency and anticipated interaction in the emergence of consumer resistance toward future interaction. We will also present the main limits and contributions of this work, alongside future research avenues.

The following figure summarizes the structure of this doctoral dissertation.

## Introduction



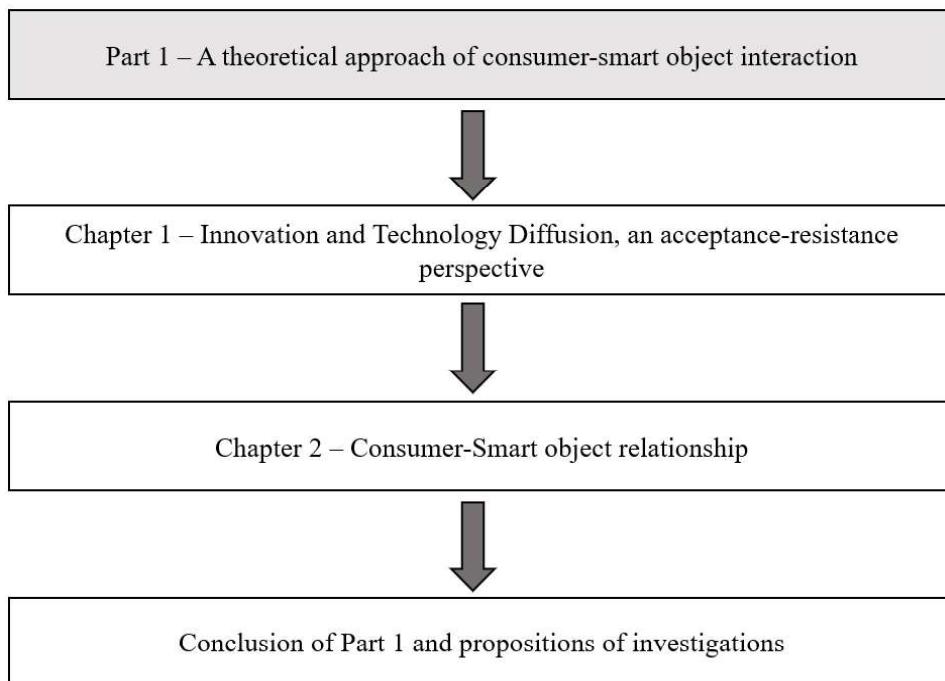
*Figure 5 - Research Plan*

## **Part 1 – A theoretical approach of consumer-smart object interaction**

### Introduction to Part 1 – A theoretical approach of consumer-smart object interaction

As mentioned previously, this first part is dedicated to our literature review. A first chapter will expose the different theories and models that explain the main principles of technology diffusion, acceptance, and resistance. This chapter will also investigate the concepts associated with technology resistance and the main limits of traditional approaches in explaining the consequences and implications of the consumer-smart object relationship.

Then, a second chapter will expose another approach for assessing human-object interaction, the object-oriented ontology. Accordingly, different theories and models will be relied upon to understand the anticipated interpersonal relationship in which consumers and smart objects might get involved prior to a real-life interaction. At the end of this chapter, assumptions, and inferences regarding the resistance toward smart objects are provided.



*Figure 6 - Part 1 organization - A theoretical approach of consumer-smart object interaction*

## Part 1 – A theoretical approach of consumer-smart object interaction

### Chapter 1 - Innovation and Technology Diffusion, an acceptance – resistance perspective

#### Introduction to Chapter 1 – Innovation and Technology Diffusion, an acceptance-resistance perspective

This chapter is dedicated to the literature review of the main theories and models of technology acceptance and resistance. Accordingly, a first part will expose the theory of technology diffusion and models of acceptance. A second part will focus on resistance toward technology and investigate the origin of negative attitudes toward technology.

A third part will explore the concept of domination and control, putting into light an interesting aspect of consumer-smart object relationship. This chapter will also expose in its last part, the different limits of actual theories and models in assessing consumer-smart objects interaction, highlighting the need for additional theoretical support.

This first chapter will be structured as follow:

Chapter 1 – Innovation and Technology Diffusion, an acceptance – resistance perspective

I – Technology diffusion and acceptance models

II – Resistance and negative attitudes toward technology

III – The struggle for domination and control

IV – Limits of the human-oriented ontology in Human-Technology Interaction

*Figure 7 - Chapter 1 organization - Innovation and technology diffusion, an acceptance-resistance perspective*

I- Technology diffusion and acceptance models

A- Innovation diffusion theory

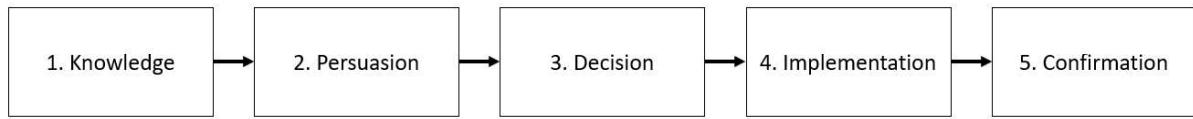
Before trying to introduce innovative products or services to the market, managers must think about adoption. Questions such as “will users adopt it?”, “are they going to use it?” or “will they cease to use it?” are important and must be considered by any company willing to achieve market success for their innovation (Moore 2014). Both managers and researchers have written about these issues and tried to understand what drives and mitigates adoption. Many models have attempted to grasp how and why people tend to adopt innovations, starting with the diffusion of innovations theory.

The diffusion of innovations theory, first developed by Everett Rogers in 1962, posits that the adoption of innovations is a process that relies mainly on trying to reduce potential users' uncertainty (Rogers 1995). This theory originates from communication and posits that a new product or service (but also ideas) can spread through a population according to its innovativeness which is induced by different factors (Yi and Bae 2017). The aim of this theory is trying to understand how an innovation (product, service, concept) diffuses among a specific social system (population) (Dearing 2009).

Rogers proposed to define adoption as the phenomenon under which a person is about to do something differently than he used to do previously, by assimilating something new (such as performing a new behavior, using a new product or service etc.). The diffusion of an innovation refers to the process under which a new product, service or idea is introduced and communicated over time, through different channels and among individuals. On the other hand, innovation refers to anything (product, service, concept, practice, etc.) perceived as new by individuals. Thus, the innovativeness of an object not only rely on its characteristics but also on the perception people have about it, with the adoption depending on time and knowledge (Roger 1995).

The process of innovation adoption is also called the innovation-decision process and can be sub-divided into five different stages.

## Part 1 – A theoretical approach of consumer-smart object interaction



*Figure 8 - The Innovation-Decision Process (Rogers 1995)*

According to the diffusion of innovations theory, individuals must come across each of these steps (Rogers 1995):

- (1) Knowledge: Individuals must become aware of the innovation itself. They must know about the existence of the new “thing” and acquire the knowledge about how it works and how to use it. People can learn about innovations by reading news, blogs, and any channel of communication.
- (2) Persuasion: After gaining knowledge about the innovation, people tend to develop attitudes toward it with favorable or unfavourable opinions about its adoption. For example, after learning more about the innovation, individuals might perceive the innovation as useful and find it beneficial for them, or conversely useless and futile (Dearing 2009).
- (3) Decision: Triggered by attitude toward the innovation, individuals will decide whether they will adopt (favorable opinion) or reject (unfavorable opinion) the innovation. Most of the time, this stage requires a trial phase under which people will test and try the innovation before deciding.
- (4) Implementation: People start using the innovation, they still learn about it and face problems that might arise with usage (technical issues for instance), contributing to reduce innovation’s uncertainty and assimilating day after day the innovation to people’s routine.
- (5) Confirmation: After a certain period of usage, people will try to evaluate their previous decision. If the innovation really meets or exceed their expectations, then they will keep on using the innovation and will adopt it. Conversely, if the innovation is deceiving, the frustration can lead to its abandonment.

## Part 1 – A theoretical approach of consumer-smart object interaction

Adopters must get aware of the innovation and understand its usefulness and advantages. Then, they must decide whether they will adopt or reject the innovation based on their attitude toward it. After that, adopters must try the innovation and test it. Finally, the adoption is considered achieved when adopters rely on the innovation in the long run and use it regularly. During this process, people gradually improve their knowledge about the innovation, reducing all the uncertainties associated with it (Rogers 1995). However, individuals have different capacities to process information and to assimilate changes, which implies asymmetric adoption among people (Moore 1991).

Indeed, according to Rogers, adoption is a heterogenous process throughout society. Some people are more akin to adopt innovations than others, expressing different degree of innovativeness (Roerich 1994). Innovativeness can be defined as “the degree to which an individual is relatively earlier in adopting new ideas than the average member of his social system” (Rogers 1983, p.27). Consequently, the spread and diffusion of an innovation depends on both innovations and users’ characteristics (Murray 2009). Therefore, the understanding of the different users’ profiles becomes crucial (Yi and Bae 2017). The diffusion of innovations theory provides an interesting classification of adopters. Based on several studies, Rogers provided categories according to users’ average time to adopt the innovation (compared to the population average time of adoption) and their personality traits:

- Innovators: These people are characterized by their need for trying innovations first. They show strong interest for new ideas and are willing to take risks to try latest products and services. They express a high level of “innovativeness” (Rogers 1983), or similarly “technology readiness” (Parasuraman 2000). This concept refers to the natural individual tendency to adopt new technology, thus influencing the intention to use new products and services (Roerich 1994). They are venturesome and have a great capacity to process information, overcoming innovation uncertainties easily. This population is intrinsically attracted towards innovation and does not require a lot of investment to appeal them. They are the first vector of spreading among a social system.
- Early adopters: They can be considered as opinion leaders within the society, which is the main difference with innovators. They tend to endorse the role of leaders by adopting innovations early in the process and have more relationships with their peer. They are comfortable with new products and services and very flexible in their capacities to change. Most of the time they don’t need to get convinced to adopt the innovation, yet

## Part 1 – A theoretical approach of consumer-smart object interaction

some support can be provided. Playing the role of models, early adopters are deemed to be the gates for reaching the majority market.

- Early majority: These people are not early adopters, yet they tend to embrace innovation a bit earlier than the average person. They are willing to adopt the innovation only if tangible results can be provided. Without evidence for the effectiveness of the new product or service, it is difficult to convince them. While they don't endorse the role of leaders, they contribute to diffusing innovation among their peers.
- Late majority: They are that part of the population described as skeptical regarding changes. These people will adopt the innovation only if it has already spread within the majority. They can get convinced to adopt the innovation if we communicate about how many people have already adopted the innovation, or if the social pressure increases.
- Laggards: These people are characterized by traditions and conservatism. Most of the time, they rely on the past to take decisions. They don't show any flexibility toward adopting changes and will be very skeptical as regard any innovation. The main influence lever to get them adopting the innovation remains social pressure. Compared to innovators, they possess lower levels of technology readiness (Roehrich 1994, Parasuraman 2000).

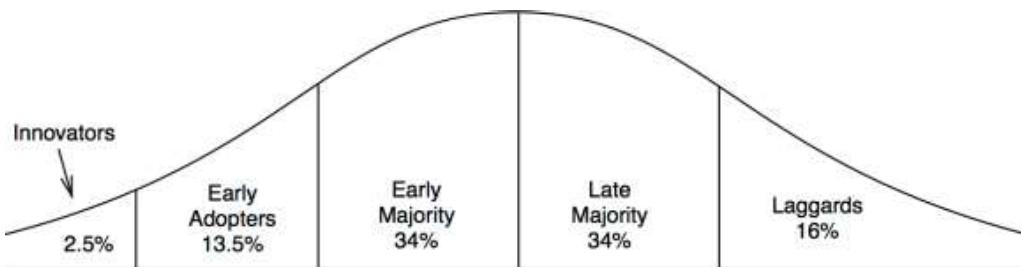
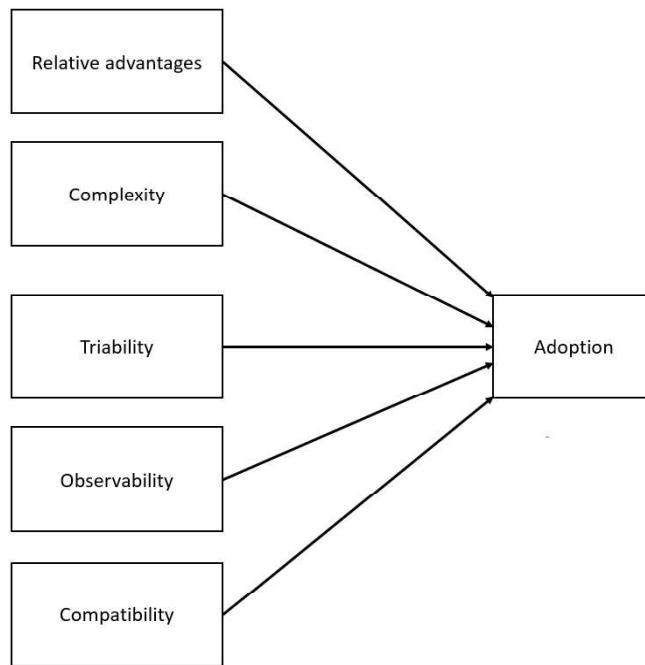


Figure 9 - Segments of adopters (Rogers 1995)

On the other hand, adoption is also influenced by the innovation itself (Dearing 2009). Indeed, its perceived innovativeness represents a key factor of adoption. Rogers (1983) claims that it is not about the innovation's attributes, but more about how “innovative” it is perceived by people.

## Part 1 – A theoretical approach of consumer-smart object interaction

The author argues that there are five main attributes that can significantly influence adoption. The factors that aim at measuring innovations' attractiveness are the following: the relative advantages of adopting the innovation, its complexity, triability, observability and compatibility.



*Figure 10 - Perceived Innovations' Attributes*

Relative advantages refer to the degree to which the innovation is perceived better than the previous product or service it replaces. It is the perception of improvement compared to a previous solution. This variable is positively correlated with the innovation's adoption. Relative advantages are determined by the nature of the innovation and can encompass various types of advantages, such as performance, social prestige, financial benefits etc.

Complexity is defined by how difficult to use and understand the innovation is perceived. It is negatively correlated with the innovation's adoption. Indeed, a strong perception of complexity represents a barrier to adoption. Every single innovation can be classified according to its degree of simplicity-complexity, which can partially explain its adoption rate. According to Tornatzky and Klein (1982), adoption of innovations is dependent of innovation's characteristics. Most of the time, the main barrier to adoption is represented by its complexity, or the degree to which a specific innovation is perceived difficult to use (Davis 1989).

## Part 1 – A theoretical approach of consumer-smart object interaction

Triability refers to the degree to which the innovation can be tested and experienced before adoption. According to Rogers (1995), innovations that can be tested are usually more rapidly adopted than others as the trial contributes to reduce uncertainties associated to the innovation. This aspect is particularly important for late adopters that are likely counting on their peers to take decisions. It is also positively correlated to the innovation's adoption.

Observability can be defined as the extent to which the innovation can provide tangible results to others. Observing peers using the innovation and the results associated with its usage can enhance its diffusion and contribute to its adoption. It is assumed to be positively correlated with the innovation's adoption. This variable is also important for early majority, late adopters, and laggards, which are more sensible to social norms than innovators and early adopters.

Compatibility is the extent to which the innovation is perceived consistent with one's beliefs, culture, values, needs and past experiences. The degree of compatibility will indicate the amount of behavioral change required to adopt the innovation, or the proximity between the innovation and individual's life situation. To improve the adoption, the innovation must consider how compatible it is regarding the social system where it is diffused. A compatible innovation will be perceived as familiar and will diffuse more rapidly across the system. Conversely, an incompatible innovation with cultural values and beliefs will diffuse more slowly or will be blocked. Compatibility is positively correlated with the innovation's adoption.

Each of these factors have different salience according to the adopter category, but overall, explain about half of the variance of innovations' adoption (Rogers 1995).

In addition to these different factors of adoption, the diffusion of innovations theory provides other explaining variables such as the type of innovation-decision, the nature of communication channels, the nature of the social system and the extent of change agents' promotion efforts.

## Part 1 – A theoretical approach of consumer-smart object interaction

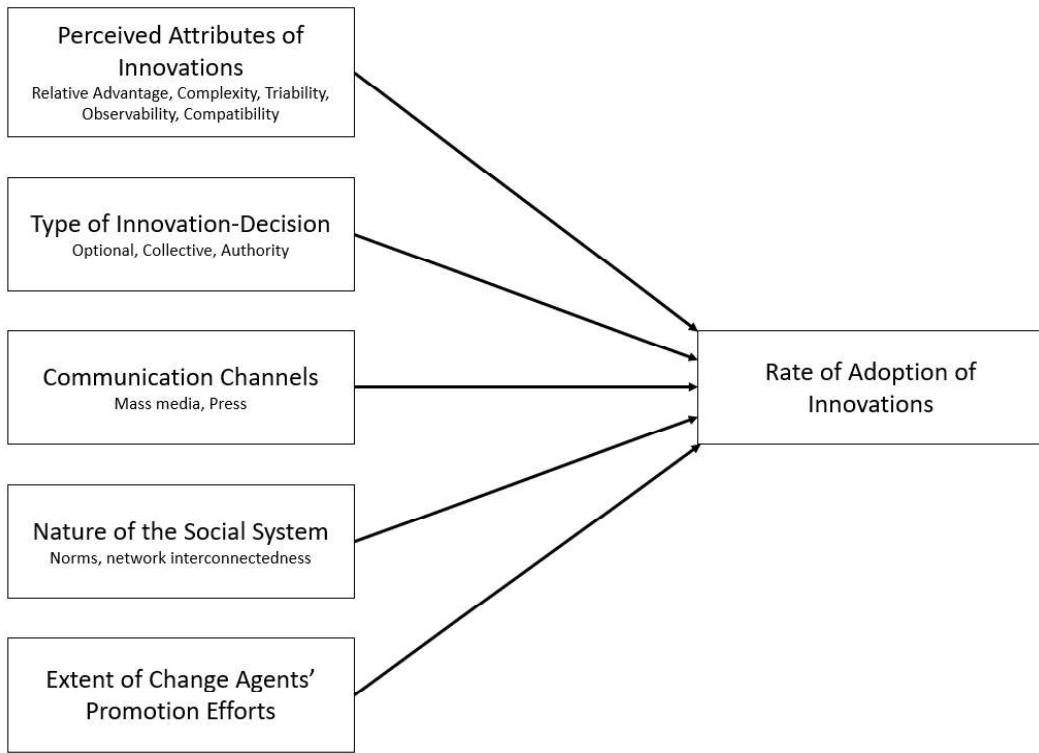


Figure 11 - Determinants of the Adoption of Innovations Rate

The type of innovation-decision (optional, collective, authority) refers to the number of persons involved in the decision-adoption process, and the nature of the adoption (volitional or not). According to Rogers, it has a direct influence over the adoption rate of innovations. “Innovations requiring individuals-optimal innovation-decision are generally adopted more rapidly than when an innovation is adopted by an organization” (Rogers 1995, p.207). Consequently, reducing the number of “deciders” can contribute to diffuse the innovation more rapidly within a social system.

The communication channels used to communicate and diffuse knowledge about the innovation is also an important variable that will influence the adoption rate (Moore 1991). The choice of an appropriate channel will depend on the complexity of the innovation. The more complex the innovation is, the less appropriate mass media will be. Indeed, there is a need for using interpersonal channels of communication for reducing uncertainties associated with complex innovations. “If an inappropriate communication channel were used, such as mass media channels for complex new ideas, a slower rate of adoption resulted” (Rogers 1995, p.208).

## Part 1 – A theoretical approach of consumer-smart object interaction

Regarding the nature of a social system, Rogers (1983) argues that social norms will shape the level of interconnectedness between individuals. The diffusion of an innovation among people also depends on the proximity and connection between peers (leaders with late adopters). Consequently, “the degree to which the communication network structure is highly interconnected also affects an innovation’s rate of adoption” (Rogers 1995, p.208).

The extent of change agents’ promotion efforts refers to the promotion efforts for the diffusion of innovation made by opinion leaders (Cho et al. 2009). The influence of this variable on the adoption rate is not linear. The greatest influence occurs when opinion leaders have adopted the innovation and promote it. On the other hand, the influence decreases after a certain amount of mass adopters have been reached (Rogers 1995).

### Limits of Rogers’ innovation diffusion theory and the emergence of the CHASM

Rogers’s conceptualization for diffusion of innovations is appealing. It offers an interesting framework based on adopter segments, to understand how fast or slow an innovation diffuses across a specific social system. This classification provides a useful understanding on how users’ characteristics can determine adoption through time (Yi and Bae 2017). Therefore, we must consider that in the reality, frontiers between each category are not that clear, with a various range of profiles that exist on continua (Greenhalgh et al. 2004). Yet, it represents an interesting framework to understand the influence of users’ characteristics over the adoption.

However, the model suffers from several limits. A lack of evidence to support the notion of frontiers between each segment of adopters, few considerations for individual’s determinants of adoption, the notion that patterns of adoption indicate personality traits, and the inability to provide insights about ceasing behaviors before mass market is reached, were the main criticisms (Greenhalgh et al. 2004, Lyytinen and Damsgaard 2001).

In 1991, Geoffrey Moore proposed to enrich this model and to fill some identified limits of Rogers’ theory. Based on the diffusion of innovations theory, Moore introduced the technology adoption life cycle model (TALC), trying to understand how computers diffused within the society during the 80s. This concept relies on Rogers’s observations, such as segments of adopters, but focuses on the frontiers between each segment (Moore 1991).

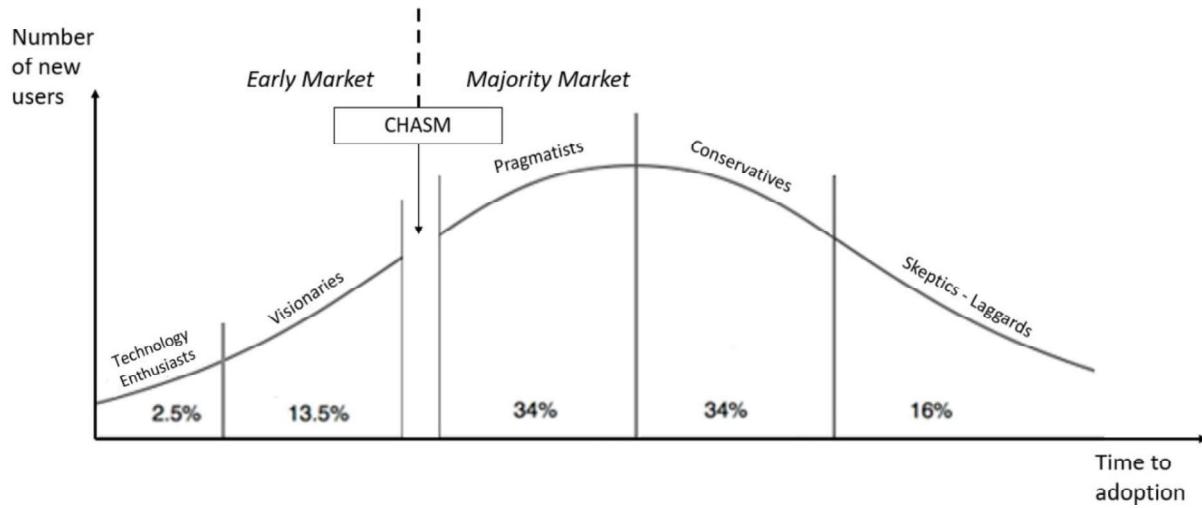


Figure 12 - The Technology Adoption Life Cycle (Moore 1991)

With the TALC, the adoption of technological innovations is also modeled by a sequence of segments, in line with Rogers's diffusion of innovations theory. Yet, Moore described adopters from a different perspective. In Rogers's approach, different determinants of segments are retained (personality traits, level of knowledge, capacity to process information) trying to understand adopters' profiles within consumer markets. While Moore's segmentation is more generic and relies mainly on adopters' capacity to adapt their behavior to disruptive innovations and can be operationalized for business markets as well (Gigliano, et al. 2011). Consequently, the sequence of adopters is defined by adopters' propensity to absorb new practices, new products, new services imposed by the innovative technology (Cho et al. 2009). The TALC keeps the same five segments with little differences in terms of characteristics:

- Technology enthusiasts (innovators): they are curious and have a natural inclination for innovative technology, as it is intriguing.
- Visionaries (early adopters): they can detect the advantages of adopting the new technology earlier than the average adopter, as they embrace a long-term vision.
- Pragmatists (early majority): they can adopt the new technology if we adapt it to their motives and needs, they want it to be quick and with low efforts to change.
- Conservatives (late majority): they will wait until they can clearly identify a tangible advantage before changing. This category will not adopt the new technology until we provide strong evidence for its usefulness and ease of use.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Skeptics (laggards): They will not adopt the new technology, unless they are forced to do so. They are satisfied by their traditional way to do things and are not willing to change, even for something better.

The new element introduced by Moore, is the concept of “Chasm”. According to Moore (1991), each segment of adopters requires a specific marketing strategy to reach them. Thus, the differences between adopters in terms of propensity to adopt new technologies create discontinuities and frontiers between segments, forcing companies, to adapt their strategy for each category. Yet, the differences between the early adopters (visionaries) and the early majority (pragmatists) are so extreme and divergent that a gap called “chasm” splits up the adoption curve (Moore 1991; 2002, Andrus and Moore 1997). This gap between visionaries and pragmatists is also defined by Moore as “the credibility gap”. It represents a space between two segments, where the segment on the right uses the segment on the left as a reference point before taking the decision to adopt the innovation. Accordingly, left segments are supposed to “convince” adopters from their right. The difficulty is that adopters are akin to follow their peers from their own segment. Therefore, relying on one group to diffuse the innovation appears to be highly ineffective (Andrus and Moore 1997). According to Moore (1991), that is even more pronounced between visionaries and pragmatists, making the cross from the early market to the majority market a challenging task for innovations. Consequently, the chasm emerges.

The chasm is a very unpleasant place to stay for companies (Gigliano, et al. 2011). According to Andrus and Moore (1997), it refers to that period characterized by a decrease in sales (no more new users), as all visionaries already use the innovation, but no pragmatist has started using it yet. Accordingly, the main goal is to cross the chasm as quickly as possible to ensure a large diffusion, achieving market success for the innovation (Moore 1991).

To do so, and to improve the adoption of innovations regarding the rest of the population, Moore argues that companies must follow three steps to leave the chasm (Moore 2014, Andrus and Moore 1997):

- First step is to reach “a beachhead segment” from the pragmatists: The most difficult part of crossing the chasm consists of trying to identify a niche segment of pragmatists that need the innovation and could be interested in adopting the innovation, even without references from their segment. The company must understand the needs and motivations, and all factors of acceptance and resistance associated to this niche, as they

## Part 1 – A theoretical approach of consumer-smart object interaction

will trigger or impede the adoption. The strategy is to target this beachhead and to propose them a dedicated and complete solution (whole product solution) with all services associated with the innovation (fast delivery, setup and installation, customer service), reducing uncertainties and efforts to change. By doing so, the company is trying to make from this beachhead segment, a reference base for all pragmatists.

- Second step is the “bowling alley”: After reaching the beachhead, the company must try to identify close segments that share similar characteristics with the “reference segment” (the beachhead). Moore defines this step as the “bowling alley” where the company tries to hit adjacent segments. The company relies on its beachhead segment to reach all other pragmatists in a chain reaction. This step requires from the company, a good understanding of factors of acceptance and resistance from each sub-segments of pragmatists.
- Last step, the “tornado” phase: After a certain period of time, competitors will enter the market with similar offerings, leading the market into a “tornado” phase. During this stage, all pragmatists will hurry to get the innovation, providing evidence for conservatives to adopt it after them. The company must communicate and differentiate its offering from competitors.

To summarize, an innovation is quickly adopted by innovators and visionaries (the early marker), as their motivations to adoption are intrinsic (based on their technology readiness, own interest, and sensibility toward technology). Conversely, the majority market (pragmatists, conservatives, and laggards) must be convinced to adopt the innovation, relying on extrinsic motives of adoption (evidence of product’s relative advantages, complexity, social norms, references segments and leaders). Consequently, the key to step over the chasm is to understand these external factors of acceptance or resistance (Moore 2014).

The following table summarizes the main concepts that originate from Rogers and Moore’s conceptualization of innovation diffusion:

## Part 1 – A theoretical approach of consumer-smart object interaction

Table 5 - Rogers and Moore's innovation diffusion theories

Framework	Concept	Definition
Diffusion of innovations theory (Rogers 1983;1995, Moore 1991;2014)	Relative advantages	Degree to which the innovation is perceived better than the previous product or service it replaces.
	Complexity	The perception of how difficult to use and understand the innovation is.
	Triability	Degree to which the innovation can be tested and experienced before adoption.
	Observability	Extent to which the innovation can provide tangible results to others.
	Compatibility	Extent to which the innovation is perceived consistent with one's beliefs, culture, values, needs and past experiences
	Reference base	Small segment of a specific adopters' category that will serve in diffusing the innovation among peers.
	Communication channels	All the medias relied on for diffusing knowledge and information regarding an innovation.
	Volitional	The extent to which adopting the innovation depends on one's will (optional/personal or mandatory adoption).
	Chasm	A split in the adoption curve that occurs between early adopters and the mass market, due to their diverging motives to adopt the innovation.

Both Rogers's conceptualization and the TALC offer a great conceptual framework to analyse how an innovation diffuses among a social system. Yet, there are limited in explaining which factors of acceptance or resistance will reduce the gap between the early market and the majority (Faiers and Neame 2006, Yi and Bae 2017).

If we refer to the percentages provided by Rogers's model, the chasm occurs when around 16% of the population have adopted the innovation (2.5% of technology enthusiasts and 13.5% of visionaries). Focusing on penetration rates, the penetration rate for smart home devices around the world is rarely above 15% (Kemp 2021). These penetration rates can be seen as relatively low considering that the technology has been released almost ten years ago. IoT companies might be currently facing the famous chasm conceptualized by Moore and must explore and understand what mitigates adoption for pragmatists and the majority market. Researchers and managers have tried to investigate this question, providing insightful models of technology acceptance and resistance.

For that reason, the next section will explore the literature of Technology Acceptance Models.

## Part 1 – A theoretical approach of consumer-smart object interaction

### *B- Models of Technology Acceptance*

Literature on consumer response to technological innovation often divides into two perspectives: studying factors of adoption or resistance (Laukkanen 2016, Mani and Chouk 2017). At the beginning of human-computer interactions, “there was a growing necessity for comprehending reasons why the technology is accepted or rejected” (Marangunić and Granić 2014, p.84). Studying factors of adoption provides insights on consumers’ willingness to adopt a product or a service, whereas studying factors of resistance provides insights on consumers’ reluctance to adopt a product or service (Ram and Sheth 1989, Mani and Chouk 2018). The acceptance or resistance of such innovative technologies is due to multiple factors, such as context of use (organizations, homeplaces) or user’s reactions toward innovation (Alvarez 2001, Alvarez and Urla 2002, Singh and Shoura 2006). Despite the fact they are perceived innovative from a technical perspective, innovations are not always adopted by users (Merril and Feldman 2005). Consequently, studying both factors of acceptance and resistance remains important for a successful diffusion of innovations.

Adoption-based approaches were first grounded in the psychology literature. They gave birth to models of technology acceptance (Venkatesh and Davis 2000). The main goal was to try to identify factors that could predict people’s acceptance of newly developed IT systems (King and He 2006). Most models have stemmed from Rogers’s diffusion of innovations approach, such as Premkumar and colleagues (1994) or Cooper and Zmud’s model (1990). Accordingly, these models have focused on identifying factors of adoption instead of factors of resistance (Mani and Chouk 2017).

From that perspective, the most dominating model investigating user’s acceptance of technology is undoubtedly the technology acceptance model – TAM, first introduced by Fred Davis in 1989. This model has been proposed as “an instrument to predict the likelihood of a new technology being adopted within a group or an organization” (Turner et al. 2010, p.464). The TAM stems from psychology theories such as the Theory of Reasoned Action (TRA) and posits that the user motivation is a good predictor for potential system usage (Davis 1989).

### The Theory of Reasoned Action

The TRA introduced by Ajzen and Fishbein in 1975, argues that people are rational, taking decisions based on the available information, their belief’s structure, and evaluations

## Part 1 – A theoretical approach of consumer-smart object interaction

forming both attitudes and intentions. The TRA aims at predicting behavioral intentions with attitudes and subjective norms as the main antecedents (Hale et al. 2012). The concept of attitude originates from psychology theories which argue human behavior can be assessed according to the positive or negative evaluations of performing the behavior (Fishbein and Ajzen 1975). With the TRA, predicting human behavior results in trying to measure the intention to perform a specific task, based on attitudes and subjective norms attributed to both the behavior and its consequences (French et al. 2005). With this conceptualization, the TRA posits that attitude is structured by three properties (Fishbein and Ajzen 1975):

- Attitude is a predisposition.
- Attitude is a latent variable which influences the intention but cannot be directly observed.
- Attitude is shaped by user's past experiences and beliefs.

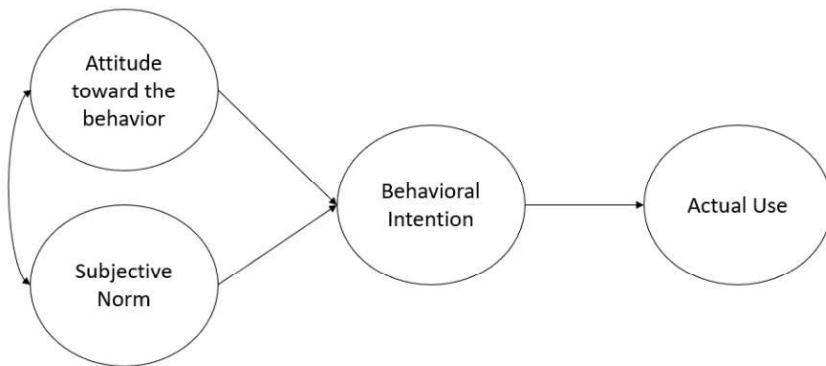


Figure 13 - - Theory of Reasoned Action (Ajzen & Fishbein 1980)

Accordingly, one way to measure attitude toward a behavior is to consider the beliefs associated with the consequences and their evaluation (positive or negative). Considering for instance, a person's attitude toward adopting a system. The attitude became determined by the sum of all behavioral beliefs about the consequences, multiplied by the evaluation of those consequences (Fishbein and Ajzen 1975, Ajzen and Fishbein 1980).

A belief refers to “individual’s subjective probability that performing the target behavior will result in a consequence” (Davis et al. 1989, p.984), while consequences are getting evaluated implicitly (Fishbein and Ajzen 1975). Behavioral beliefs are those beliefs associated with consequences in terms of behavior, while normative beliefs are associated with social

## Part 1 – A theoretical approach of consumer-smart object interaction

consequences (status, appreciation, or depreciation of peers...). The TRA represents the cognitive process of attitude formation based on behavioral beliefs and their evaluations (Ajzen and Fishbein 1980). The same process can also be applied for subjective norm, made by the sum of normative beliefs about the consequences, multiplied by the evaluation of those consequences.

Authors of the TRA make the conceptual distinction between four different sets of constructs: affective (favorable and unfavourable emotions), cognitive (beliefs), intentions and actual behavior. Attitude and subjective norm emerge because of the evaluations of salient beliefs, which in turn will influence intentions and actual behavior. Individual's belief's structure and intentions are supposed to play a central role in predicting behavior, which in turn will influence those beliefs (Ajzen and Fishbein 1980, Langridge et al. 2007).

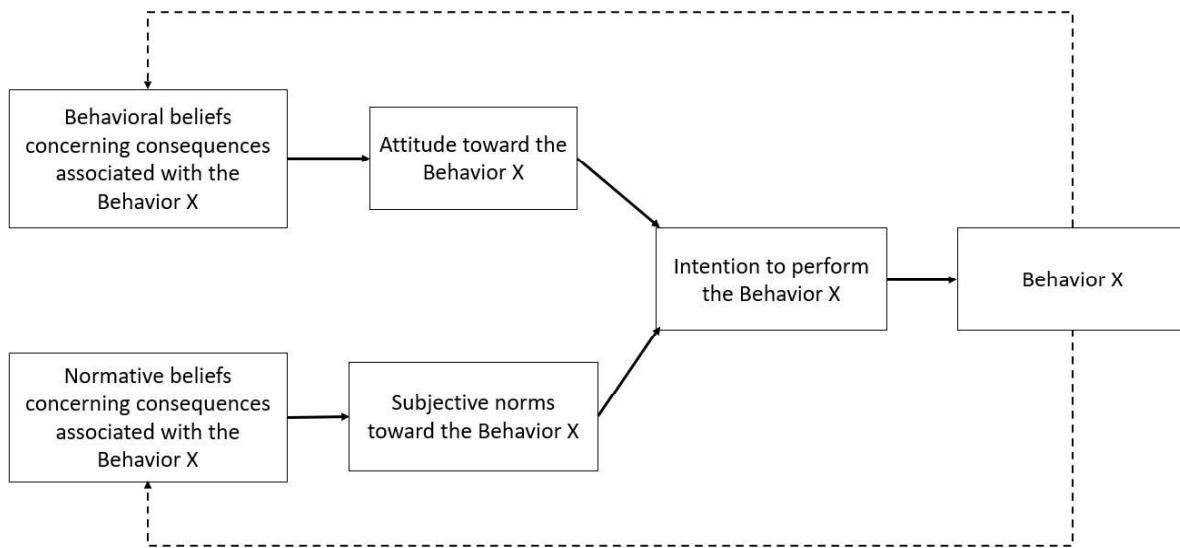


Figure 14 - TRA loop

Fishbein and Ajzen (1975) suggest that people's future behavior could be predicted by considering intentions and beliefs attributed to a specific behavior. According to Ajzen (1991), "Intentions are assumed to capture the motivational factors that influence the behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (p.181). The TRA relies on behavioral intention as the main predictor of the model, with attitudes and social norms as antecedents of intentions (Ajzen and Fishbein 1980, Davis 1986). Indeed, "a key principle of TRA is that attitudes mediate the effects of beliefs on intentions." (Davis et al. 1989, p.989).

## Part 1 – A theoretical approach of consumer-smart object interaction

To summarise, the TRA and models that derives from it posit that a combination of salient beliefs combined with an evaluative process of potential outcomes lead to the formation of attitudes which influence the intention to adopt a specific behavior (Ajzen and Fishbein 1980). Before influencing the actual behavior, salient beliefs are primarily shaped by different factors (personality traits, prior attitude, demographic, ...). Yet, as a retroaction of the specific behavior, beliefs can also be influenced by it.

The TRA represents a general theory trying to understand and to explain human behavior regardless of the context (Davis 1991). While the TRA provides insights on how to predict behavioral intentions for people expressing a great perceived control over their behavior (Ajzen and Fishbein 1980, Ajzen and Driver 1991, Ajzen and Madden 1986, Smetana and Adler 1980), some limitations rapidly emerged. As a general model, the TRA was not effective with behaviors that necessitate to identify salient beliefs specific to them (Ajzen and Fishbein 1980). Another limit of the TRA was its lack for considering behavioral control variables, with users that had little power over it for instance (Roberts and Henderson 1996). To fill this gap, Ajzen proposed to add a new variable to the model, the perceived behavioral control. Accordingly, a new framework emerged, the theory of planned behavior – TPB.

### The Theory of Planned Behavior

The TPB works as an extension of the TRA. This model aims at addressing the deficiency of the TRA to apprehend individual's behavior when they express a lack of control over it (Ajzen 1985). This theory provides three determinants of intention: attitude toward the behavior, subjective norm, and perceived behavioral control. Like the TRA, the TPB still considers attitudes and subjective norms as antecedents of behavioral intention which is still the main factor for predicting future usage. However, this model integrates a new antecedent of behavioral intention. According to Ajzen (1991), behavioral intentions depend on individual's intent to perform a specific behavior. The intent is influenced by the attitudes toward the behavior, subjective norms and more importantly, the perception to be able to successfully perform that specific behavior. "In fact, the theory of planned behavior differs from the theory of reasoned action in its addition of perceived behavioral control" (Ajzen 1991, p. 183).

## Part 1 – A theoretical approach of consumer-smart object interaction

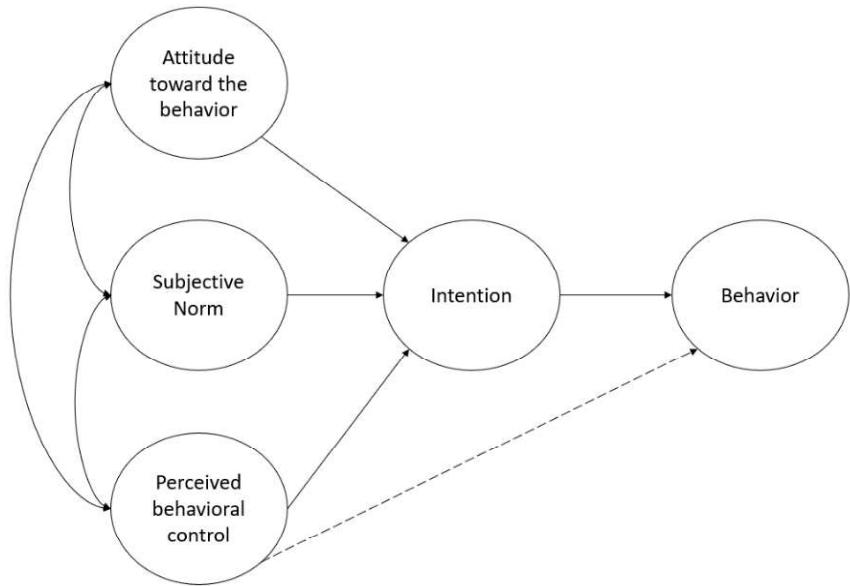


Figure 15 - Theory of Planned Behavior (Ajzen 1991)

In line with the TRA, Ajzen (1991) posits that all these determinants originate from beliefs, more precisely salient beliefs, which finally determine intentions. Attitudes toward the behavior are influenced by behavioral beliefs, subjective norms are shaped by normative beliefs and control beliefs are the basis for perception of behavioral control. While individuals can hold a great number of different beliefs, these three are considered specific “determinants of a person’s intentions and actions” (Ajzen 1991, p.189).

Concerning attitudes toward the behavior, it refers to the TRA conceptualization, which is defined as positive and negative evaluations of engaging in the behavior, more precisely “the degree to which a person has a favorable or unfavourable evaluation or appraisal of the behavior in question” (Ajzen 1991, p.188). Subjective norm refers to social pressure attributed to performing or not a specific behavior and how people would react. Regarding the perception of behavioral control, it refers to the feeling of possessing all the resources required to engage in and perform the behavior. This concept can be compared to the Self-Efficacy construct theorized by Bandura in 1977. It refers to the perception of being able to perform actions required during specific situations (Bandura 1982). The TPB posits that perceived behavioral control is intermingled within a broader set of factors (context, beliefs, attitudes, intentions) and have an influence over thoughts patterns and emotional reactions (Ajzen 1991).

## Part 1 – A theoretical approach of consumer-smart object interaction

These different determinants of intention derive from prior beliefs that are specific for each of them (Madden et al. 1992).

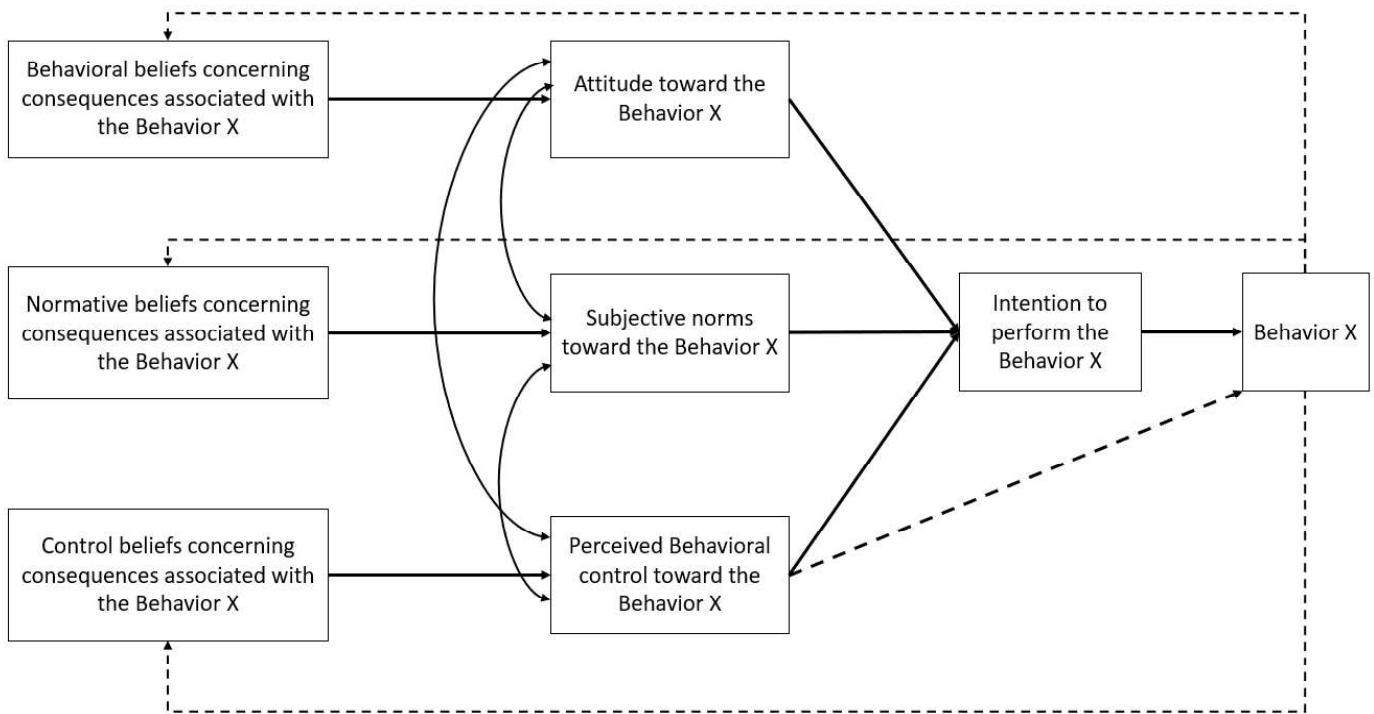


Figure 16 - TPB loop

According to the TPB, even if individuals express the same level of behavioral intention, people with higher perception of behavioral control are more likely to succeed in engaging the behavior, than those with low perceived level of control. According to Ajzen (1991), “a person may believe that, in general, her outcomes are determined by her own behavior (internal locus of control), yet at the same time she may also believe that her chances of becoming a commercial airplane pilot are very slim (low perceived behavioral control).” (p.183).

Despite the major contributions of the TPB, limitations remain. According to Mathieson (1991), the TPB suffers from three main concerns. First, the model does not fully grasp specific aspects of the behavior that were not under volitional control, making it reliable mostly with mandatory usage. Secondly, the TPB is still grounded in the TRA, assuming that individuals are rational, taking decisions based on available information. Thus, the model does not tackle unconscious or irrational motives. Last concern, the TPB lacks consideration for demographic factors and individual variables such as personality.

## Part 1 – A theoretical approach of consumer-smart object interaction

With the ever-changing technology, and despite its relative effectiveness, the TPB rapidly faced the need to adapt to specific and different contexts (Conner and Armitage 1998). Consequently, measures of technology acceptance from the TPB became less reliable and hardly generalizable as they became context specific (Marangunić and Granić 2014). Regardless of these limits, both the TRA and TPB provided strong basis for understanding technology acceptance even with technologies that emerged after them (George 2004). As the need for a more reliable framework became crucial, Davis proposed in 1986 to cover the limitations of the TRA and introduced a conceptual framework of the future Technology Acceptance Model – TAM, with the core idea that computer features and capacities trigger user's motivation to use it, which in turn directly shape actual usage. This model was designed specifically for user acceptance of information systems.

### The Technology Acceptance Model

Davis was convinced that user motivation explains and predicts actual usage. Thus, he relied on the TRA to propose a model, the TAM, aiming at identifying determinants that influence the adoption of computers and technology (Davis 1986). The TAM was also designed to explore a variety of usage behavior and with the core idea of providing a parsimonious framework (Davis et al. 1989). Davis brought major changes trying to make the TAM a framework that will serve as a basis for additional research. First, subjective norms, behavioral control and intentions were initially removed from the model, relying only on attitudes toward usage as the main predictor for actual usage. Indeed, subjective norms and behavioral control were removed due to theoretical uncertainties in measuring those variables. Regarding intentions, as they are supposed to be shaped by attitudes there were no need for conserving it (Davis 1986). Indeed, for Davis positive attitudes are deemed to result in positive intentions and conversely, negative attitudes result in negative intentions.

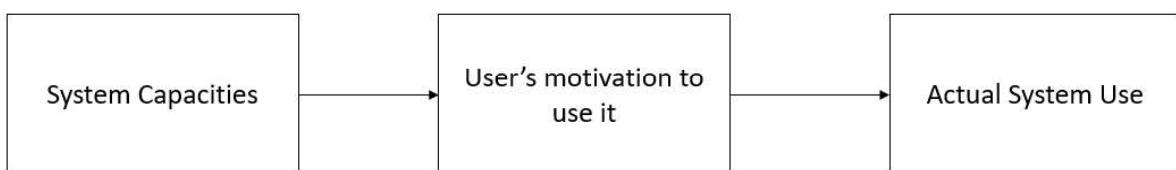


Figure 17 - TAM first conceptual framework (Davis 1986)

## Part 1 – A theoretical approach of consumer-smart object interaction

The second major change was the introduction of two central antecedents of behavioral intention: perceived usefulness and perceived ease of use (Davis 1986, Davis et al. 1989). User motivation became central with the TAM (Venkatesh 2000).

According to Davis (1986), usage behavior was directly influenced by attitudes. The major determinant of whether users will adopt or reject a system was its attitudes toward using it. This variable was supposed to be influenced by the perception of the system's usefulness and ease of use. These two major instrumental beliefs are central in Davis's conceptualization. Perceived usefulness stems from the expectancy theory (Fishbein and Ajzen 1975) and refers to the degree to which a user believes using the system will improve and enhance his performance, while perceived ease of use is defined as the feeling that using the system will be free of effort (Davis 1986-1989, Davis et al. 1989, Venkatesh and Davis 2000). Perceived ease of use within the TAM is supposed to have a direct influence over perceived usefulness, while both perceived usefulness and ease of use are supposed to be influenced by the system's characteristics (external factors). Indeed, "TAM theorizes that the effects of external variables (e.g., system characteristics, development process, training) on intention to use are mediated by perceived usefulness and perceived ease of use. According to the TAM, perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use the more useful it can be." (Venkatesh and Davis 2000, p.187).

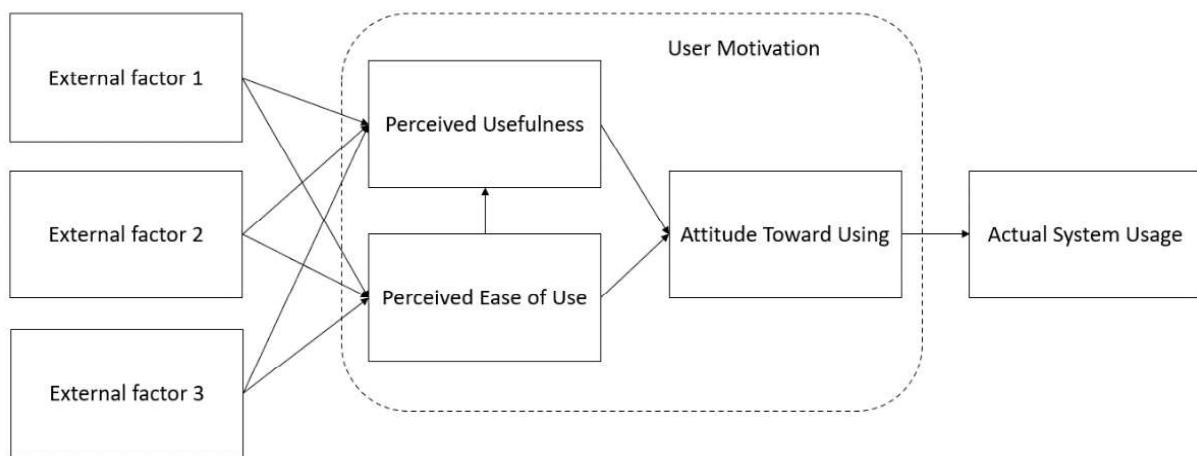


Figure 18 - Original TAM (Davis 1986)

Yet, usefulness and ease of use does not share the same influence over usage (Davis 1989). Accordingly, "users need to perceive the system as being useful or they will not attempt

## Part 1 – A theoretical approach of consumer-smart object interaction

to use it regardless of how easy or difficult it is to use. Ease of use is less important because difficulty in using a system can be overcome if the user thinks that the system will be useful to them.” (Gardner and Amoroso 2004, p.2).

With a growing number of research being conducted using this version of TAM, results suggested that the relationship between perceived usefulness, perceived ease of use and actual system usage, was not fully mediated by attitude toward using (Davis 1989). Thus, Davis, Bagozzi and Warshaw (1989) proposed to reincorporate a behavioral intention variable, directly influenced by perceived usefulness and attitude toward using. According to them, users might face situations under which system’s characteristics might elicit behavioral intentions through perceived usefulness, without eliciting necessarily attitude toward using it. By doing so, the model was more accurate in predicting the actual system usage (Davis et al. 1989).

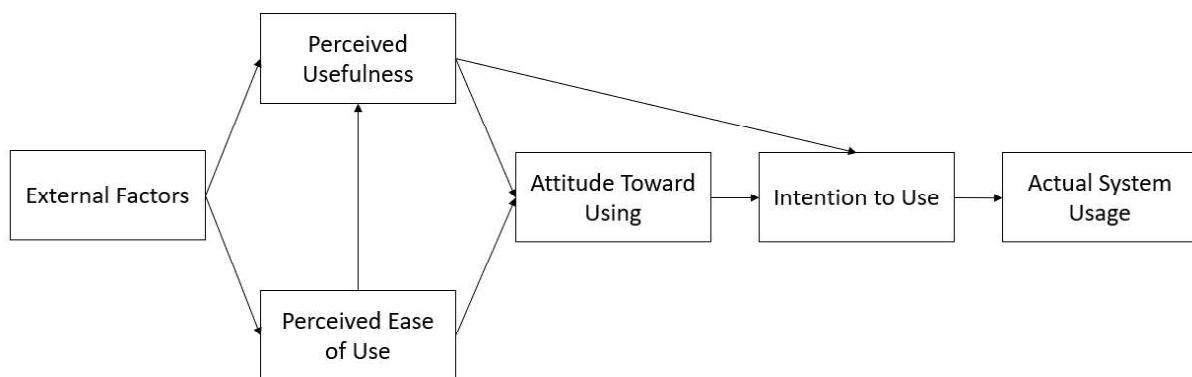


Figure 19 - Technology Acceptance Model (Davis et al. 1989)

The other major change brought by Davis’ model (1986) was the consideration for external factors, mainly system’s characteristics, but also user experience and other factors (Venkatesh and Davis 1996). This conceptualization has permitted the emergence of several contribution to the TAM literature, making it the leading predicting model for technology acceptance (Lee et al. 2003, Gardner and Amoroso 2004).

Based on this strongly supported model, Venkatesh and Davis (2000) introduced an extension model called TAM 2, which was supposed to identify several antecedents of perceived usefulness. They decided to remove attitude toward using as they believed it had a limited role in explaining behavioral intention.

## Part 1 – A theoretical approach of consumer-smart object interaction

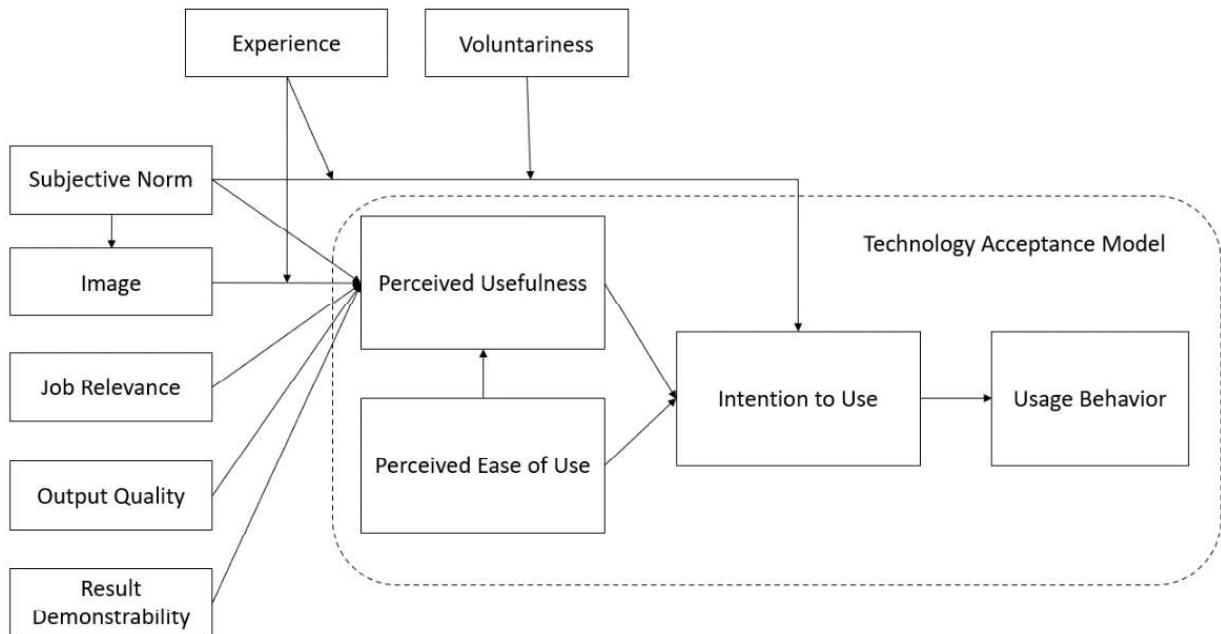


Figure 20 - TAM 2 (Venkatesh and Davis 2000)

The antecedents for perceived usefulness were divided into social influence processes (impact of interrelated social forces to adopt or reject a system) and cognitive instrumental processes (what a system can do according to what people need to get the job done). According to Venkatesh and Davis (2000), the introduced antecedents were defined as follow:

- Subjective norm: how others might influence user's acceptance, or the perception of what people think about adopting or rejecting a system and the compliance to such pressure. This antecedent directly stems from the TRA, which is supposed to be moderated by experience and voluntariness (mandatory vs non-mandatory adoption).
- Image: the importance of keeping a pleasing image with others and the degree to which adopting the system will enhance one's social status. This variable originates from the research field of diffusion of innovation and its influence supposed to be moderated by experience (reduces through time).
- Job relevance: the extent to which the technology was appropriate with the job, or the extent to which the system's capacities fit with the job's situations.
- Output quality: the degree to which the technology operated adequately, or how well it performs specific tasks.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Result demonstrability: the technology capacity to provide tangible results, or the concrete observation of positive results.

This model was introduced alongside the growing integration of computers within companies. Thus, “researchers and practitioners devoted substantial research effort determining which factors affect user’s beliefs and attitudes on the technology acceptance decision” (Marangunić and Granić 2014, p.87). Most of these concepts originated from Rogers’s model of innovations diffusion. Several extensions of TAM 2 emerged, such as Venkatesh’s model (2000) trying to account for determinants of perceived ease of use, also called TAM 3.

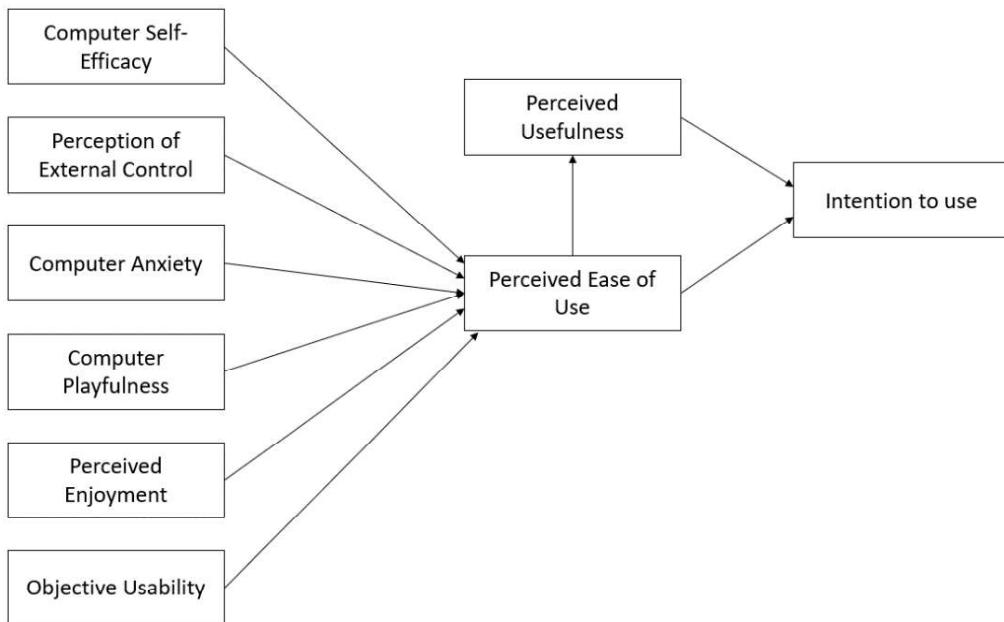


Figure 21 - TAM 3 (Venkatesh 2000)

According to Venkatesh (2000), there were a need to reflect not only on perceived usefulness antecedents, but also to consider factors that can influence the perception of ease of use. His modification of TAM brought several antecedents of perceived ease of use, categorized in anchors and adjustment variables. Anchors are referring to control variables (internal such as self-efficacy and external such as external control), an intrinsic motivation variable (computer playfulness) and a negative emotion (computer anxiety). On the other hand, adjustment variables (perceived enjoyment and objective usability) result from the interaction with the technology and are supposed to bring more influence over the ease of use through time. With TAM 3, Venkatesh introduced the notion that perceived ease of use was dependent of

## Part 1 – A theoretical approach of consumer-smart object interaction

both individual characteristics, and situational factors with an influence that vary based on experience. Thus, individual differences must be considered and incorporated to models of technology acceptance alongside object's characteristics (Venkatesh 2000).

Because of its parsimony, the TAM literature quickly enriched from multiple contributions (Marangunić and Granić 2014). Extensions have mainly followed three directions:

- Determinants of behavioral intention: from other related models such as self-efficacy (Taylor and Todd 1995).
- Belief factors: trying to investigate antecedents of attitude toward using, such as content richness (Lee and Lehto 2013) or trialability (Agarwal and Prasad 1997).
- External factors: related to direct or moderating factors of perceived usefulness and ease of use, such as demographics (Venkatesh 2000, Venkatesh and Morris 2000) or personality traits (Gefen and Straub 1997).

More than extensions, the TAM was also challenged by other models of technology acceptance. According to Kim and colleagues (2009), the TAM relies mainly on salient beliefs and the perception of benefits that result from using the technology. Yet, it does not sufficiently explore other cognitive processes that might shape user's acceptance. For that reason, some researchers have tried to incorporate additionally, other beliefs that were independent from that perception.

The other models for technology acceptance differed in measuring actual usage (Marangunić and Granić 2014) and focused mainly on identifying additional factors and antecedents:

- Additional external factors: new models have incorporated additional antecedents for both perceived usefulness and ease of use, for instance confidence and anxiety in technology (Amoako-Gyampah and Salam 2004, Saadé and Kira 2006), or prior usage (Burton-Jones and Hubona 2006, Oh et al. 2003).
- Determinants of behavioral intentions: incorporating additional factors of intention to use, to improve the predictive validity, such as perceived risk (Featherman and Pavlou 2003, Pavlou 2003) and trust (Gefen et al. 2003, Wu et al. 2011), user commitment (Amoako-Gyampah 2007) or expectations (Venkatesh et al. 2003).

## Part 1 – A theoretical approach of consumer-smart object interaction

- Contextual factors: most of the time, moderating variables across the model such as technology characteristics (Plouffe et al. 2001) or cultural influence (Huang et al. 2003, Straub et al. 1997).

Compeau, Higgins and Huff (1999) model for instance, have relied on the social cognition theory to incorporate different prior beliefs. Their model relies on the Self-Efficacy concept from Bandura (1977) which is defined by individuals' perceived capacity to perform a specific task. Bandura also argues that most of human behavior stems from our capacity to simulate expectations, based on our self-efficacy. Humans tend to mentally simulate future consequences, such as humans' influence over objects (Bandura 1977). These simulations are based on "efficacy expectations" that depend on our self-efficacy (Bandura 1982). Based on Bandura's concept of self-efficacy, Compeau, Higgins and Huff (1999) decided to provide a model of technology adoption that incorporates "efficacy expectations":

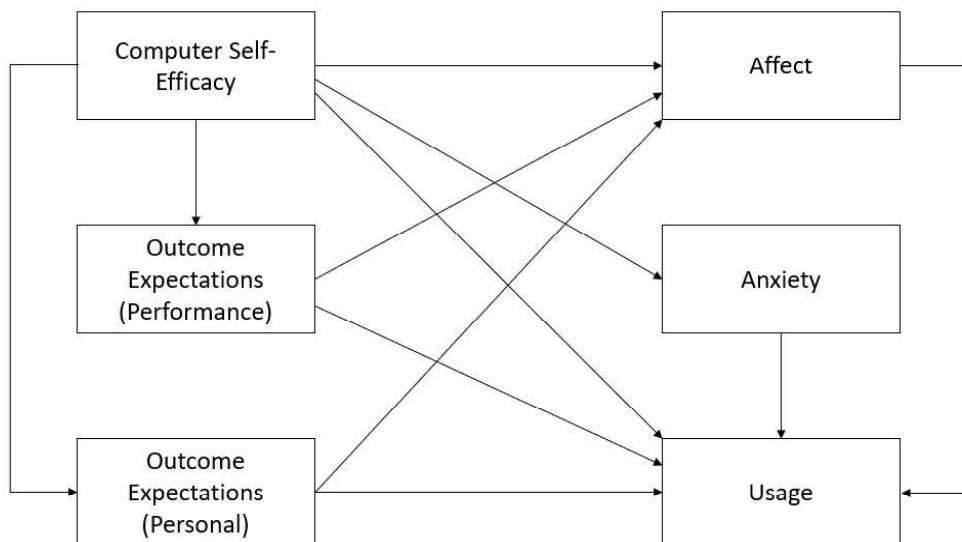


Figure 22 - Compeau et al (1999) model of technology adoption

Outcome expectations is divided into two different perspectives: the expectations in terms of advantages and improvements in work performance (Performance), and the expected effects in terms of image and social status changes (Personal). The affect variable refers to favorable thoughts associated with the usage, while anxiety refers to all negative emotions aroused by using the technology (fear, anxiety, etc.).

Another model, proposed by Agarwal and Karahanna (2000), introduces variables from the cognitive absorption theory to enrich the TAM. Relying on this theory, they were able to

## Part 1 – A theoretical approach of consumer-smart object interaction

provide a model that integrates to the TAM, different determinants such as interaction playfulness, curiosity, and personal innovativeness.

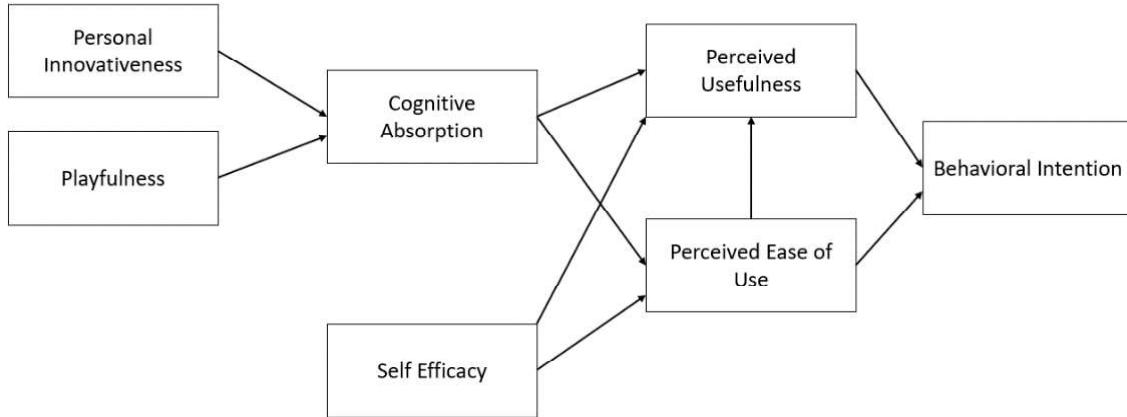


Figure 23 - Agarwal and Karahanna (2000) model of technology acceptance

Many other models have been proposed, such as Dishaw and Strong (1999) technology acceptance model relying on the Task Technology Fit theory, Wixom and Todd (2005) model integrating users satisfaction variables, or McFerland and Hamilton (2005) model also based on the social cognition theory. Yet, limitations and shortcomings regarding the TAM remained.

### Limits of the TAM approach

Even though these models tried to incorporate different variables which were not previous salient beliefs, the differences with TAM 2 or TAM 3 in terms of conceptualization remain too thin. Indeed, regarding Compeau et al. (1999) for instance, *outcome expectations* in terms of performance can be associated to the variable perceived usefulness. *Personal outcomes expected* also refers to subjective norms as conceptualized by Venkatesh and Davis in TAM 2. All in all, the approach proposed by these alternative models is interesting, yet they tend to focus on specific aspects of TAM and reduce the understanding of technology acceptance (King and He 2006). Considering other beliefs and expectations which were not related to performance evaluations into the process of technology acceptance stressed the need for a new model to emerge.

## Part 1 – A theoretical approach of consumer-smart object interaction

In 2003, Venkatesh, Morris, Davis and Davis proposed the Unified Theory of Acceptance and Use of Technology (UTAUT). By reviewing the most relied on models of technology acceptance, the authors proposed a unified model to predict technology acceptance. The model originates from the TAM literature but also encompasses variables from other theories (Social Cognition Theory, Innovation Diffusion Theory, Task Technology Fit). The aim was to simplify the conceptualization of technology acceptance by including the main variables into four main categories: performance expectancy (perceived usefulness, intrinsic motivations, relative advantages), effort expectancy (perceived ease of use, complexity), social influence (subjective norms, social image, and status) and facilitating conditions (control, compatibility).

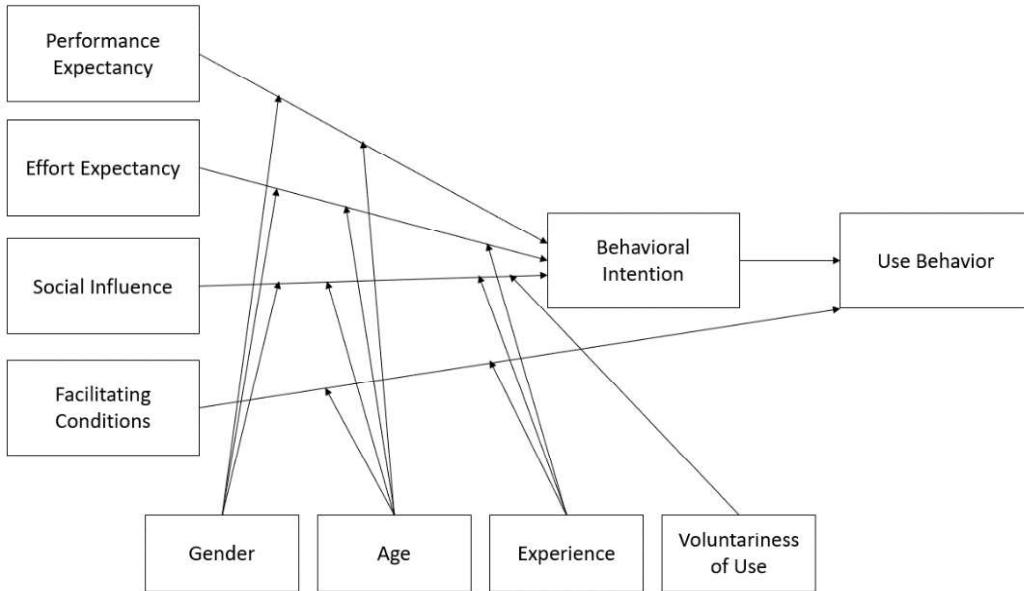


Figure 24 - Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003)

Most of these authors have based their work on the TAM. Thus, a great variety of domains of application have been investigated, from information systems (Pai and Huang 2011) to computer and security systems acceptance (Igbaria et al. 1995, Hu et al. 2005). The TAM not only works with physical products but can also be operationalized for IT services (Mani and Chouk 2018), internet-based applications (Shih 2004, Lee et al. 2012), or mobile acceptance (Lu et al. 2003, Wu et al. 2011). The great number of research and the support from various literatures have identified perceived usefulness and perceived ease of use, as the backbone of almost all technology acceptance models (Venkatesh and Davis 2000, Hoeffler

2003). This conceptualization offers to researchers a convenient framework for simplifying users' acceptance (Marangunić and Granić 2014). Indeed, "TAM has come to be one of the most widely used models in information systems, in part because of its understandability and simplicity." (King and He 2006, p.740).

Unfortunately, even if these authors tried to explain technology acceptance by considering different theories and perspectives, a major concern remains. The main issue with these models is that they keep on trying to understand technology acceptance from a rational perspective (King and He 2006). Focusing on the UTAUT (Venkatesh et al. 2003), the dominance of rational thinking in explaining technology acceptance is overwhelming, with no consideration for unconscious and irrational mechanisms in explaining behavioral intention (Legris et al. 2003). They do not consider sufficiently irrational motives as antecedents for perceived usefulness and ease of use.

Additionally, King and He (2006) also claim that the TAM is "imperfect". According to some researchers, while the abstraction and simplification provided by the TAM has given rise to a lot of different research, the real problem of technology acceptance remains (Venkatesh 2000, Chittur 2009, Turner et al. 2010, Mani and Chouk 2017). Another criticism lied on Venkatesh and Davis (2000) decision to remove attitude toward usage from TAM. According to Kim, Chun, and Song (2009), this argument was made without strong theoretical support, limiting our understanding of technology acceptance behavior. Indeed, the influence of attitude on behavior and intention is widely supported in social psychology, providing indication on whether users are inclined or not to perform a specific task, regardless of its perceived usefulness and ease of use (Ajzen and Fishbein 1980).

For Legris and colleagues (2003), the TAM remains uncomplete and needs to integrate broader factors related to social interactions between users and objects. In line with that statement, Sharp (2007) also provides three interesting areas for extension in TAM-related research:

- Considering Perceived Usefulness and Ease of Use as less important determinants.
- Comparative studies between mandatory and volitional usage.
- Integrating other antecedents and irrational motives as determinants of perceived usefulness, ease of use and attitude regarding user acceptance.

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 6 - Extensive TAM reviews (Marangunić and Granić 2015)*

Authors	Research methodology	Main findings
<b>Lee et al. (2003)</b>	Review of TAM history and assumptions for future trajectory	The TAM has evolved between 1986 and 2003, yet it must incorporate emerging issues related to user-machines interaction.
<b>Legris et al. (2003)</b>	Review of empirical TAM-based research.	TAM-based research's results are not consistent, and most have missing factors.
<b>King and He (2006)</b>	Meta-analysis of TAM-based articles.	The TAM is robust and fits across many different fields and applications.
<b>Sharp (2007)</b>	Review of TAM's extensions.	The TAM must adapt to recent issues in human-machines interaction fields.
<b>Chittur (2009)</b>	Review of theoretical and practical effectiveness of TAM.	The TAM often lacks rigorous results.
<b>Turner et al. (2010)</b>	Cross-analysis of TAM effectiveness in different contexts.	The TAM predictions outside the context of validation are not really accurate.

This section has allowed us to better apprehend the main theories and concepts that have structured the understanding of consumer acceptance of technology-based solutions. From the theory of reasoned action to the technology acceptance models, researchers have tried to conceptualize the main mechanisms involved in the process.

Accordingly, the following table summarizes the core concepts that are involved in predicting technology adoption from the TAM literature:

*Table 7 - List of variables for predicting technology acceptance (Venkatesh et al. 2003, Kukafka et al. 2003)*

Framework	Variable	Definition
<b>Theory of Reasoned Action – TRA (Ajzen and Fishbein 1975)</b>	Behavioral intention	Subjective probability or intention to perform a specific behavior based on the consequences stemming from prior beliefs.
	Attitude toward usage	Positive or negative evaluations of behavioral beliefs and consequences associated to performing the behavior.
	Behavioral beliefs	Prior beliefs associated to behavioral consequences.
	Evaluations	Positive or negative opinion attributed to a specific belief.
	Subjective norms	Social pressure attributed to performing or not a specific behavior and how people would react.
	Normative beliefs	Prior beliefs associated to social consequences (status, appreciation, or depreciation of peers...).

## Part 1 – A theoretical approach of consumer-smart object interaction

<b>Theory of Planned Behavior – TPB (Ajzen 1991)</b>	Perceived behavioral control	Feeling of possessing all the resources required to engage in and perform the behavior.
	Control beliefs	Prior beliefs related to consequences in terms of behavioral control.
<b>Technology Acceptance Model – TAM (Davis et al. 1989)</b>	Perceived Usefulness	Degree to which a user believes using the system will improve and enhance his performance.
	Perceived Ease of Use	Feeling that using the system will be free of effort.
<b>Social cognition theory (Bandura 1977, Compeau et al. 1999)</b>	Self-Efficacy	Individuals' perception of being able to perform a specific task.
	Outcome expectations	Anticipated advantages (Performance), and expected consequences in terms of image (Personal)
	Affect	Favorable thoughts associated with the behavior.
	Anxiety	Negative emotions aroused by the technology (fear, anxiety).

Theories of technology acceptance and the different models rely on the TRA and TPB theoretical grounding to identify factors of adoption (Venkatesh et al. 2003). This approach considers users as rational agents, evaluating and taking decisions based on available information (Ajzen 1991, Davis et al. 1989). Despite the different limits and concerns, the TAM has highlighted the effectiveness of Perceived Usefulness, Ease of Use and Attitudes toward usage for predicting behavioral intention (Venkatesh and Davis 2000, Hoeffler 2003). As seen above, the perception of usefulness and ease of use appears to be strong and reliable predictors of acceptance. Yet, the literature seems to focus only on rational motives as the antecedents of performance-effort expectancies.

To summarise, the decision to adopt the technology innovation from this rational perspective depends on two core elements:

- Technology characteristics (usefulness, ease of use).
- Consumers' evaluation of these characteristics (attitudes).

However, if consumers were indeed rational, then models of technology acceptance might have been sufficient for explaining and predicting adoption. Yet, while 70% of consumers believe smart objects represent an opportunity for society and individuals, they are 66% which hold negative evaluations toward them, considering them as “gadgets” (Credoc 2019). Consumers tend to feel ambivalent attitudes as regard robots and smart objects (Ardelet et al. 2017, Bayart et al. 2017). This ambivalence between positive and negative opinions toward the same object can hardly be captured and explained by models of technology acceptance alone.

## Part 1 – A theoretical approach of consumer-smart object interaction

Indeed, “the majority of existing research takes an adoption or a diffusion perspective on the study of technological innovations” (Mani and Chouk 2017, p.77), while these approaches are not designed for evaluating innovation’s potential influence over the consumer behavior (Page & Rosenbaum, 1992). One way to overcome this weakness is to consider resistance alongside acceptance as part of users’ motives to adopt the innovation (Moore 2014, Ram and Sheth 1989, Wiedmann et al. 2011).

While some researchers believe adoption and resistance factors are independent (Gatignon and Robertson 1989), others argue resistance and adoption might coexist and share mutual factors (Ram 1987, Ram and Sheth 1989, Mani and Chouk 2017). As mentioned previously, understanding users’ motives to adopt a technology innovation encompasses the comprehension of factors of acceptance and resistance (Moore 2014). According to Ram (1987), innovation adoption and technology acceptance cannot be achieved until consumer resistance remains. Despite the relative effectiveness of TAM and derived models in predicting acceptance, they are not sufficient alone for IoT companies to understand consumer resistance and for crossing the actual chasm.

With the ever-going evolution of technology and emergence of new products, technology acceptance and resistance remain relevant topics of interest (Marangunić and Granić 2014). With the birth of IoT-based objects and new interactions between people and smart objects, researchers have tried to understand how such products were perceived by users, thus studying their acceptance, but also their resistance. Studies on smart objects adoption mainly focus on acceptance instead of resistance (Kim and Shin 2015, Chang et al. 2014). Understanding resistance is essential to the path of adoption (Moore 2014). Indeed, “understanding consumer resistance, in the first stage of the innovation lifecycle, is a key factor” (Mani and Chouk 2017, p.78). Hence, apprehending smart objects’ adoption from the prism of resistance can help to better understand their diffusion rate.

II- Resistance and negative attitudes toward technology

A- Consumer Resistance to innovation

Regardless of the widespread of the IoT, smart objects remain a source of concerns (Verhoef et al. 2017). Consumer adoption of smart objects is littered with barriers (Mani and Chouk 2017). About 66% of the population consider smart objects as mere gadgets (Crédoc 2019), while 88% of consumers are not willing to adopt them (Ifop 2014). This association between smart objects and gadgets is an expression of resistance, which can represent a threat for tech-companies (Mani and Chouk 2018).

Resistance to innovation is one of the main causes for innovation failure (Ellen et al. 1991). Indeed, “studying innovation under the paradigm of resistance provides a better understanding of the factors that inhibit its adoption and reduce its failure rate” (Mani and Chouk 2018, p.782). Consequently, understanding barriers which prevents the adoption is extremely important if you want to reduce consumer resistance (Heidenreich and Handrich 2015). Reducing consumer resistance allows companies to cross the chasm, for a better innovation diffusion and adoption (Moore 2014).

Resistance is defined as the opposition to a specific situation, which is perceived as dissonant by people (Roux 2007). Consumer resistance to innovation is defined by the opposition to an innovation that conflicts with consumers’ beliefs (Ram and Sheth 1989). It is considered by some as an intention (Kleijnen et al. 2009), or an attitude (Ellen et al. 1991) or a mix of attitude and intention (Ram and Sheth 1989). The concept of consumer resistance originates from the resistance to change theory and can be operationalized as the opposition to change caused by an innovation (Ram 1987).

Researchers have tried to identify the different determinants of resistance and the mechanisms behind its emergence. First, they tried to reflect on the “nature” of the resistance consumers might feel. The literature on consumer resistance identifies three different types of resistance: passive, active and very active resistance (Ram 1987, Ram and Sheth 1989, Ellen et al. 1991, Heidenreich Spieth 2013, Heidenreich and Handrich 2015, Chouk and Mani 2016, Mani and Chouk 2018).

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 8 – Types of resistance*

Type of resistance	Definition
<b>Passive</b>	The consumer feels reluctant to adopt the innovation because of a predisposition to resist to changes.
<b>Active</b>	The consumer postpones an adoption due to a functional or psychological barrier, such as the perception of uselessness.
<b>Very Active</b>	The consumer decides to get engaged in actions against the adoption of the innovation (calling for boycotts, negative “word of mouse”, etc.)

Active and very active resistance originate from negative evaluations of a new product, based on evaluations from which result the perception of different risks. Accordingly, consumers will adopt specific behaviors to express a form of resistance (such as opposition or postponement). While passive resistance to innovation depends more on consumer's predisposition to resist, to develop reluctance and unfavourable opinions, from which determinants of active resistance originate (Chouk and Mani 2016, Heidenreich and Spieth 2013, Talke and Heidenreich 2014). As with the theory of innovation diffusion, active resistance (like acceptance), emerges depending on individuals' belief's structure and the way the innovation conflicts with it (Ram and Sheth 1989). Conversely, passive resistance is more latent and difficult to apprehend. That is why the literature have mainly focused on studying determinants of active resistance (Ram 1987, Ellen et al. 1991, Kleijnen et al. 2009, Heidenreich and Handrich 2015, Mani and Chouk 2017).

Regarding resistance to innovation, it corresponds to the large spectrum of negative attitudes and emotions toward new products or services triggered by various set of factors (Heidenreich and Spieth 2013). Resistance to innovation holds a cognitive dimension (usage evaluation, expectancy-value processing etc.) and an emotional dimension (surprise, fear, playfulness, etc.). According to the literature, consumer resistance to innovation can manifest through three different forms of behavioral response: rejection, opposition, and postponement (Kleijnen et al. 2009, Szmigin and Foxall 1998, Mani and Chouk 2018).

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 9 - Different expressions of consumer resistance (Mani and Chouk 2018)*

<b>Consumer Response</b>	<b>Definition</b>	<b>Example</b>
<b>Rejection (passive)</b>	Consumers are not willing to adopt the smart objects, based on predispositions to resist.	Consumers that tend to feel reluctance based on irrational anxiety and fear toward smart object's, preventing them to adopt the innovation.
<b>Opposition (active)</b>	Consumers not willing to adopt smart objects based on prior beliefs and evaluations.	Laggards not willing to adopt the innovation sticking to traditions and culture.
<b>Postponement (active)</b>	Consumers may not adopt the smart objects depending on circumstances.	Consumers such as pragmatists, that need to get convinced by opinion leaders, will wait before adopting the innovation, until they can clearly observe relative advantages from their peers.

The reasons explaining consumer resistance to innovation depend on the context and the type of innovation (Claudy et al. 2015). Most of the time, resistance is oriented toward the product itself, resulting in behaviors of avoidance (Chouk and Mani 2016, Ardelet et al. 2017). Depending on the innovation's characteristics and the context, consumers might face different kinds of barriers (Ram and Sheth 1989). Surveys have identified different barriers such as privacy concerns and trust issues (Accenture 2016). Accordingly, the literature on smart objects resistance have focused on several factors and determinants of active resistance (Sicari et al. 2015, Alhadlaq et al. 2017, Hsu and Lin 2016, Weinberg et al. 2015, Cowan et al. 2018, Slettemeås 2009, Monsurro et al. 2020).

In active resistance to innovation, privacy and trust concerns are deemed to be important determinants (Chouk and Mani 2016). The widespread of technology had a significant impact on how people interact with their surroundings (Verhoef et al. 2017). Personal information such as location, habits, or preferences are usually collected while using technology (Sicari et al. 2015). These technologies allow the sharing of private information where consumers do not fully grasp how and where their data is stored and who is using it (Mani and Chouk 2017). Studies have shown the negative effect of privacy concerns on both attitudes toward usage and intention to use smart objects (Hsu and Lin 2016, Muller-Seitz et al. 2009). With the IoT revolution, objects have become data collectors, involving huge amount of collected information exposing consumers to privacy and trust concerns.

## Part 1 – A theoretical approach of consumer-smart object interaction

Privacy issues and trust in technology often evolve in a dyadic. Indeed, the literature has shown privacy concerns often come alongside trust issues (Yan et al. 2014). When consumers express privacy concerns, interacting with a trusted brand can help reducing security barriers (Chaudhuri and Holbrook 2001) and enhancing purchase intention (See-To and Ho 2014).

Trust is often cited as a determinant of technology adoption in the technology acceptance and resistance literature, but also in the human-robot interaction literature (HRI), especially with the emergence of Internet and digital interactions (Fusaro 2002). According to Mayer and colleagues (1995), the need for trust emerges during situations of uncertainties and risks. This situation stems from the dissonance between two agents, a “trustee” and a “trustee”. The “trustee” tries to anticipate the actions of a “trustee” to keep the situation under control. Due to information asymmetry, the trustee cannot reduce the uncertainties associated with the trustee actions. It results in the emergence of a risk (financial, health, loss of control, etc.) if the trustee actions don’t match the trustee expectations (Mayer et al. 1995).

In the user-technology context, trust translates into the perception of different risks and barriers associated with the technology adoption such as performance and financial issues, social concerns, privacy issues, loss of control and technology dependency (Ram 1987, Ram and Sheth 1989, Featherman and Pavlou 2003, Mani and Chouk 2017). These risks can result in the emergence of resistance. Most of the time, they are associated with usage, making perceived risk as an expected functional or psychological outcome (Compeau et al. 1999). Before interacting with the technology, consumers try to predict and anticipate the interaction’s outcomes (Bandura 1977, Hoeffler 2003). Users are trying to anticipate the technology’s actions to keep the situation under control. Consequently, expectations are made based on the innovation’s characteristics and consumer’s perception (Rogers 1995, Ram 1987).

According to Ram (1987), resistance toward innovation depends on multiple factors. These determinants can be categorized into three different sets of determinants: innovation characteristics, consumer characteristics and propagation mechanisms characteristics.

*Table 10 - Determinants of consumer resistance (Ram 1987)*

Determinants’ category	Determinants
<b>Innovation characteristics</b>	Relative advantage, compatibility, perceived risk, complexity, communicability
<b>Consumer characteristics</b>	Personality, attitudes and prior beliefs, previous experience, motivations
<b>Propagation mechanisms characteristics</b>	Clarity, credibility, type of source

## Part 1 – A theoretical approach of consumer-smart object interaction

Regarding this conceptualization, active resistance toward innovation can emerge depending on the innovation itself (risks, complexity), consumers (innovativeness, personality traits, beliefs) or the communication channels relied on for diffusing the innovation. This approach originates from Rogers' theory of innovation diffusion. Ram argues resistance and adoption are nested, an idea shared among other researchers (Bagozzi and Lee 1999, Wiedmann et al. 2011). However, Rogers and Ram's approaches differ in terms of objectives. Rogers' model aims at understanding the rate of adoption, while Ram's approach focuses on explaining consumer resistance to adoption. Following this slightly different paradigm, Ram and Sheth proposed in 1989 a model supposed to identify more precisely determinants of consumer active resistance and explaining the process under which such resistance toward innovation technology emerges.

According to Ram and Sheth (1989) determinants can be conceptualized as barriers preventing consumers to adopt the innovation. Consequently, two distinct barriers' categories emerge: functional barriers and psychological barriers, focusing on active and very active forms of resistance (Mani and Chouk 2017).

*Table 11 - Barriers preventing consumers to adopt the innovation (Ram and Sheth 1989)*

Barriers' category	Definition	Barriers	Definition	Example
Functional barriers	Caused by innovation's characteristics	Usage barrier	Consumers resist to adopting the innovation as it can be perceived complex.	The innovation introduces a new practice or new technology that requires a period of adaptation, preventing the conservatives and laggards from adoption, such as the emergence of Internet in the early 90's.
		Value barrier	The innovation must hold a significant economic benefit compared to existing products or services.	Despite the fact smart thermostats provide comfortable, interactive, and entertaining experiences, the relative advantage compared to the price for traditional thermostats remains insufficient to convince pragmatists and conservatives.
		Risk barrier	Consumers resist to adopting the innovation as there is uncertainties alongside the adoption (economical, physical, related to performance or social)	Giving access to homeplaces for autonomous and connected devices elicits the emergence of apprehension, based on expectations of future issues with the device, preventing the adoption.

## Part 1 – A theoretical approach of consumer-smart object interaction

<b>Psychological barriers</b>	Caused by consumer's beliefs structure	Tradition barrier	The innovation conflicts with prior beliefs and culture, preventing its adoption.	The Amish will always assess technology innovation based on their beliefs and system values and will reject any innovation that conflicts with their tradition and culture.
		Image barrier	The congruency between the innovation's perceived image and consumer's identity	Diesel and gasoline "lovers", attached to a certain image of cars and driving, are not likely going to move to electric and autonomous vehicles based on the unfavourable opinion and lack of congruence in terms of innovations and consumers' identity.

Functional barriers (usage, value, and risk) are triggered when consumers “perceived significant change from adopting the innovation” (Ram and Sheth 1989, p.7) whereas psychological barriers emerge when the innovation disturbs one’s belief structure. According to Ram and Sheth (1989) usage barriers represent the main factor of resistance to innovation, assuming human behavior is driven by rational motives.

Risk barriers directly refer to the perceived risk theory that posits consumers are evaluating uncertainties associated to a potential loss when they intend to adopt a specific behavior (Featherman and Pavlou 2003). Indeed, innovations and uncertainties are naturally nested (Ram and Sheth 1989). Thus, consumers tend to apprehend adoption of innovations until they manage to reduce the uncertainty associated with the new product (Ram 1987).

On the other hand, tradition barriers refer to the degree to which an innovation is perceived incompatible with one’s beliefs values and experiences (Ram and Sheth 1989). While image barrier refers to the identity of innovation. Here, innovation’s identity refers to the meaning, origin and category of the product. Consumer’ identity and new product’s identity must be congruent. Thus, according to Ram and Sheth, unfavourable image associations can raise image barrier and resistance to adoption.

## Part 1 – A theoretical approach of consumer-smart object interaction

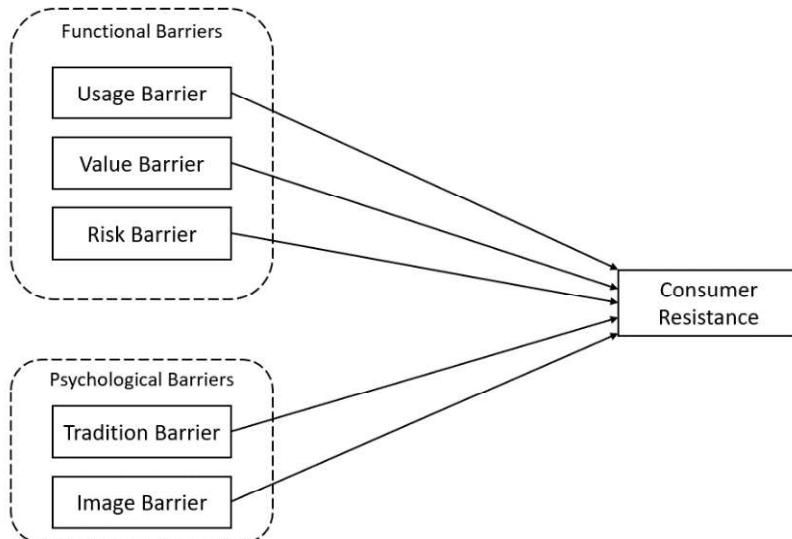


Figure 25 - Ram and Sheth's model of Resistance to innovation (1989)

Because of its parsimony, the model has been enriched by multiple contributions, across various context of consumption, allowing for a broader comprehension of consumer resistance, such as Laukkanen and Kiviniemi (2010) extension or Joachim and colleagues (2018) model, and the work of Hoeffler (2003). However, resistance toward smart objects remains insufficiently investigated (Slettemeås 2009, Verhoef et al. 2017).

Yet, Mani and Chouk (2016, 2017, 2018) extensive work on consumer resistance toward smart products and services provides tremendous insights about the phenomenon of smart objects resistance and must be exposed.

### Resistance toward smart objects

Regarding consumer active resistance toward smart objects, Chouk and Mani (2016) proposed to understand resistance toward smart objects through their characteristics: connectivity, intelligence, and ubiquity. Each of these features hold intrinsically factors of resistance.

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 12 - Consumer resistance toward smart objects based on their capacities (Chouk and Mani 2016)*

Feature	Definition	Source of Resistance	Perceived risk associated	Definition
Connectivity	Smart objects possess communication protocols allowing them to share information with their environment	A lack of control over data transmission.	Security	Refers to the loss of control over private data processing.
		Private data can be shared.  The consumer is not aware about what kind of information is being shared.	Health integrity	The huge amount of data being shared represents a risk for physical integrity, in terms of electromagnetic waves daily exposition.
Intelligence	Smart objects possess agentic capacities allowing them to take decisions, sometimes autonomously.	Consumers might lose control over the smart objects.	Dependency	Relying on smart objects capacities can generates feeling of technology dependency and isolation.
		Smart objects capacities can be relied on for harming users (piracy).	Performance	As smart objects are getting more complex, consumers might not be able to manage those objects in case of malfunctions.
Ubiquity	Smart objects are investing our environments, both indoor and outdoor, and operate continuously from any place.	The fear of being trapped in a “big brother” system	Privacy	As smart objects operate continuously, by collecting data through their sensors, without consumers being aware of it, they challenge the notion of privacy.

As shown by Chouk and Mani, consumer resistance toward smart objects potentially originates from their properties (connectivity, intelligence, and ubiquity). These properties allow them to monitor consumers with sensors, to express control through their actuators, to improve and act autonomously with artificial intelligence (Porter and Heppelman 2014). Accordingly, resistance toward smart objects may originate from their unique capacities to interact with their environment (consumers and other objects), and perceived potential outcomes (risks) preventing consumers to adopt smart objects (Chouk and Mani 2016).

## Part 1 – A theoretical approach of consumer-smart object interaction

Based on these findings, Mani and Chouk (2017) proposed to rely on Ram and Sheth conceptual framework to explain how reluctance and resistance regarding IoT devices emerge. To this purpose, they operationalized functional barriers (innovation characteristics) through four different variables (perceived uselessness, perceived novelty, perceived price, and intrusiveness), while psychological barriers (consumer characteristics) involved three variables (privacy concerns, dependence, and self-efficacy).

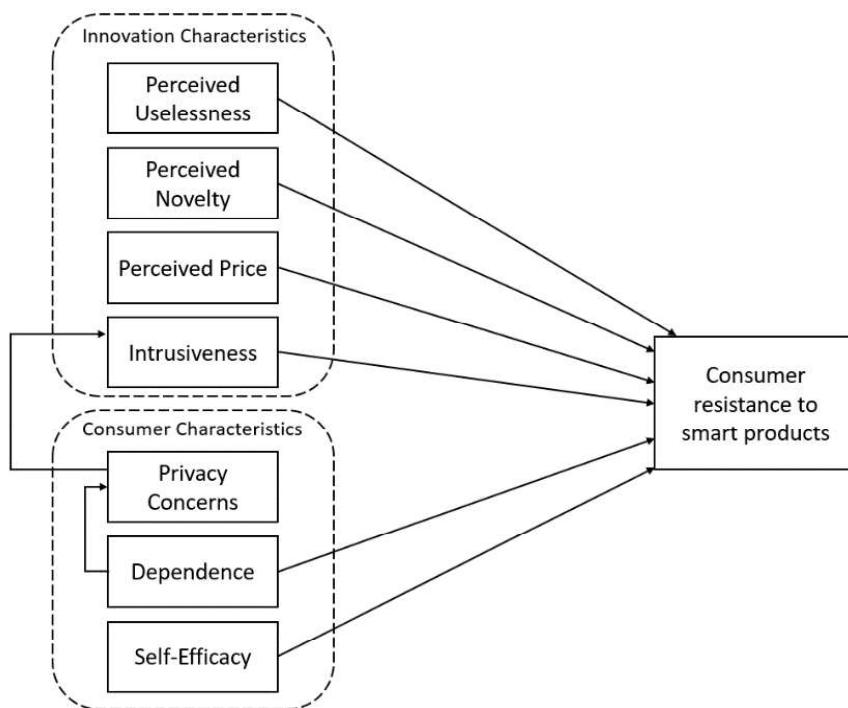


Figure 26 - Ram and Sheth conceptual framework applied in Consumer Resistance to smart products (Mani and Chouk 2017)

Regarding functional barriers, perceived uselessness was conceptualized based on the concept of perceived usefulness from the technology acceptance model (Davis 1989, Davis et al. 1989). As perceived usefulness involves the perception of different advantages in using the product (in terms of performance, convenience, utility), perceived uselessness is supposed to measure the extent to which the smart objects possess no relative advantages, eliciting the emergence of resistance (Mani and Chouk 2017). Concerning perceived novelty, it refers to the perception of product's innovativeness or the degree to which it is perceived new compared to the product it replaces (Ram 1987). Based on Rogers' theory of innovation diffusion, the perception of novelty is supposed to improve the adoption, therefore, negatively impacting resistance to its adoption. The perceived price barrier is defined as the perceived appropriate amount of money to sacrifice to get the product (Mani and Chouk 2017). According to Ram

## Part 1 – A theoretical approach of consumer-smart object interaction

and Sheth (1989) a weak performance-price ratio is likely going to reduce the adoption rate. Consequently, if the price is perceived too high compared to the performance it offers, resistance will emerge. Finally, the barrier called intrusiveness was supposed to measure the extent to which the smart object is perceived intrusive, eliciting unfavourable opinions, negative emotions, and resistance. The authors considered that this feeling was determined by the importance attributed to privacy. That is why it is directly influenced by the variable privacy concerns.

On the other hand, Mani and Chouk decided to incorporate three different psychological barriers. First, privacy concerns were relied on to measure consumer's sensibility as regard private data collection. This variable can be defined as the importance of concerns users attribute to the collect and management of personal and private information by smart objects (Mani and Chouk 2017). These products are perceived intrusive due to their capacities to collect and analyse data (Slettemeås 2009). Consequently, privacy concerns are supposed to have a direct and positive influence over perceived intrusiveness. The second psychological barrier refers to the feeling of dependence. According to Mani and Chouk, it refers to the extent people "rely upon technology to reach their goals" (2017, p. 85). As the sensation of dependence increases, consumers might feel enslaved by the smart object, leading to the emergence of resistance. Additionally, relying on smart objects increases the amount of private data collected by the product, which suppose a positive relationship between the feeling of dependence and privacy concerns (Mani and Chouk 2017).

Finally, the authors decided to incorporate self-efficacy as a determinant of consumer resistance toward smart products. Defined as the perception of being able to use the technology (Compeau and Higgins 1995), self-efficacy is widely relied upon within the technology acceptance literature (Davis et al. 1989, Ellen et al. 1991). Research have shown the extent to which self-efficacy positively influence adoption of new technological product (Yangil and Chen 2007). As a matter of fact, "when consumers feel confident about their ability to understand the use of a smart product, they tend to show less oppositional reactions" (Mani and Chouk 2017, p.85). Consequently, this variable is supposed to have a negative impact over consumer resistance to smart product.

Results from Mani and Chouk (2017) confirmed all the relationships identified across the literature except regarding the link between dependence and consumer resistance. Interestingly, they found no direct influence of dependence over consumer resistance while at the same time, it is indeed a good "predictor of privacy concerns" (p.89). Overall, their

## Part 1 – A theoretical approach of consumer-smart object interaction

operationalization of Ram and Sheth model have shown the effectiveness of both functional and psychological barriers in predicting active forms of resistance to smart products.

This is not surprising as most studies on consumer resistance to innovation stem from Ram and Sheth model, providing strong support for the relevance of functional and psychological barriers as determinants of active resistance. Yet this conceptual framework only considers functional and psychological barriers and neglects the role of individual's predispositions for passive resistance (Heidenreich and Handrich 2015). Ram and Sheth model tend to focus on situational determinants and might not fully grasp drivers of consumer resistance, especially inner characteristics that trigger passive resistance (Laukkanen 2016). For that purpose, Mani and Chouk (2018) proposed not only to rely on Ram and Sheth model, but to provide an extension where they identify a set of barriers to adoption regarding smart services, which includes an individual barrier.

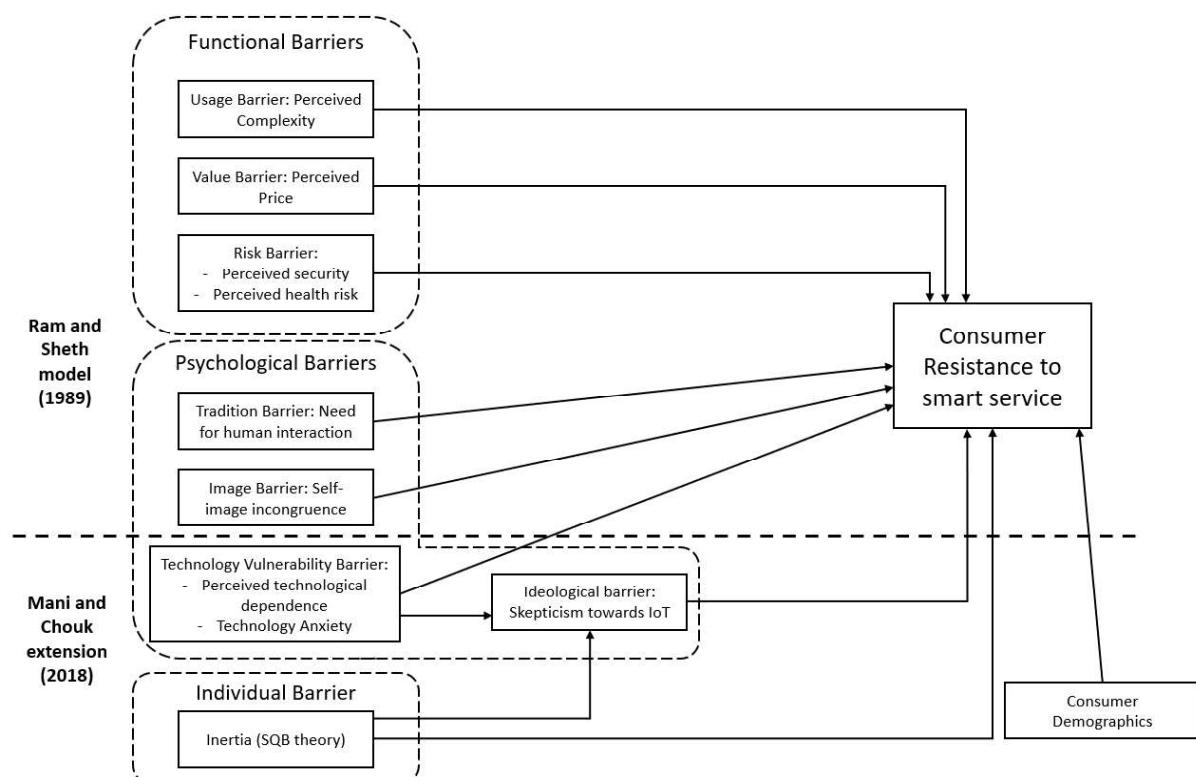


Figure 27 - Mani and Chouk extension (2018) of Ram and Sheth (1989) model of resistance to innovation in smart services

This approach is very interesting, and the reasons are twofold. First, they identified different variables aiming at catching the essence of each barrier from Ram and Sheth model.

## Part 1 – A theoretical approach of consumer-smart object interaction

Accordingly, the original model was modified based on these specific constructs. Secondly, they introduced a new barrier category, called Individual Barrier, trying to count for individual antecedents of resistance.

As regard functional barriers, usage barrier was operationalized through the “perceived complexity” of usage. From the expectancy-value literature, this variable can be compared to both perceived ease of use and usefulness. The cognitive effort of evaluating innovation’s complexity causes resistance to arise. Perceived complexity refers to the cognitive process under which consumers try to understand the innovation and how to use it (Ram 1989, Rogers 1995). Thus, resistance emerges “when the innovation is not compatible with existing workflows, practices, or habits” (Mani and Chouk 2018, p.787). In line with Ram and Sheth model, they found a positive influence of perceived complexity over consumer resistance.

Value barrier was operationalized with the variable “perceived price”, which refers to a lack of perceived new product’s value (performance-price ratio) compared to existing and current products (Mani and Chouk 2018). The resistance emerges when the innovation’s performance doesn’t justify its price, or the financial sacrifice required for it. Perceived price is a well-known determinant of resistance, which partially explains smart objects’ low penetration rate (Hoffman and Novak 2015). Studies have shown its positive influence on resistance toward IoT devices (Laukkanen 2016, Claudy et al. 2015).

Mani and Chouk proposed to operationalized risk barriers through two main risks associated with resistance to innovation: security and physical risks. Security risk refers to the risk of losing control over private data, known as a main barrier to adoption of IoT devices (Shin and Park 2017). The security risk also refers to the fear of piracy and negative feelings associated with fraudulent usage of private data “and to the potentially adverse consequences of the technology-based service experience” (Mani and Chouk 2018, p.791). On the other hand, physical risks refer to health concerns and worries associated with usage of IoT devices (Ram and Sheth 1989). The increasing number of technological devices in consumers’ surroundings increases the perceived risk for physical harm (cancer, electromagnetic fields) due to their connectivity attribute (Mani and Chouk 2018).

Regarding psychological barriers, tradition barriers were operationalized through the “need for human interaction”. As the model focuses on service experience, the lack of human interaction was supposed to elicit the emergence of resistance. Indeed, tradition barriers emerge when the innovation is perceived as not compatible with one’s norms (Ram and Sheth 1989).

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Mani and Chouk (2018), considering smart object's capacities (intelligence, autonomy), the need for human interaction barrier refers to the influence of a lack of human interaction. As human interaction is deemed to be important during service experience (Bagozzi and Lee 1999), a lack of human contact can elicit negative feelings and therefore, resistance.

On the other hand, image barriers were operationalized using the concept of "self-image congruence", which refers to the relationships and consequences in terms of social status, between consumers' self-image and product's identity and attributes (Sirgy 1985). Image refers to the identity associated with the innovation (Ram and Sheth 1989). Favourable opinions regarding the association between consumers' image and innovation's image arise when they are both congruent. Conversely, unfavourable opinions emerge when there is a lack of congruence between them. In Mani and Chouk extension, the image barrier is defined as a lack of self-image congruence between product's image and consumer's self-image.

Additionally, Mani and Chouk proposed to fill the theoretical gap of Ram and Sheth model, by extending the model with the introduction of new barriers. First, they relied on previous research to introduced demographics variables (age, gender) as direct determinants of resistance (Laukkanen et al. 2007, Laukkanen 2016). Secondly, they enriched the literature of consumer resistance by introducing the concept of technology vulnerability, ideational and individual barriers as determinants of resistance. They argued that Ram and Sheth's model of resistance did not consider technology evolutions and the complexity of human/machine interactions. Thus, they decided to extend psychological barriers with the technology vulnerability barriers comprising of technology anxiety (fear, negative emotions) and technology dependency (loss of control, isolation).

According to them, technology can accentuate the perception of dependence and the emergence of negative emotions such as anxiety. Indeed, with the ever-going evolution of technology and innovation, consumers are getting more and more dependent to technology, reducing their autonomy, with the probability of feeling enslaved by it (Mani and Chouk 2017). While technology anxiety refers to "individual's apprehension, or even fear, when she/he is faced with the possibility of using computers" (Venkatesh, 2000, p.349). Both technology anxiety and dependency elicit consumer resistance, fear, and apprehension (Parasuraman 2000), driving the sensation of being unable to use the technology (Chouk and Mani 2016). As the feeling of dependency and the emergence of anxiety refer to psychological variables (Parasuraman 2000, Venkatesh 2000, Meuter et al. 2005), technology vulnerability barriers are considered psychological barriers, which negatively influence the adoption rate.

## Part 1 – A theoretical approach of consumer-smart object interaction

As regard ideational barriers, consumers might develop negative evaluations regarding an innovation that conflicts with their beliefs, which influences the emergence of skeptical thinking (Mani and Chouk 2017). Here, skepticism is supposed to be “a psychological barrier that leads consumers to doubt the truthfulness of companies’ arguments and discourses about IoT devices and promised benefits” (Mani and Chouk 2018, p.795). This skeptical thinking arises from the cognitive process of attributed meanings to the innovation characteristics and how it affects attitudes and behaviors. Consequently, skepticism towards IoT is supposed to be influenced by different factors such as technology anxiety and perceived dependency, but also inertia (Mani and Chouk 2018).

As Ram and Sheth’s model focuses on psychological and functional barriers (which are situational antecedent), it lacks individual predispositions for resistance (Heidenreich and Handrich 2015). This is the reason why Mani and Chouk decided to add an individual factor of resistance. Thus, they relied on the status quo bias theory (SQB) to define the inertia factor as the “personal predisposition to prefer the current situation to the uncertainty of change” (Mani and Chouk 2018, p.794). This individual barrier considers individual’s predisposition to maintain a status quo (preferring the current situation) over the adoption of any new idea, practice, product, or service. Consequently, Mani and Chouk posit that this individual tendency increases the emergence of resistance.

Results from Mani and Chouk (2018) can be compared with their previous work (2017). First, all relationships identified within the model are significant except for three of them: perceived price, perceived technological dependence and technology anxiety. For perceived price, the authors have supposed that consumer might had no clear idea about the price of a service, leading to biased price-performance ratio. But more interestingly, technological dependence and anxiety had no direct influence over consumer resistance to smart services, consistent with their previous work on smart products (Mani and Chouk 2017). However, the effect of these two variables seems to be well captured by the variable Skepticism toward IoT. This indicates that technology dependence and anxiety might not be direct determinants of active resistance, but instead determinants of passive resistance.

In other words, while technology dependence and anxiety are not good predictors of active resistance, they might be relied upon to explain passive forms of resistance toward smart objects (skepticism). Once again, models of resistance (like models of acceptance) such as Ram

## Part 1 – A theoretical approach of consumer-smart object interaction

and Sheth framework, or Mani and Chouk extension capture and predict resistance from a rational perspective, relying on functional and psychological barriers as main determinants of active resistance. However, regardless of the extensive work provided in trying to identify determinants of consumer active resistance, the main problem remains as regard passive resistance.

### Passive resistance toward smart objects

Indeed, both Ram and Sheth model and Mani and Chouk extension focus on explaining consumer active resistance by considering rational motives without considering hidden mechanisms from which those determinants might emerge. Models of acceptance and resistance are mainly descriptive, exposing from a rational perspective, factors that predict adoption or resistance (Laukkanen 2016).

Yet, these approaches are not meant to explain the “*reasons why*”, or unconscious motives, from which those barriers emerge (Legris et al. 2003). The literature of both acceptance and resistance to new technological products is in need for considering irrational motives and hidden mechanisms of reluctance, which represents perhaps, the main barrier to technological adoption (Sharp 2007). This is even more important considering smart objects and their emergent capacities (Hoffman and Novak 2015). Indeed, innovative objects intrinsically elicit uncertainties (Rogers 1995).

According to Chouk and Mani (2016), consumers tend to justify and express their resistance toward smart objects from two perspectives: rational justifications and irrational expressions, with a predominance of negative and irrational thinking as an expression of resistance toward smart objects.

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 13 - Rational and irrational motives behind resistance toward smart objects (Chouk and Mani 2016)*

Type of expression	Themes	Definition
<b>Rational justifications of resistance (43% of overall resistance expressed by consumers)</b>	Critical view	Consumers are questioning smart objects' utility. They also try to explain from a rational perspective, the reasons why companies are trying to sell smart objects, and why consumers are invited to adopt them.
	Explicative posture	Consumers are trying to explain and understand how smart objects work, to reduce the uncertainties associated with usage.
	Solution oriented	Rational expressions of consumer resistance toward smart objects are confirmed by the need for finding a solution to counter-balance the perceived risks (legislate, data protection policies etc.).
<b>Irrational expressions of resistance (57% of overall resistance expressed by consumers)</b>	Aggressive	Ideological expression of resistance in response to smart objects capacities (intelligence, connectivity, ubiquity), characterized by violent and aggressive verbatims towards all actors of the market (smart objects, consumers, companies, and governments).
	Ironic	A sarcastic posture used to mock the perceived uselessness of smart objects. The verbatims are caricatural and aim at mocking smart objects (gadgets, toys, futile etc.)
	Pessimism	The verbatims directly refers to emotions such as fear or anxiety that originate from the feeling of technology dependency. Most of the time, these negative emotions stem from meanings attributed to what the smart object can do.

Rational justifications of resistance are more balanced and positive. They rely on cognitive processes of evaluations to apprehend the interaction with smart objects. Conversely, irrational expressions are more violent, negative, and predominant. They tend to rely on predispositions and ideological reluctance toward smart objects which don't involve rational

## Part 1 – A theoretical approach of consumer-smart object interaction

motives (Chouk and Mani 2016). Accordingly, both Ram and Sheth model and Mani and Chouk extensions might not fully apprehend determinants of passive resistance.

Literature on consumer resistance toward smart objects focuses on identifying the factors which influence the emergence of resistance, such as the perception of risks associated with smart objects functionalities (Mani and Chouk 2017). Therefore, researchers must consider the questions related to the origin of resistance (Verhoef et al. 2017), such as: why resistance toward smart objects emerges? What kind of mechanism triggers the negative attitudes and emotions associated with them?

Models such as Ram and Sheth framework or Mani and Chouk extensions are designed for explaining resistance from an active perspective, using rational motives to identify determinants of resistance (Mani and Chouk 2017). A critical limit of actual models of resistance is that they often rely on factors of resistance to change (Mani and Chouk 2018), focusing on consumer innate capacity to adapt to new situations that conflict with their belief structure (Ram and Sheth 1989). Yet, it would be perhaps also interesting to focus on consumer resistance from a passive perspective, considering adopters' intrinsic motivation not to reject innovations or changes, but instead to reject smart objects for what they are (Rijsdijk et al. 2007, Schweitzer et al. 2019).

The literature on consumer resistance to innovation mainly focused on active and very active resistance (Heidenreich and Handrich 2015). Consequently, research on passive resistance remains insufficiently addressed. Studying passive resistance and hidden mechanisms that elicit ideological reluctance toward smart objects might represent the key for reducing negative and unfavourable opinions toward them (Verhoef et al. 2017). Thus, the entire field of passive resistance and its mechanisms remain neglected or unexplored (Monsurrò et al. 2020).

Yet, this section has provided us insights regarding the resistance toward technology, highlighting different core concepts that are summarized in the table below:

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 14 - Resistance to innovation and smart objects - Main concepts*

Framework	Concept	Definition
<b>Resistance toward innovation (Ram and Sheth 1989, Mani and Chouk 2017)</b>	Active resistance	The consumer postpones an adoption due to a functional or psychological barrier, such as the perception of uselessness.
	Passive resistance	The consumer feels reluctant to adopt the innovation because of a predisposition to resist to changes.
	Functional barriers	Barriers raised regarding the innovation characteristics and the extent to which its characteristics will impede the adoption.
	Psychological barriers	The extent to which the innovation conflicts with one's belief structure, raising different barriers to adoption.
<b>Resistance toward smart objects (Mani and Chouk 2018)</b>	Individual barriers	Individuals' predispositions to resist to smart objects adoption.
	Technology vulnerability	Consumers' characteristics preventing to adopt the smart object due to the feeling of technology dependence and anxiety felt regarding its adoption.
	Rational justifications	Consumers' justifications based on rational reasoning to explain the reason why they are not willing to adopt the smart object.
	Irrational justifications	Consumers' justifications based on irrational thinking, trying to explain why they are not willing to adopt the smart object.

As seen above (Chouk and Mani 2016), irrational expression of consumer resistance to smart objects often translates into negative emotions such as anger, fear, and anxiety toward technology. A phenomenon also reported within the literature of technology acceptance (Bagozzi and Lee 1999, Venkatesh 2000). However, no direct influence on active resistance was observed in Mani and Chouk studies (2017-2018), which supposes a more complex relationship between technology anxiety and resistance.

Researchers have investigated determinants of resistance such as usage barrier, technology dependency, negative emotions, and apprehension. But actual models of resistance are unable to explain why passive resistance toward smart objects emerge (Verhoef et al. 2009). Such emotions and concerns are relied on for explaining active and very active resistance. Therefore, studying passive resistance is equivalent to studying determinants, beliefs and prior attitudes that result in negative emotions and concerns (Compeau et al. 1999). The next section will focus on exploring the origin of negative thoughts and emotions towards technology and smart objects, starting with ambivalent attitudes.

*B- Ambivalence toward smart objects*

Surveys have shown the interest expressed by consumers as regard smart objects and the IoT (Gfk 2019), but also their reluctance to adopt them (Crédoc 2019). Robots, smart objects, and artificial intelligence seem to elicit discomfort, ambivalence, and negative reactions for both users and non-users (Nomura and Kanda 2004, Goudey and Bonnin 2016, Ardelet et al. 2017). This feeling of discomfort leads consumers to adopt a posture of rejection regarding smart objects, fostering the emergence of negative thoughts and emotions (Nordgren et al. 2006). Indeed, ambivalence and discomfort often elicit negative reactions (Olsen et al., 2005).

Ambivalence is quiet an old concept, but quickly adapted to marketing (Scott 1966). It is defined as a state under which consumers feel, at the same time, contradictory attitudes, and feelings (Thompson et al., 1995). It refers to the simultaneous experience of contradictory emotions and thoughts such as pleasure/displeasure, joy/sadness, confidence/fear (Costarelli and Colloca 2004, Ardelet et al. 2017). This cognitive dissonance relies on a dualistic thinking. According to the Construal Level Theory (Trope and Liberman 2010), people hold different types of reasoning: a rational reasoning based on cognitive evaluation and relying on information processing, and a more unconscious thinking, which relies more on emotions and is more irrational and spontaneous.

While the active resistance to innovation (such as perceived uselessness, complexity) result from rational thinking, passive resistance and reluctance toward technology are likely resulting from a higher and unconscious level of construal (Achim and Kassim 2015). Accordingly, both models of technology acceptance and resistance must consider the influence of irrational motives and thinking, instead of focusing mainly on rational reasoning (Mani and Chouk 2018).

The literature shows that the state of ambivalence is unstable. In fact, consumers are facing a series of uncomfortable situations in which they tend to justify their behavior with false justifications (Cialdini, 2004). However, it does not last very long. In the long run, consumers often turn to drop the behavior that elicit ambivalence (Olsen et al., 2005).

Ambivalence regarding technology is a well-known phenomenon, especially within the Human-Robot Interaction literature with different frameworks trying to explain it (Złotowski et al. 2017). The roboticist Masahiro Mori, for instance, have tried to conceptualize a theory aiming at explaining why robots elicit positive reactions alongside avoidance behaviors. Thus, in 1970, Mori introduced the Uncanny Valley Theory, with the intention to conceptualize the emergence of negative feelings toward robots.

The uncanny valley theory posits that the more a robot looks like a human being, in terms of physical likeness (movement, anatomy, etc.), the more affinity people express, until the emergence of discomfort, repulsion and rejection (Mori et al. 2012). The notion of acceptance or resistance is conceptualized by the sense of familiarity and proximity. According to Mori (1970), robots are perceived more, or less, close to us depending on their similarities with humans. Accordingly, humans express a form of empathy and have affinity with products that hold similar characteristics, until they reach a certain threshold of similarities. From that point, the robot is no longer perceived close and familiar, but instead weird and uncanny. When the boundaries between humans and machines become unclear, individuals will tend to develop negative attitudes toward them, expressing lower levels of empathy and familiarity (Mori et al. 2012). The gap formed by the clash between these two expressions of familiarity (positive vs negative) is what refers commonly to the Uncanny valley.

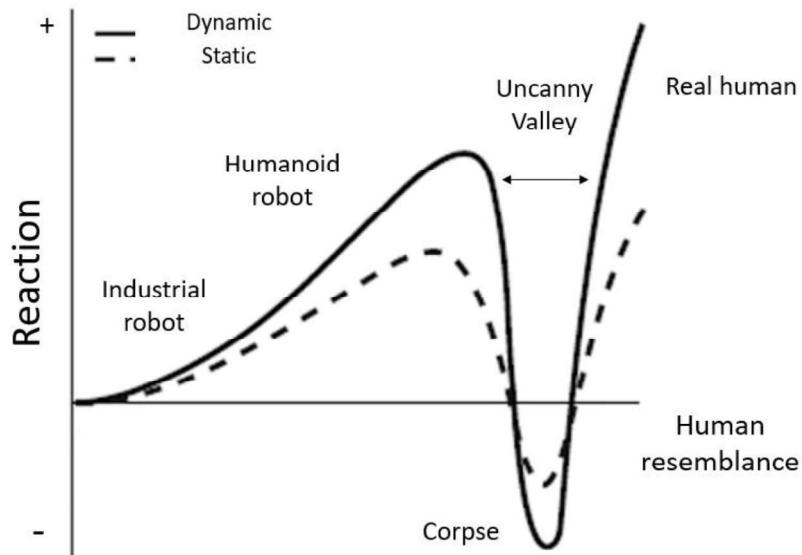


Figure 28 - The Uncanny Valley in action – Mori et al. (2012)

## Part 1 – A theoretical approach of consumer-smart object interaction

In summary, there are three distinct stages within this theory:

- (1) The first part of the curve is related to the level of positive attitudes felt before the uncanny valley. This area refers to the maximum level of similarities between humans and machines before the rise of ambivalent and negative attitudes.
- (2) The second step refers to the maximum threshold of negative attitudes elicited by the machine, indicating the depth of the valley.
- (3) Finally, the last step represents the maximum level of familiarity humans can share with other humans, and potentially with robots perceived as if they were humans.

According to Mori (1970), the last step represents the level of interaction and familiarity close to the one people have with other humans. In other words, a level of interaction that suggests consumers perceive robots as humans, even though they are machines. According to the uncanny valley theory, a robot that crosses the valley is so close to humans in terms of appearance, mobility, and movement, that it will elicit the same feeling of familiarity than interacting with real humans (Mori et al. 2012). Yet, according to Mori (1970), it is preferable for robot designers to seek the first peak, before the valley as it is easier to reach it, avoiding the need to cross the valley and maximizing consumer's positive reactions. Consequently, robots' designers must consider the maximum amount of physical resemblance with humans before falling into the uncanny valley.

Indeed, many research streams have also shown the extent to which similar phenomenon may occur. The entire research field of anthropomorphism investigates the relationships between objects' human-likeness and their adoption, supposing an influence of anthropomorphic cues on consumer behavior (Nass et al. 1993, Epley et al. 2007, Belk and Kniazeva 2018). Anthropomorphism can be defined as the attribution of humanlike characteristics to non-human entities (Ambroise and Valette-Florence 2010). It refers to the process of attributing human characteristics such as thought, feelings or personality to nonhuman entities (Fournier 1998, Shi 2017) or the process of "attributing humanlike properties, characteristics, or mental states to real or imagined nonhuman agents and objects." (Epley et al. 2007, p.865). According to Aggarwal and McGill (2007), anthropomorphism is a natural tendency, relied on for understanding our surroundings. Indeed, anthropomorphism can

## Part 1 – A theoretical approach of consumer-smart object interaction

be seen as the attribution of “cognitive or emotional states to something based on observation in order to rationalise an entity’s behaviour in a given social environment” (Duffy 2003, p.180).

Fournier (1998) argues that this process stems from animism. The meanings attributed to nonhuman entities depend on their proximity with humanlike characteristics or evocations, such as brands often associated to one’s experience, or objects received as gift that possess the essence, or spirit of the giver. This suggests that human-characteristics are relied on to understand our environment and surroundings. Indeed, people attribute human traits to non-human entities to justify and provide a rational explanation for their actions (Bartneck et al. 2006).

In line with Mori’s theory, scholars such as Goudey and Bonnin (2016) have shown the negative influence of anthropomorphism over the adoption of smart robots, supporting the uncanny valley. However, contradictory results indicate that the uncanny valley suffers from a lack of consistency and statistical significance (Bartneck et al. 2007). Aggarwal and McGill (2007) have also provided support for a positive influence of anthropomorphic cues over adoption, and several studies advocate for the same effect (Purington et al. 2017, McLean and Osei-Frimpong 2019). Additionally, Hanson (2005) have shown anthropomorphism as applied in the uncanny valley theory did not result in Mori’s conclusions. Other studies have shown the opposite and advocate for the relevance of the uncanny valley, indicating that the perception of the robot’s resemblance to humans leads to positive reactions toward it until a certain threshold (Tung, 2016). According to Geller (2008), the uncanny valley remains criticized for its lack of empirical evidence and for the accumulation of contradictory results pointing toward a more complex mechanism of ambivalence toward technology and robots.

Despite contradictory results, the uncanny valley highlights the core idea that machines and technology elicit negative attitudes and feelings, with the human appearance as the cornerstone of such ambivalence. Yet, the uncanny valley focuses on physical aspect and resemblance with humans. Nevertheless, technology seems to intrinsically provoke ambivalent attitudes and negative feelings, regardless of its nature and aspect, be it computers (Igbaria and Parasuraman 1989, Nass et al. 1993), robots (Nomura and Kanda 2004) or smart objects (Mani and Chouk 2017). Moreover, according to Keeley (2004), objects’ resemblance with humans involves two distinct features: psychological and non-psychological features.

Non-psychological features refer to the physical anthropomorphism and can be defined as the resemblance with physical likeness with humans in terms of anatomy (eyes, body shape,

## Part 1 – A theoretical approach of consumer-smart object interaction

legs, and arms). Psychological features encompass the process under which people infer to non-human objects, human psychological characteristics such as emotions, intelligence, behaviors, and personality traits that are being imagined by people. According to Goudey and Bonnin (2016) this process refers to an interpretative process which “consists of interpreting a feature of an object or animal as being the consequence of mechanisms close to those at work in Man” (p.4). Such attribution does not involve physical aspect. The uncanny valley focuses on physical resemblance, in other words, non-psychological human features. Accordingly, it does not provide enough material to fully grasp how anthropomorphism of psychological cues influence the emergence of anxiety and fear (Goudey and Bonnin 2016). And what about smart objects?

### Ambivalence toward smart objects

Smart objects’ intelligence is no longer inferred by humans but embedded inside objects with evidence of product intelligence through their autonomy, reactivity, or ability to learn and cooperate (Rijsdijk et al. 2007). This suggests a different kind of consumer reaction regarding smart objects, which departs from traditional anthropomorphism (Schweitzer et al. 2019).

The understanding of the mechanisms behind such ambivalence toward technology remain insufficiently investigated, especially as regard smart objects (Monsurrò et al. 2020). But reactions toward smart speakers is a perfect illustration of ambivalence toward smart objects. Smart speakers such as Amazon Alexa, Google Home, Apple Siri, are Intelligent Personal Assistants (Schweitzer et al. 2019). These conversational agents, or voice-controlled agents, are defined as an “emerging technology designed to support text and speech input/output and perform a wide variety of tasks ranging from information retrieval to playing music and controlling Internet of Things (IoT) devices” (Lopatovska et al. 2019, p.2). They integrate artificial intelligence and mimic human behavior (Li et al. 2019). Despite the increasing sales of smart speakers across the early market (Kinsella and Mutchler 2018), the majority market remains non-users with penetration rates below 20% (Kemp 2021) and consumers facing ambivalence toward them (Ardelet et al. 2017). Indeed, consumers can express both positive and negative reactions regarding smart speakers (Lopatovska et al. 2019).

Positive reactions toward smart speakers are due to their convenience and usefulness (Cowan et al. 2018). Smart speakers are often relied on for simple tasks such as playing music or checking weather (Villas-Boas 2017). These simple tasks seem to elicit positive reactions and satisfaction, while task complexity seems to be negatively correlated with satisfaction

## Part 1 – A theoretical approach of consumer-smart object interaction

(Kiseleva et al. 2016). On the other hand, negative experiences with smart speakers stem from a lack of transparency regarding user's data (Alhadlaq et al. 2017), not knowing what they can do and how they work (Cowan et al. 2018). Moreover, smart speakers' capacity to converse with consumers and create a relationship sometimes results in positive evaluations (Purington et al. 2017) but turns in negative experiences and disappointment if the experience does not meet expectations (Bopp 2018, Guo et al. 2017, Luger and Sellen 2016). These ambivalent reactions reflect a conflict between consumers and their relationship with smart objects.

Regarding ambivalence toward smart objects, Ardelet and colleagues (2017) identify four dimensions structuring the dissonance leading to discomfort and rejection: usefulness, intelligence, social, and affective.

*Table 15 - Dimensions of ambivalence toward smart objects (Ardelet et al. 2017)*

Dimension	Definition	Ambivalent feelings
<b>Usefulness</b>	Smart objects can be quite useful and source of facilitation in everyday life, but they can also be complex.	Utility vs Complexity
<b>Intelligence</b>	Smart objects possess unique capacities of intelligence and autonomy, allowing people to become more efficient, but also dependent.	Efficiency vs Dependency
<b>Social</b>	Smart objects and technology can create new social relationships with people but are also sources of isolation and lack of human interaction.	Interaction vs Solitude
<b>Affective</b>	Smart objects can provide experiences of pleasure and joy, as well as fear and worries.	Pleasure vs Fear

Each of these dimensions provide an interesting grounding for assessing ambivalence toward smart objects. According to Ardelet and colleagues (2017), ambivalent feelings regarding smart objects are supposed to shape both factors of acceptance (positive reactions) and resistance (negative feelings).

The Utility vs Complexity ambivalence corresponds to a situation where consumers recognize smart objects as useful, but they also apprehend and fear the day they won't be able to understand how they work and how to use them properly. Regarding the Efficiency vs Dependency ambivalence, it refers to the sensation of efficiency provided by smart objects but associated to the fear of becoming servant of the technology and dependent.

## Part 1 – A theoretical approach of consumer-smart object interaction

On the other hand, Interaction vs Solitude ambivalence is defined as the opportunity to create new digital relationships with smart objects and people, but with the probability of having no real-life interaction with others. Last, the Pleasure vs Fear ambivalence refers to the sensation of pleasure and joy associated with the expectations of new and interactive experiences with smart objects, but also fear and worries of living negative experiences with them.

As seen above, smart speakers can elicit positive reactions regarding simple tasks and their interactivity (Utility, Efficiency, Interactive and Pleasure) as well as negative feelings regarding their intrusiveness, complexity, and capacities to potentially harm users (Complexity, Dependency, Solitude, Fear). Hence, both rational and irrational justifications are relied on by consumers to explain such feelings, providing support for considering irrational motives as key factors of both adoption and resistance (Chouk and Mani 2016).

It appears that the central thread of negative feelings toward smart objects is the fear or anxiety often associated with the interaction. Indeed, the perception of complexity, or the feelings of dependency, solitude and fear are all associated to the apprehension of negative anticipated experiences with smart objects. This anxiety toward technology is also heavily relied upon in the literature of consumer resistance with contradictory results, suggesting a complex mechanism at the source of these negative feelings (Mani and Chouk 2017, 2018, Bagozzi and Lee 1999, Venkatesh 2000). Moreover, both users and non-users are likely experiencing ambivalence and negative feelings as regard smart objects (Ardelet et al. 2017, Monsurro et al. 2020), supposing an anxiety profoundly associated with smart objects' nature, but not necessarily with real-life interaction.

Smart objects and IoT devices are spreading among workplaces and cities, leading sometimes to unavoidable interaction with them. Accordingly, understanding the feelings of fear and anxiety they provoke becomes fundamental for companies willing to achieve market success for their innovations.

### C- *Fear and anxiety toward technology*

*"Science fiction can be defined as that branch of literature which deals with the reaction of human beings to changes in science and technology."*

## Part 1 – A theoretical approach of consumer-smart object interaction

This citation attributed to Isaac Asimov (1920-1992) is perhaps the leading thread of this part. Fear and reluctance toward technology did not emerge with smart objects or artificial intelligence. Indeed, these negative expressions toward technology are deeply anchored in people's reactions for a little longer than that.

Evidence for this statement can be found across science-fiction movies and books, which gather huge amounts of fictitious stories depicting technology as a malicious entity trying to take the control over humans. According to Nomura and colleagues (2004), people's attitude toward robots are significantly influenced by science-fiction movies, most of the time eliciting anxiety toward them. Movies such as Wall-E, Terminator, Resident Evil, or I Robot always represent technology and artificial intelligence first as a useful and efficient *tool*, and finally as a dangerous *entity* imposing its will and domination over humans.

Interestingly, the phenomenon described by Mori in 1970 appears continuously within science-fiction as a repeated framework, where the technology elicits the emergence of both positive and negative reactions, depending on its proximity with humans, but not in terms of appearance, but instead in terms of behavior.

Isaac Asimov is perhaps the most famous author of science-fiction novels. He wrote many stories and novels such as “I, Robot” or “Robots and Empire”, which are compiled in his “Robot Series”. Asimov have focused on robots, technology, and artificial intelligence, trying to apprehend how the evolution of technology will impact humans in the future. Asimov have dealt in substance with a concept that, until now, only belonged to fiction. All his stories depict a universe where robots are conscious and intelligent entities which interact smoothly with humans, relying on intrinsic human mechanisms to apprehend such situations. These robots can understand the concept of morality and are also able to experience emotions (anger, sadness, love, etc.). He designed the famous “three laws of robotics” without knowing they will become the basis of current artificial intelligence’s ethic.

- (1) *A robot may not injure a human being or, through inaction, allow a human being to come to harm.*
- (2) *A robot must obey orders given it by human beings except where such orders would conflict with the First Law.*
- (3) *A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.*

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Asimov (1975), these laws are meant to protect humans from robots to make them feel confident while interacting with them. Indeed, the science-fiction literature constantly considers them as dangerous entities that must be kept under control, fantasizing about their capacities to overtake humans and to dominate them. Accordingly, the three laws of robotics are designed to keep robots and artificial intelligence under humans' control and domination (Asimov 1975). But why do humans fear them? Where does this fear and apprehension come from? Why do humans attribute such motives to non-human entities? To answer these questions, digging into the origin of fear toward technology is fundamental.

The first appearance of fear toward technology in the modern era is the story of Frankenstein. Written in 1818 by Mary Shelley (1797-1851), under the influence of the industrial revolution, the story of Dr. Victor Frankenstein tells how an eminent scientist discovers the way to elaborate a humanoid made of different human parts, after the death of his mother. The novel is about a humanoid called Creature, endowed with intelligence and emotions, and experiencing life.

To begin with, Creature is of a repulsive physical aspect and is quickly rejected by Victor and by the entire society. From this exclusion, Creature took the time to learn how to speak and write with the friendship of an old blind man, but also by secretly observing humans. This old man decided to introduce Creature to his family. Unfortunately, the family was also horrified by its appearance and Creature was rejected again. After reaching a certain amount of knowledge, and painfully trying to understand life, Creature noticed humans were living in families and felt the desire to live the same experience. One day, Creature went back to its father, Victor, to confront its requests, such as asking him to make an entire family with a spouse and children. The scientist answered negatively to Creature's requests, which led Creature to become aggressive, seeking revenge by imposing its will over its father and threatening him.

From this struggle rises a different kind of fear. Creature was no longer rejected because of its physical aspect but feared because of being able to impose its authority over its own creator. In the Frankenstein novel, fear originates from the perceived authority and domination expressed by Creature over humans.

Based on Mary Shelley's novel, Asimov has conceptualized what he has called "The Frankenstein Complex" (Asimov 1975). The Frankenstein complex refers to the degree to which a person tends to develop anxiety about machines as they mimic humans. It is defined as

## Part 1 – A theoretical approach of consumer-smart object interaction

the feeling that an artefact (human's conception) violates the established and natural order, with the risk that the artefact turns against humans one day (Asimov 1975, Nomura et al. 2012). This theory is similar to the “Terminator Effect”, where robots are perceived as a threat because of mental representations originated from science-fiction culture (Carpenter et al. 2008).

These concepts are close to the Uncanny Valley theory, which suggests that the more robots look like humans, the more humans develop anxiety and fear toward them (Mori, 1970). However, Creature is not feared because of his humanlike appearance, but because of his humanlike behavior, or “authority”. This Frankenstein complex can also be found in the famous novel Planet of the Apes (1963), where apes are feared by humans because of the perceived threat of being dominated and replaced. If we transpose this to robots, smart objects, and technology in general, it could be supposed that the more a technological object is perceived as being able to impose its authority over consumers, the more they will intrinsically feel resistance, fear, and anxiety towards it.

Anxiety can be defined as “a complex combination of negative emotional responses that include worry, fear, apprehension and agitation” (Achim and Kassim 2015, p.702). According to Barbeite and Weiss (2004), anxiety is a natural response to the perception of a risk. The literature often refers to anxiety as a trait or a state (Meuter et al. 2003). A trait is defined as an individual's characteristic that is lasting (Robertson 1976) while state refers to a temporary reaction or response given a specific stimulus (Mitchell 1979). Anxiety as a trait is considered as a stable and lasting reluctance toward something specific while state anxiety refers to the negative emotions felt in specific situations (Nomura and Kanda 2004). An individual with trait anxiety will experience anxiety constantly, regardless of the situation. Conversely, state anxiety will depend on the situation. The anxiety arises in response to a perceived danger or threat.

Anxiety toward technology have first been conceptualized according to computers, and then relied on for various technologies such as robots (Nomura et al. 2005). Computer anxiety refers to “individual's apprehension, or even fear, when she/he is faced with the possibility of using computers” (Venkatesh 2000, p.349). According to Nomura and Kanda (2004), “Computer anxiety is considered as anxiety or apprehension evoked in individuals when they use computers, do things leading them to computers, or think on the meaning of using computers” (p.373). This anxiety indicates an uncomfortable state of tension and worry generated by potential technology threats (Thatcher et al. 2007). It is supposed to impede both the intention to use and technology acceptance (Meuter et al. 2003). Accordingly, anxiety was integrated to

## Part 1 – A theoretical approach of consumer-smart object interaction

different models of acceptance and resistance (Mani and Chouk 2018, Venkatesh et al. 2003, Compeau et al. 1999).

Within the human-robot interaction literature, Nomura and colleagues (2012) identify anxiety as a determinant of resistance, preventing people to interact with robots. According to them, there are two distinct kinds of anxiety: a general and intrinsic anxiety (trait) toward robots and a situational anxiety (state) that refers to expectations about the consequences of interacting with robots. Several measurement scales of anxiety toward technology have been established. However, they focus most of the time on robots, such as the Robot Anxiety Scale (RAS), proposed by Nomura and Kanda (2004), the Negative Attitudes toward Robots Scale (NARS) proposed by Nomura and colleagues (2005), computers (Achim and Kassim 2015) or the Internet (Thatcher et al. 2007). These scholars have oriented the attention on trying to measure negative attitudes toward technology and were able to identify different contexts where the anxiety felt refers to a state or trait (Bartneck et al. 2007).

Unfortunately, little is known about the nature of anxiety toward smart objects, and the mechanism behind its emergence. While the literature about computer or robot anxiety can be interesting to be relied on for smart objects, IoT devices depart from traditional technological products (Hoffman and Novak 2015), stressing the need for a specific conceptualization of smart object anxiety.

### Anxiety toward smart objects

Smart objects evoke anthropomorphic cues regardless of their physical resemblance with humans based on their capacities. The human likeness of smart objects is no longer induced by humans but expressed by objects themselves (Rijsdijk et al. 2007). Consequently, the nature of anxiety encountered with robots or computers cannot be fully relied upon for assessing the apprehension of users-smart objects interaction.

Yet, all these theories suggest that fear toward technology is related to how people perceive the "intentions" of technology, apprehending the interaction with it. Perceived uncertainty related to technological innovation influence the emergence of fear and resistance (Mani and Chouk 2018). Additionally, the perceived proximity between technology and humans, and people's tendency to infer human intentions to non-human entities can elicit the emergence of

## Part 1 – A theoretical approach of consumer-smart object interaction

fear and anxiety toward it (Carpenter et al. 2009). Despite the absence of humanoids such as Creature, smart objects also possess intrinsic capacities to act, sometimes autonomously imposing a form of control (Hoffman and Novak 2018), eliciting perhaps the same uncertainties explained by the Frankenstein complex.

This statement is supported by both surveys and the literature. Indeed, 34% of French people consider the feeling of being dependent to smart objects as the main source of anxiety, preventing their adoption (Opinion Way 2017). In their model of consumer resistance and acceptance of innovation, Bagozzi and Lee (1999) already identified negative emotions of anger, fear, sadness, and disgust as factors of resistance to innovation. According to Meuter and colleagues (2005), technology anxiety can reduce intentions to use the product or service. Technology anxiety leads to apprehension, fear, and reluctance toward usage (Igbaria and Parasuraman 1989). It is therefore well documented that consumers tend to develop anxiety toward technology preventing both usage intention and adoption (Parasuraman 2000).

The literature also emphasizes the existence of anxiety toward smart objects. According to Touzani and colleagues (2018), using smart objects can elicit the emergence of anxiety. Smart objects are sources of resistance and are likely eliciting feelings of dependence and enslavement (Mani and Chouk 2017). This feeling of dependence can lead to technostress and anxiety (Shu et al. 2011).

Accordingly, the aim is to precisely identify the determinants of anxiety toward smart objects. While most research on computer anxiety advocate for a state anxiety regarding technology (Nomura and Kanda 2004, Meuter et al. 2003, Barbeite and Weiss 2004), Beckers and colleagues (2007) have shown the extent to which anxiety felt regarding technology and computers relies on pre-existing tension, advocating for a trait anxiety toward computers. Regarding the nature of anxiety toward smart objects, literature have shown it was both a trait and state. Indeed, as regard state anxiety, negative feelings elicited by the perceived intrusiveness of the object are likely emerging from situations where the product have access to private data (Mani and Chouk 2018), while the feeling of technology dependence originates from an innate and stable desire for control and domination (Schweitzer et al. 2019).

Monsurro and colleagues (2020) have identified four different types of fears that emerge regarding the potential interaction with smart objects:

## Part 1 – A theoretical approach of consumer-smart object interaction

- The fear of being controlled: when the smart object influences consumers decisions and interacts as a “stalker”. The smart objects express capacities of intrusiveness and mystery, constantly observing the consumer without knowing exactly how it works. Leading the consumer to feel exposed to different kinds of risks (security, intrusiveness) being the weakest agent of the relationship.
- The fear of being dominated: when the smart object uses his captors to express capacities of “domination”. The consumer is losing autonomy as the object is developing its own capacities. This development makes the consumer feel impotent and fear being dominated, trapped, or even replace by the smart object.
- The fear of being subordinated: when the smart object interacts as a “master” of the relationship. Not having the capacities to control smart objects agency. The consumer feels frustration as he is losing autonomy and feels like being in a master-servant relationship.
- The fear of losing self-control: when the smart object interacts as a “seducer”, meaning that consumers perceive the smart object as useful and fascinating and thus developing the fear of being dependent or addict to smart objects, losing autonomy, health, and social interactions with real humans.

The notions of anticipated relationship, domination and control are persistently evoked, supposing a close link between the perception of control and the feeling of anxiety. Models of technology acceptance and resistance often incorporate anxiety as a determinant of the intention to adopt or reject the innovative product or service (Meuter et al. 2003, Oyedele et al. 2007, Compeau et al. 1999, Venkatesh 2000, Venkatesh et al. 2003, Mani and Chouk 2017,2018). Yet, none of them considers the intrinsic desire for control and domination as a determinant for anxiety.

The TPB with the perception of behavioral control (Ajzen 1991) or the self-efficacy concept (Bandura 1982) refer to the feeling of possessing all the resources required to perform the behavior. According to Ajzen (1991), behavioral control refers to “people’s perception of the ease or difficulty of performing the behavior of interest” (Ajzen 1991, p.183). These two concepts cannot be relied upon for measuring the perception of domination people believe they hold in their relationship with smart objects. Indeed, these models does not incorporate

## Part 1 – A theoretical approach of consumer-smart object interaction

relational determinants of anxiety, and only rely upon consumer's feeling of efficacy (Monsurrò et al. 2020).

Exploring the notion of fear and anxiety toward technology has highlighted several concepts which are summarized in the table below:

*Table 16 - Fear and anxiety toward technology - Main concepts*

Framework	Concept	Definition
<b>Fear and anxiety toward technology (Mori 1970, Asimov 1975, Nomura and Kanda 2004)</b>	Affinity	The notion of familiarity people tends to feel while facing a human-like robot.
	The uncanny valley	The moment where people start feeling discomfort regarding the robot physical resemblance with humans, resulting in a drop in terms of affinity.
	The Frankenstein complex	The degree to which a person tends to develop anxiety about machines as they mimic humans.
	Terminator Effect	The extent to which sci-fi novels influence the emergence of negative feelings toward technology, apprehending what they can do, based on science fiction stories.
	Anxiety toward technology	Negative feelings of fear, apprehension and discomfort induced by technology, that can either be a trait (individual predisposition) or a state (situational).

Just like the Frankenstein complex, consumers seem to apprehend the relationship with smart objects based on the object's capacity to act autonomously, as if they were Victor facing Creature apprehending what the technology can do. Indeed, according to Nomura and colleagues (2020), people can start feeling anxious before interacting with technology, by anticipating the interaction with it. This state of anticipatory anxiety can also prevent the adoption of technology while perceived at the same time, useful and beneficial for the individual. Accordingly, people developing anticipatory anxiety are likely showing "a tendency to avoidance" (p. 382), which refers to the notion of passive resistance.

Consequently, understanding the Frankenstein complex mechanism is perhaps the key to reduce passive resistance toward smart objects. "Are we doomed to treat technology like Dr. Frankenstein's creation, or can we learn to be better parents than Victor?" (Hidalgo et al. 2021, p.3). To answer this question, we must reflect about the nature of the relationship between Victor and Creature, exploring the concept of domination and control.

### III- The struggle for domination and control

#### A- *The Frankenstein complex and the Master-Servant Dialectic*

In Mary Shelley's novel, Victor Frankenstein designed Creature based on his obsession for mastering artificial life. Accordingly, Creature was seen as a possession, an entity made by different body parts, barely alive but still, inferior to its father in terms of capacities. At this moment, Victor had no idea about the capacities held by Creature, such as intelligence, the ability to learn and feel emotions. Yet, after its multiple abandonments, Creature learned and was able to express itself, communicating about its thoughts and emotions. When Creature went back to Victor, it was able to put into words its thoughts, feelings, and desires. Requesting something from its father, Creature knew the only way to have one day a family was to force Victor to make one for it. From that moment, the entire relationship between Victor and Creature changed. Indeed, at the beginning, Victor was mastering the relationship. He was the master and expressed a form of domination upon Creature, by making it and rejecting it with no consideration. Creature was first a servant, a slave of Victor's obsession, and had no other reason of being except for Victor's desires.

However, when Creature was able to express a need, to manifest and reveal a form of control and domination, imposing its will over Victor, it was no longer a servant. Creature was able to challenge Victor's position of Master trying to make Victor its Servant. This relationship dynamic is also known as the Master-Servant dialectic (Hegel 1977).

The master servant dialectic is a well-known theory in philosophy (Kohn, 2005). Proposed in 1807 by Friedrich Hegel (1770-1831), the master servant dialectic represents a passage of its famous book the Phenomenology of Spirit. This theory is deeply related to the concept of consciousness (Aksoy, 2011) and attempts to explain how the quest for freedom and domination occurs between individuals. But what does it state?

It tells the story of the interaction between two individuals, resulting in one becoming the master and the second, the servant of the relationship. The man who has been enslaved by the master can only express himself through serving the master's needs and wants (Aksoy 2011). The struggle for freedom, or domination, occurs when two conscious entities initiate an interaction (Hegel 1977). But first, there is a need to define what refers to conscious entities.

## Part 1 – A theoretical approach of consumer-smart object interaction

Consciousness is often defined as a state of awareness. Unfortunately, there is no consensus among researchers about its definition (Block 2001). Indeed, “consciousness” has many meanings in the literature. Williams and Poehlman (2017) have thus established a literature review in which they identify three main definitions of consciousness:

- Consciousness defined as a state of spontaneous knowledge.
- Consciousness as the state of expressing control over a specific action.
- Consciousness as the state of initiating cognitive processes.

According to Williams and Poehlman (2017), considering consciousness as a state of spontaneous knowledge and awareness encompasses all the other definitions. Accordingly, spontaneous awareness is seen as the state of both perception and response to an environment, which basically refers to consciousness (Sweldens et al. 2017).

Humans are conscious entities in the way they can perceive (through their senses), but also because they are able to act upon and interact with their surroundings. From this definition, each entity capable of perceiving and responding rationally to their environment can be qualified (or at least perceived) as a conscious entity.

Yet, the basic state of consciousness is not enough for achieving “certainty of the self”. Certainty of the self refers to the concept of becoming aware of our own existence (Aksoy 2011). Certainty of the self can only be achieved when our conception of reality is recognized by another conscious entity as true (Pinkard 1996). Accordingly, conscious entities are inexorably attracted by the need to become self-conscious which cannot be reached individually but involves the interaction between two conscious entities (Kohn 2005). The literature also shows the extent to which people interact with other entities (objects, animals, humans) to better apprehend their own identity and essence (Leung et al. 2018, Zlotowski et al. 2017).

According to Hegel (1977), each conscious entity involved in a relationship can only reach self-consciousness (or the certainty of the self) by imposing authoritatively its vision of reality to the other. The master of the relationship is the conscious entity that imposes its own vision of reality over the other conscious entity, which submits and endorses the role of slave, serving the master’s conception of reality (Hegel 1977).

The master-servant dialectic describes the journey from the state of consciousness to self-consciousness. Conscious entities inexorably need to be recognized as self-conscious by others

(Hegel 1977). This Hegelian dynamic considers two phases: the need for recognition and the struggle of death.

These conscious entities intrinsically express a need for recognition. However, the recognition is only expressed through domination, forcing other entities to recognize us as the master of the relationship. When two conscious entities interact, they simultaneously express a need for recognition and domination. The struggle between these two entities ends up with one entity mastering the relationship, and the other entity choosing submission to save its life (Kohn 2005).

To explain the dynamic of recognition, Hegel proposed the story of two men or conscious entities that interact together to reach certainty of the self. Each conscious entity has its own desires and conception of reality. They want it to be recognized as true by the other conscious entity to achieve self-consciousness (need for recognition). Both entities try at the same time to impose authoritatively their own vision, and are not willing to give up, as they “would rather die than renounce” (Kohn 2005, p.506). This refers to the struggle of death (Hegel 1977).

However, one conscious entity involved in the struggle will always prefer life instead of dying, renouncing to be recognized. Consequently, the most dominating conscious entity is likely going to master the relationship, achieving self-consciousness by imposing its reality to the other conscious entity, which becomes the servant of the relationship. Accordingly, the master dominates the relationship because of his desire for control and autonomy, while the servant voluntarily choose submission instead of death because of his desire for life (Aksoy 2011).

Back to Frankenstein and Creature relationship, we can clearly identify the need for recognition and struggle of death. Indeed, both Victor and Creature hold their own vision of reality, while Creature believes it has a right for having a family, Victor firmly believes the opposite. The struggle of death occurs when Creature tries to impose its will over Victor by threatening him. This master-servant relationship relies upon two distinct elements: the ability to dominate and the need for recognition. These are basically the two fundamental dimensions structuring social and interpersonal interactions (Kiesler 1996).

The interesting aspect of Frankenstein novel is the evolution of Victor-Creature relationship. From a mere possession, Creature learned and became conscious, seeking recognition and challenging Victor as an equal entity. The fear toward Creature felt by Victor

## Part 1 – A theoretical approach of consumer-smart object interaction

originates from the struggle of death. Accordingly, the ontological status hold by Creature was no longer defined by Victor's desires, but instead, defined by its own desire for achieving certainty of itself. Creature was not anthropomorphized anymore but recognized as a conscious and social entity since it was able to impose its authority. Previous research on consumer-object relationship have considered possessions as contributing to the building of the self (William 1980, Belk 1988). Yet, smart objects diverge from traditional objects and possess unique capacities to perceive and react in pursuit of their own agenda (Hoffman and Novak 2018). Accordingly, is it possible to consider smart objects as a form of conscious entities? Can we apply such reasoning to smart objects?

### B- Smart objects as conscious and social entities

Nonhuman entities can be assigned human characteristics such as brands, to the point the relationship can be considered as social (Fournier 1998). According to Hoffman and Novak (2018), consumer-smart object interactions are intrinsically relational. The literature emphasizes that objects contribute to the building and extension of the self (Belk 2014). Consequently, smart objects can be perceived as partners within social relationships (Monsurro et al. 2020, Novak and Hoffman 2019, Hoffman and Novak 2016).

The most important aspect of social interactions is the feeling of social presence. According to Biocca and colleagues (2003), social presence refers to feelings of interacting with another social entity. Putting more simply, it refers to the capacity of interacting with non-human entities with the sensation of having a real social actor as a relationship partner.

Assigning human features to technology-based objects is a well-known human tendency. Consumers can interact with computers as if they were interacting with humans (Nass et al. 1996). Considering that smart objects hold capacities to interact autonomously with consumers, thanks to artificial intelligence, it is therefore logical to consider that smart objects are blurring the frontier between humans and machines more than ever (Belk and Kniazeva 2018).

This is also supported by the anthropomorphism literature. Some objects interact in such resemblance with humans in terms of behavior that people can perceive them as if they were alive (Carpenter et al. 2008). Robots for instance, can emulate a humanlike mind. According to Zhao and colleagues (2019), anthropomorphic cues hold by a robot, such as physical human

## Part 1 – A theoretical approach of consumer-smart object interaction

appearance or human behavior, can elicit the impression of a mind. More interestingly, mental capacities that do not involve physical cues can also elicit the feeling of human resemblance.

According to these authors, “any nonhuman agent can thus resemble humans in two fundamental ways: it can appear human-looking, and it can seem human-minded” (Zhao et al. 2019, p.3). According to Epley and colleagues (2007), people can even attribute emotions and intentions to objects. A phenomenon also supported and described by the work of Urquiza-Haas and Kotrschal (2015).

The literature shows that products can hold personality attributes based on consumers inferred meanings (Sirgy 1985). More than simply expressing agentic features, some smart objects can also show tangible social cues while interacting (Shang et al. 2012). According to Mitew (2014), smart objects not only depart from traditional objects in terms of capacities to act but also in terms of sociability, with communication capacities involving intimacy and emotional responses. Accordingly, smart objects and usual objects departs from one another because of smart objects’ perceived capacities to socially interact with humans (Bartneck et al. 2009, Goudey and Bonnin 2016).

This is also supported by the work of Duffy (2003), who investigates the extent to which social interactions with robots originates from our tendency to rationalise and understand robots’ actions, especially their intelligence. As seen previously, consumers tend to anthropomorphize non-human entities to better understand their nature (Epley et al. 2007).

Yet, according to Hoffman and Novak (2016), there are two different kinds of anthropomorphisms: human-centric anthropomorphism and object-oriented anthropomorphism. Human-centric anthropomorphism refers to the natural inclination of attributing humanlike characteristics to non-human entities based on the consumer perspective. Conversely, object-oriented anthropomorphism is defined as the process under which people try to understand the object from its own perspective. Accordingly, the attribution of humanlike characteristics is no longer inferred by people but emerge from the object’s agentic capacities (Hoffman and Novak 2016). However, the shift from human-centric to object-oriented anthropomorphism requires to understand objects according to them, thus affirming their role as conscious entities.

## Part 1 – A theoretical approach of consumer-smart object interaction

As they are interacting with different entities (humans / other objects), smart objects become actors of interactive networks. Within these networks, they also possess a unique identity making each object recognizable. Thus, they become “context-aware”. According to Abowd and colleagues (1999) objects considered as context-aware are those objects possessing an identity (ID number for instance, or a specific name), which can engage in relationships dynamically, modifying their location and state. From the human perspective, objects embedded with smart features have become “suddenly sociable things” (Mitew 2014, p.6), shifting from a status of mere possessions to the rank of social and conscious entities. However, the notion of smart objects as conscious entities must be precisely conceptualized.

Smart objects hold capacities to affect and to be affected while interacting with consumers and other objects (Hoffman and Novak 2015-2018, Novak and Hoffman 2019). These capacities originate from features they possess thanks to their sensors, actuators, and connectivity. From a technical perspective, this is fundamentally what makes smart objects different from usual objects.

From a pragmatic perspective, smart objects are considered “intelligent” because they are capable to express agentic features. Rijsdijk and colleagues (2007) proposed a conceptualization of smart object’s intelligence, called “product intelligence” according to six dimensions: autonomy, ability to learn, reactivity, ability to cooperate, humanlike interaction and personality.

Autonomy refers to the object’s capacity to operate independently, for a purpose, without human intervention. As objects possess capacities to perform different operations, autonomy refers to the degree to which objects act on their own. The ability to learn is defined as the object’s capacity to improve through functioning, constantly adapting its behavior to its environment by processing data for a better performance.

On the other hand, reactivity is defined as the “ability of a product to react to changes in its environment in a stimulus/response manner” (Rijsdijk et al. 2007, p. 342). While autonomy refers to the degree of independence to act, reactivity refers to the capacity of reaction toward events. The ability to cooperate refers to the objects’ capacity to act for achieving a shared objective. Thus, it refers to the capacity to operate in line with others’ goals and purposes.

## Part 1 – A theoretical approach of consumer-smart object interaction

Humanlike interaction involves the degree to which the object acts like humans through communication and interaction (voice communication, humour, etc.). Finally, the dimension personality refers to objects' ability “to show the properties of a credible character” (Rijsdijk et al. 2007, p.343). This includes both physical (e.g., facial expression) and psychological cues (e.g., emotions).

According to the authors, all these dimensions work independently, and are not all required to consider a product as intelligent. Indeed, an autonomous product without the capacity to learn or a weak reactivity remains a smart and intelligent object. Nevertheless, these dimensions are intermingled, “when a product is intelligent in terms of one dimension, it may also possess properties that match another” (p.343). All these dimensions provide sufficient cues for considering smart objects as capable of sensing and responding to different situations and stimuli. Accordingly, the smart object's capacity to perceive and react to its environment can be seen as a state of spontaneous awareness as proposed by William and Poehlman (2017) and captured by Rijsdijk and colleagues (2007) conceptualization of smart object's intelligence.

However, smart objects possess different features and does not express the same level of “intelligence”. According to Novak and Hoffman (2019), smart objects are considering smart because of their capacity to express agentic capacities while interacting. According to Hoffman and Novak (2018), smart object's ability to act and react exist on continua, and can hold different levels:

*Table 17 - Different levels of smart object's intelligence (Hoffman and Novak 2018)*

<b>Agency</b>	<b>Autonomy</b>	<b>Authority</b>
The capacity to interact, to affect and to be affected by its surroundings (Franklin and Graesser 1996).	The capacity to interact without consumer's intervention. To act independently in pursuit of their own agenda (Parasuraman et al. 2000).	The capacity to act independently, expressing control over how the smart object's responds to other entities (objects and consumers), but also controlling how other entities interacts with it, making their own decisions without consumer's consent (Hansen et al. 2007).

## Part 1 – A theoretical approach of consumer-smart object interaction

Agency is defined by the capacity to interact, or the ability to affect and to be affected by other entities (Hoffman and Novak 2015, Franklin and Graesser 1996). It represents the basic set of possibilities that entities can potentially exercise while interacting with other entities (DeLanda 2011). This ability is expressed by actuators and other mechanisms through which the object “acts upon an environment” (Mitew 2014, p. 7). Agency is expressed by agents regardless of their status (it can be humans, objects, artificial intelligence, etc.). Accordingly, humans, dogs, and smart thermostats can be considered as agents expressing different degree of agency (Franklin and Graesser 1997).

Autonomy represents the next level of agentic features, which is defined by the capacity to express agency independently from consumers intervention (Parasuraman et al. 2000). Smart objects express tangible abilities to act without human intervention, taking initiatives through decision making processes (Rijssdijk et al. 2007). Accordingly, “An agent that acts in pursuit of its own agenda is acting autonomously” (Franklin and Graesser 1997, p.26).

Authority is defined by Hansen and colleagues (2007) as the capacity, alongside with agency and autonomy, to control how they interact with other entities and how other entities interact with them. The more smart objects are granted capacities of control, the more they tend to express authority (Hoffman and Novak 2018). For instance, some smart objects like smart plugs require human intervention and will work when they are triggered by consumer’s actions. These objects, also called “dumb” smart objects by Verhoef and colleagues (2017) are only capable of the lowest level of agency. Conversely, “native” smart objects, those granted with high level of automation such as voice-controlled assistants or autonomous vehicles, can act autonomously and sometimes with authority, taking decisions by themselves without the consumer intervention (Verhoef et al. 2017, Parasuraman et al. 2000, Mani and Chouk 2017). Native smart objects can also be involved in “non-consumer-centric” relationships where the consumers never get involved in interactions with the smart object (Hoffman and Novak 2018).

This categorization of smart objects’ agency is also relied on by Cila and colleagues (2017) taxonomy of products’ agency where smart objects are seen as either data collectors (Agency), actors (Autonomy) or self-aware (Authority) entities regarding their levels of agentic features. This way of categorizing objects depending on their capacities has not emerge with smart objects. In 1996, Barber provided a categorization of object’s complexity, based on object’s capacities. According to the author, objects’ complexity can be classified in four categories:

## Part 1 – A theoretical approach of consumer-smart object interaction

Table 18 - Object's complexity categorization (Barber 1996)

Manual (Traditional objects)	Bounded (Agency)	Supervised (Autonomy)	Symbiosis (Authority)
The object requires continuous supervision of a human to operate.	The user performs an action and is waiting for the object's response, which follows specific instructions.	The user triggers the object which can make decisions based on sensors and actuators.	This stage “assumes ongoing communication between user and product to fulfil some goal, e.g., setting a domestic control system which governs heating, air conditioning, security alarms etc.” (Barber 1996, p.2)

Franklin and Graesser (1997) also proposed a list of characteristics trying to isolate what constitute autonomous agents based on their capacities:

Table 19 - Franklin and Graesser (1997) taxonomy for autonomous agents

Property	Meaning
<b>Reactive</b>	Responds adequately to changes in its environment
<b>Autonomy</b>	Has the control over its actions
<b>Goal-oriented</b>	Does not act only in response to its environment
<b>Learning</b>	Changes its behavior based on prior experience
<b>Communicative</b>	Can communicate with other agents (objects / user)
<b>Temporally continuous</b>	Operates continuously
<b>Character</b>	Expressing a personality

Hence, agency, autonomy and authority represent the different degrees of how “intelligent” or “conscious” a smart object can be perceived (Rijssdijk et al. 2007, Hoffman and Novak 2018, Novak and Hoffman 2019). Indeed, “the issue will not be whether a system is fundamentally intelligent but rather if it displays those attributes that facilitate or promote people’s interpretation of the system as being intelligent” (Duffy 2003, p.179).

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Hoffman and Novak (2018), smart products interact with their surroundings, acting and reacting to different stimuli. More than just smart features, smart objects can perceive (through their sensors) and respond (with their actuators) adequately to their environment. This feature assumes a similarity between smart objects and a form of life (Zwick & Dholakia, 2006).

If we relate to Williams and Poehlman definition of consciousness, we can assume that smart objects possess elements referring to a form of spontaneous awareness. As these capacities are expressed by smart objects, people might deliberately or not, attribute consciousness to smart objects. This statement is supported by the literature. According to Zhao and colleagues (2019), people can hold the impression of a human mind expressed by objects such as robots, based on the extent they express smart features and cues of intelligence.

Additionally, Gray and colleagues (2007) posits that perception of a mind often derives from the perception of agency expressed by an entity, and the interaction experienced with it (or emotional outcomes). Moreover, Dennett (1996) posits that humans hold a natural tendency to attribute intentions to non-human entities (animals, objects, etc.), considering them as rational agents performing actions with purpose and meaning. Accordingly, people can unconsciously rely on projective intelligence (the perception of object's intelligence) to attribute consciousness, a mind, intentionality, and social rules to objects (Duffy 2003, Nass and Moon 2000).

The perception of a form of smart objects' consciousness coupled with the dynamic of social relationships (such as the master-servant relationship) can potentially explain how anticipatory fear and anxiety emerge. According to Hoffman and Novak “smart objects possess their own point of view and their own experience in interaction with consumers” (2016, p.4). Hence, people might seek recognition and desire for control with smart objects or apprehending the smart object's capacity to impose its own vision over the consumer.

According to Rijssdijk and Hultink (2003), there are enough evidence to think smart product's adoption can be mitigated by individuals' desire for control. Issues and concerns regarding smart objects often relate to a “lack of human control and enslavement to devices” (Slettemeås, 2009, p.226). Users tend to develop anxious feelings regarding objects that express a form of autonomy (Jia et al. 2012, Sundar et al. 2015). Moreover, artificial intelligence elicits both positive expectations of potential benefits and negative expectations of fear of dependency (Hawking et al. 2017, Oyedele et al. 2007).

## Part 1 – A theoretical approach of consumer-smart object interaction

Technology dependency refers to the feeling of being “overly dependent on, and a feeling of being enslaved by, technology” (Ratchford and Barnhart 2012, p. 1212). It is also defined as “a psychological state in which people see themselves as dependent on technology for attaining their objectives or feel that using technology reduces their autonomy.” (Mani and Chouk 2018, p.793). Accordingly, technology dependency might refer to the apprehension of entering the struggle of death with technology, in other words, the apprehension of engaging into a relationship with technology.

The notion of another entity showing agency conflicts with people innate desire for expressing control and display their own agency (Hur et al. 2015). However, the need for being recognized by smart objects might also influence the desire for interacting with them, thus raising a feeling of ambivalence. That is the reason why perceived loss of control and feeling dependent to smart objects are factors of consumers resistance (Slettemeås 2009), while anthropomorphism can sometimes positively influence the intention to adopt them (Aggarwal and McGill 2007).

Nevertheless, both users and non-users can potentially feel ambivalent and negative feelings toward smart objects (Ardelet et al. 2017, Monsurrò et al. 2020). This indicates that negative or positive feelings toward smart objects might stem from both real and anticipated interactions with them. Accordingly, anxiety or anticipatory anxiety toward smart objects can potentially be a relational outcome which originates from anticipated consumer-smart objects interactions.

Consequently, we must explore the notion of anticipated anxiety and expected outcomes.

### C- *Anticipatory anxiety toward smart objects as a relational outcome*

Humans define their environment according to them, and their environment have an influence over how humans perceive themselves (Bartneck et al. 2007). Consequently, humans tend to define what smart objects are compared to them by interacting with them, and conversely, smart objects redefine constantly how humans define their own self through interaction (Novak and Hoffman 2019). During these interactions, both humans and objects express different kind of roles based on their own agentic capacities (Hoffman and Novak 2016).

According to Bandura and the social cognitive theory (2001), people’s agency originates from two different features: controlling their own actions and influencing their environment.

## Part 1 – A theoretical approach of consumer-smart object interaction

This need for control and domination is relied upon to face the uncertainties associated with unknown events and situations (Epley et al. 2007). According to Kang and Kim (2020), interacting with smart objects and non-human entities is full of uncertainties. Indeed, outcomes of the relationship are hardly predictable. To face these uncertainties, people tend to apprehend objects' intentions by anthropomorphizing it, making the object more understandable, hence "leading to a strong sense of control over the entities" (Kang and Kim 2020, p. 48). Accordingly, consumers' agency stem from people's capacity to act autonomously, and to display their domination by enabling or restraining their environment (Hoffman and Novak 2018).

Regarding consumer-smart objects interaction, users can express their agency by modifying the environment, adding, or removing objects, performing different tasks from their smartphone, or directly interacting with objects, customizing, and shaping their surroundings according to their needs and wants (Kang and Kim 2020). Following the social cognitive theory, smart objects also possess the capacity to express agency (Hoffman and Novak 2018). As a result, smart objects can control their own actions and influence their environment as well.

Regarding consumer-smart objects interaction, a smart object can also display its agentic features by modifying its surrounding, deciding how to operate and how others (people, objects) interact with it (Novak and Hoffman 2019). Considering the Master-Servant dialectic, consumers are trying at the same time, to interact with smart objects for recognition and to impose their will and domination over their environment.

Consumers are no longer using objects but involved in complex interactions with smart objects (Verhoef et al. 2017, Novak and Hoffman 2019). Hence, the relationship between consumers and smart objects becomes social, with positive or negative experiences emerging from the clash between their agentic expressions (Kiesler 1996).

Such statement can be supported by empirical evidence. Indeed, over half a million consumers have once said 'I love you' to their voice-controlled virtual assistant (Risley 2015). This intimate relationship supposes a sense of proximity where consumers feel either aloof or close to smart objects depending on the outcome of the relationship (Kang and Him 2020).

As conceptualized by Hoffman and Novak (2016), people are capable of both human-centric anthropomorphism (inferring humanlike characteristics to objects) and object-oriented anthropomorphism (understanding objects from their own agentic features). Scholars have focused on physical anthropomorphism, without considering the emerging capacities of smart

## Part 1 – A theoretical approach of consumer-smart object interaction

objects. Hence, little is currently known about the consequences of object-oriented anthropomorphism over the consumer-smart object relationship and the anticipated relational outcomes (Monsurrò et al. 2020). As the relationship with smart objects relies on social rules, myriad of potential outcomes (positive or negative) can emerge from the interaction between people and smart objects (Novak and Hoffman 2019).

Following the master-servant dialectic, considering an anticipated relationship between a consumer and a smart object, the relational outcome can be either positive or negative. Indeed, if consumers believe they can dominate the relationship, imposing their vision of reality to smart objects (controlling them), it can be assumed a positive relational outcome from the consumer-smart object relationship. Conversely, if consumers perceive a strong object's agency, they might anticipate a form of struggle for domination as conceptualized by Hegel's dialectic, anticipating a negative relational outcome and anticipatory anxiety which refers to the fear of being enslaved by the interaction with the smart object.

This statement is also supported by the literature. Jia and colleagues (2012) have shown the extent to which people were expressing concerns about losing control over technology. According to them, losing control over machines can elicit “agency tension” and anticipatory anxiety which represents a threat, in line with the natural tendency to display agency and domination. Such reaction is deemed to prevent consumers from the interaction with the smart object (Kang and Him 2020).

Current barriers to adoption of smart objects identified by the resistance literature are neglecting their social roles and implications in the emergence of resistance (Monsurrò et al. 2020). As most studies on consumer resistance to smart objects and technology often rely upon human-centric anthropomorphism, scholars should also consider the influence of object-oriented anthropomorphism over both their acceptance and resistance.

Thus, a thrilling research topic is “to examine how they form relationships with these devices. This examination includes the questions: Who (or What) is controlling whom (or what)” (Schweitzer et al. 2019, p.2), but also which framework to adopt for representing consumer-smart objects relationships (Hoffman and Novak 2016).

## Part 1 – A theoretical approach of consumer-smart object interaction

Such questioning requires a certain shift in terms of ontological paradigm. Indeed, the object-oriented anthropomorphism and the master-servant dialectic suppose an equal status between humans and objects (Hegel 1977, Aksoy 2011).

Yet, exploring the notion of control and struggle for domination have highlighted different concepts that can be summarized in the table below:

*Table 20 - Struggle for domination and control - Main concepts*

Framework	Concept	Definition
<b>Domination and Control (Hegel 1977)</b>	Master-Servant dialectic	The dynamic structuring the relationship between two conscious entities trying to impose their vision of reality.
	Consciousness	The state of spontaneous knowledge and awareness, allowing the entity to sense and react to its surrounding.
	Certainty of the self	The need to seek for the state of self-consciousness.
	Need for recognition	The need to impose our vision of reality to another conscious entity, in order to achieve certainty of the self.
	Struggle of death	A struggle for domination that occurs when two conscious entities try to impose their own vision of reality to the other.
	Domination	Imposing a form of control and authority to impose to another entity our vision of reality.
<b>Smart objects as social entities (Hoffman and Novak 2018)</b>	Smart object's consciousness	Considering smart objects as conscious entities based on their sensors and actuators, allowing them to express a form of awareness.
	Smart object's agency	The capacity to act and to react, to affect and to be affected, which can hold different levels (agency, autonomy, authority)

Recognition is sought from an equal conscious entity (Kohn 2005). Accordingly, the conceptual framework that will serve for representing all potential outcomes of consumer-smart objects interactions must relied upon an object-oriented perspective. Indeed, the human-oriented perspective falls short for considering smart objects as conscious entities. Yet, considering irrational motives might involves a shift in assessing consumers-smart objects relational dynamics.

The next part will illustrate the current human-oriented ontology (used for human-centric anthropomorphism), its approach for assessing human-objects interactions and more importantly, the limits for considering actual consumer-smart objects relationships from a human-oriented perspective.

**IV- Limits of the Human-oriented ontology in Human-Technology Interaction**

Relationship between consumers and non-human objects have been a thrilling research topic across various disciplines and literatures. The existence of relationships between consumers and inanimate objects, that go beyond the simple purchase-consumption interactions, is widely supported (Fournier 1998, Belk 1988, Fournier and Alvarez 2012). While marketing literature have focused on the relationship between consumers and possessions (Belk 1988, Fournier 1998) emergent findings suggest that the relationship between consumers and inanimate objects can be assimilated to social or interpersonal relationships (Belk 2014, Novak and Hoffman 2019, Schweitzer et al. 2019).

Consumers can get emotionally attached to brands, showing loyalty and commitments but also enmities and struggles while interacting (Fournier and Alvarez 2014). Such complex relationships cannot be fully grasp by considering inanimate objects as mere possessions. As a matter of fact, smart objects differ from usual products due to their emerging capacities to affect and to be affected by consumers, but also by other objects (Hoffman and Novak 2015). Consequently, consumers-smart objects relationships cannot be compared to traditional consumer-objects relationships in terms of relationship styles (Belk 2014;2018, Novak and Hoffman 2019).

Before delving in the topic of consumer-smart object relationship from the object-oriented perspective, we must provide an overview of human-object interaction and the limits of considering humans as the centre of the relationship. As consumers interact with inanimate objects, meanings are attributed to both objects and the interaction (Belk 2014). Consequently, the more smart objects depart from traditional objects, the more additional thinking and theories will be required (Hoffman and Novak 2018). Thus, adopting a global approach will help to better understand the phenomenon under study, and more importantly, the gap that remain within the literature.

A first step will consist of providing an overview of the two main ontologies that cover the human-object interactions literature: human-oriented and object-oriented ontologies. After exposing the way inanimate objects are depicted within the human-oriented ontology and the paradigms associated with, a second part will go more in depth in the object-oriented ontology focusing on the interdependence in consumers-objects interactions, elicited by the emerging capacities of smart objects (agency, autonomy, and authority).

## Part 1 – A theoretical approach of consumer-smart object interaction

There are two main perspectives for assessing the human-object interactions: Human-Oriented Ontology and Object-Oriented Ontology.

The first is called human-oriented ontology or anthropocentric and relies on two mechanisms: identification and anthropomorphism. Within human-oriented ontology, inanimate objects are defined as “possessions” invested with meanings. Those meanings are attributed based on an identification process, but also relied on anthropomorphism processes. Indeed, people tend to attribute human characteristics to products and common goods when they begin to shape their own identity (Bartneck et al. 2007). This identification process is relied upon for building our own identity throughout the entire journey of life. According to Belk (1988), the identification journey can be summarized in four main steps:

- When people are infant, they begin to distinguish themselves from their environment.
- Infants start to distinguish themselves from others using possessions.
- Then, possessions allow young adults to shape and manage their identity.
- Afterwards, possessions play a significant role for elders in achieving a sense of continuity, in preparation for death.

During their life, people rely on possessions to distinguish their self from environment and others. Material possessions are employed and relied upon through the entire journey of life, to reach happiness, to live experiences and for remembrance of other people (Belk 2014). The sum of these possessions indicates where they come from, playing a significant role on defining who they are and where they are going (Belk 1988). Within this paradigm, possessions are inferred with meanings stemming from human-characteristics and are slowly being incorporated in a broader socio-material world, called the “*extended self*”.

One of the most famous theories that emphasizes the incorporation of possessions to the self is the extended-self theory, proposed by Russel W. Belk in 1988. The author has investigated the extent to which possessions were integrated to the sense of self, literally, the definition of what we are. This theory stems from Williams James' conceptualization of the self in 1980. This psychologist has proposed that the self can be defined by the possessions one's might have. Based on this conceptualization, this author argued that the *self* is defined by everything seen as me, and the *extended self* includes everything seen as mine (Williams 1980).

The extended-self theory provided by Belk (1988) posits that humans are attributing meanings to their possessions, to the point they consider them as parts of themselves.

## Part 1 – A theoretical approach of consumer-smart object interaction

Possessions are not only limited to personal possessions but can also include people, places, or anything that contribute to “the building of our self” (William 1980, p.291), yet distinct from it.

According to Belk (1988) possessions are incorporated to the self when there is a physical contact or proximity (contamination process), and where they are seen through habituation, as parts of who we are (habituation process). These processes are necessarily required to incorporate possessions to the extended self. Appropriation can also derive from the perception of control one might have over external entities. Indeed, people tend to incorporate possessions to the self when they can control them (McClelland 1951), and “the greater the control we exercise, the more closely allied with self the object should become (Belk 1988, p.140).

Based on this assumption, Belk relied on McClelland’s hierarchy of possessions (1951). This author proposed a hierarchy of most to least self-allied object categories (assumed to influence the definition of the self):

- (1) Me, my “free will”
- (2) My body, conscience
- (3) My belongings
- (4) My friends
- (5) Strangers and physical universe

As we can more easily exercise power and control over possessions, they are supposed to contribute more to the definition of the self than friends. Indeed, “at the basis of property is our dependence on things such that they play a role in our lives” (Hodder 2012, p.26).

In line with this hierarchy, Prelinger (1959) provided support to Williams’ and McClelland’s assumptions. This author has shown that possessions were indeed seen as part of the self, supporting Williams’ conceptualization of the extended self. More importantly, he suggested a hierarchy of categories that contribute to the building of the self, supporting McClelland’s assumption that control over possessions influences their contribution to the sense of self.

According to Prelinger (1959), categories that contribute to the building of the self are as follow:

- (1) Body parts

## Part 1 – A theoretical approach of consumer-smart object interaction

- (2) Psychological processes
- (3) Personal identifying attributes
- (4) Possessions and productions
- (5) Abstract ideas
- (6) Other people
- (7) Objects within the close physical environment
- (8) Distant physical environment

Belk (1988) highlighted the difference between belongings and friends, and the reason why belongings are more aligned with the self than friends and people, considering McClelland's and Prelinger's hierarchies. Indeed, we recognize the "free will" of people, which is "lacking in most belongings" (Belk 1988, p.140). The more we perceive entities with their own will, differing from our goals and purposes, the least they contribute to be parts of ourselves. Indeed, we transfer and attribute our identity to external objects. Meanings and emotions are transferred to every single external object depending on their degree of alignment with the self (McClelland 1951, Belk 1988). That is the reason why we tend to impose our identity to our possessions, while others impose their identity on us (Prelinger 1959).

Interestingly, identification processes along lifespan seem to be based on the control and power one's can express upon its environment. According to French and Raven (1954), the basis of identification is power. With social interactions taking place between people, individuals are trying to find their place and status within their group. Due to the interdependence of social actors, the expression of one's identity relies on social exchange and its distinction, on the control we can express over the environment and possessions (French and Raven 1954).

## Identification, anthropomorphism, and smart objects

With the evolution of technology, products have changed. Theories have tried to understand and describe the way people interact with these emerging products. In the branding literature, Fournier (1998) highlighted the need to consider brands not only as passive objects in marketing

## Part 1 – A theoretical approach of consumer-smart object interaction

operations, but rather as active partners within relationships between consumers and brands. That is because, for the relationship to exist, there is a need for interdependence, literally the capacities of partners to “collectively affect, define and redefine the relationship” (Fournier 1998, p.344).

As consumers interact with brands, they tend to anthropomorphize brands, considering them as active partners of the relationship. Consequently, consumers tend to become emotionally attached to brands, displaying commitment, joy, or abusive relations with brands (Fournier and Alvarez 2012). However, brands’ human likeness is inferred by consumers and stems from a human-centric anthropomorphism (Hoffman and Novak 2015).

Like Hoffman and Novak (2015) definitions of human-centric and object-oriented anthropomorphism, Goudey and Bonnin (2016) posit that “Anthropomorphism” must be differentiated from “Anthropomorphization”. According to these authors, anthropomorphism refers to an objective resemblance to humans (the object bears two eyes, legs and arms that mimic the human body), while anthropomorphization is defined by the subjective perception of human features expressed by non-human entities. Consequently, anthropomorphism (human-centric) can be defined as the objective resemblance objects have with humans (non-psychological features) whereas anthropomorphization (object-oriented) involves the subjective perception of human characteristics held by non-human entities.

Within the human-oriented ontology, human beings are central and dominant. Accordingly, entities are assessed and compared to humans, with humanlike characteristics inferred by people (Hoffman and Novak 2015). This human-centric anthropomorphism derives from an animistic process which often rely upon a need for simplifying the observed reality and facilitate interactions with objects (Fournier 1998). This mechanism also refers to personification processes under which people infer human-like characteristics and traits to non-human or imagined objects, having the sensation to experience human interaction with machines, animals, and inanimate objects (Shi 2017, Lopatovska and William 2018).

Fournier (1998) argues that people project and assign human characteristics into inanimate objects to achieve their own relationship view and animism provides an insightful grounding to understand this phenomenon. There are two mechanisms behind this process:

- Association: the inanimate objects is associated with the essence, or spirit, of a person. Such as gifts associated with the spirit of the giver, or objects used as symbols for remembrances of others.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Assignment: the assignation of human characteristics to objects such as personality, thoughts, or emotions.

Researchers already emphasizes the two above-mentioned phenomenon, with people associating or inferring human like characteristics to animals, objects and imagined agents (Belk 1988, Goudey and Bonnin 2016, Shi 2017, Belk and Kniazeva 2018).

Based on this human-centric anthropomorphism process several theories and paradigms have emerged, trying to explain how consumers infer human-like characteristics to smart objects and technological products. Indeed, people tend naturally to anthropomorphise objects while interacting with them (Hoffman and Novak 2018). Hence, the scholars often refer to three main approaches: the *Human-Computer Interaction* (HCI) approach, the *Human-Robot Interaction* (HRI) approach, and the *Computer Are Social Actors* (CASA) paradigm.

Concerning both the HCI and HRI literatures, researchers have tried to understand how consumers interpret computers and robots' characteristics (such as meanings attributed based on the physical resemblance with humans), and the influence over the consumer behavior and consumer experience of such attributed meanings. On the other side, the CASA paradigm focuses on studying the consumer reaction toward technological products and posits that consumers interact with objects as if they were humans (Novak and Hoffman 2019).

The Human-Computer Interaction literature aims at studying how machines can be better designed in terms of interactivity, to enhance the user experience (Shi 2017). Thus, this paradigm focuses on three main domains: functionalities, psychology, and anthropomorphism.

In terms of functionalities, the HCI approach aims at studying the extent to which functionalities can improve the user experience. Concerning the psychology and anthropomorphism part, the HCI literature relies on psychological theories to better design technological products (Shi 2017). Researchers in the HCI are used to integrate not only computer science theories and design practices, but also psychological approaches. They integrate for instance, psychological theories to analyse and study the consumer behavior, to design products that will fit their consumers needs and wants. Consequently, with the integration of psychological perspective alongside technology innovations, computers and people are getting closer than ever. That is the reason why HCI researchers relied on human-centric anthropomorphism.

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Shi (2017), anthropomorphism plays a significant role within the HCI paradigm, providing human characteristics to nonhuman entities. This allows the design and attribution of humanlike appearance to products, to enhance the interaction between consumers and objects. Within the HCI, smart objects are designed to enhance the user experience, improving functionalities and trying to satisfy consumer's needs and wants, relying on anthropomorphic attributes.

The Human-Robot Interaction approach works as an extension of the HCI, aiming at improving the interaction between humans and robots. Indeed, the HRI strictly relates to human-robot relationships and integrates various research fields (from engineering to social sciences, including robotics and psychology). The specificity of this approach is that researchers are looking for enhancing the interaction between people and robots, trying to create natural interactions regardless of where, when, and how interaction occurs (Dautenhahn 2007). This approach also relied upon human-centric anthropomorphism to elicit social interactions (Nomura et al. 2005).

The Computer Are Social Actors (CASA) paradigm is perhaps, the most largely cited paradigm when it comes to consumer-smart object interactions. Various studies across many fields and literatures have tried to understand the implications of consumers-smart objects interactions relying on the CASA paradigm (Kang and Him 2020, Novak and Hoffman 2019).

The CASA approach posits that consumers interact with technological products, such as smart objects or robots, as if they were humans, while they are aware about the fact they interact with machines. Thus, people natural tendency to anthropomorphize objects not only refers to human likeliness, but also to humanized interactions such as social rules, where consumers infer meanings to both the object and the interaction (Schweitzer et al. 2019).

The concept of computers as social actors, roots from Nass and colleagues (1993) research. They demonstrate through a set of different studies, the extent to which computer users apply social norms while interacting with computers. Interestingly, users were attributing such meanings while they recognized at the same time it was inappropriate. The findings of Nass and colleagues (1993) provided strong support for the idea that consumer-computer interactions were social in nature, generating social responses from people during the interaction.

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Purington (2017), technology has evolved, and today's objects integrate functionalities that exhibit unprecedent human-like social cues. As a result, consumers are getting more and more engaged in interpersonal relationships with smart objects (Novak and Hoffman 2019) such as consumers showing politeness to smart objects for instance (Lopatovska and William 2018, Nass and Moon 2000).

The CASA approach posits that consumer-technology interactions are intrinsically social. According to Breazeal (2004), this social nature stems from personification processes and can be classified through four distinct sections: social evocation, social interface, social receptivity, and sociability.

Social evocation refers to the implementation of mechanisms that will enhance the personification process to trigger social interactions. For instance, the use of child-voice for a kid's robot companion. Social interface relies on the integration of social cues to humanize the interaction between people and technology, such as voice-based interactions with virtual assistants. Social receptivity refers to the emerging capacity of technological products to learn and improve through machine learning processes. This allows the objects to learn from human by copying, but also improving through ongoing interactions. Sociability refers to the highest level of social interaction, where objects try to not only learn from humans, but understand how humans work, integrating verbal and non-verbal meanings and interacting fluently with humans, such as smart speakers (Breazeal 2004).

Concerning vocal interaction for instance, the CASA approach and the classification provided by Breazeal (2004) offer an interesting framework. The relationship between consumers and vocal enabled objects is undoubtedly social (Kinsella and Mutchler 2018, Smith 2020). According to Lopatovska and William (2018), smart speakers possess unique capacities to process verbal and non-verbal input, managing conversational norms. This voice-based capacity often leads consumers to anthropomorphize smart speakers and to interact with them as if they were humans. Indeed, verbal interactions is a strong human characteristic, increasing humanization processes and perception of social interactions (Schroeder and Schroeder 2018).

Despite the large diffusion of the CASA paradigm, this approach remains limited regarding our research and cannot be relied upon.

Limits of the CASA paradigm and the need for the Object-Oriented Ontology

While the CASA supports the concept of social interactions between consumers and objects, providing strong support for the relational nature of their interactions, this approach does not consider smart objects on their own in terms of ontology (Novak and Hoffman 2019). Thus, smart objects are not considered as equal to consumers, nor living their own experiences.

From the CASA approach, artificial social actors (such as smart objects) are personified and designed to express human characteristics relying on human-centric anthropomorphism. Consequently, objects are not considered on their own but defined according to their proximity with human social expressions. Relying on this paradigm, the master-servant dialectic cannot be used to explain how anticipatory anxiety emerges from the consumer-smart object relationship, as it requires the same ontological status between people and objects for recognition to emerge (Hegel 1977).

Smart objects and usual objects depart from one another in terms of capacities but also in terms of relationships in which consumers get involved with (Verhoef et al. 2017). Consequently, it is fundamental to reflect on the relationships consumers have with these smart objects in general. Strong support has been provided for considering smart objects on their own (Novak and Hoffman 2019, Schweitzer et al. 2019, Belk 2014). In that aspect, the CASA paradigm falls short and might not be adequate.

Hence, we must find the paradigm that will provide support for considering objects regarding their own ontology, rather than relying on paradigms where objects are assessed based on a human basis.

Human-centric anthropomorphism suggests a different ontological status between people and objects that refers to humans as superiors, or models, from which objects are assessed. According to MacInnis and Folkes (2017), using anthropomorphism implies that we evaluate objects according to human's attributes and characteristics, thus assuming that objects are defined according to humans. As stated by Hoffman and Novak (2018), humanizing objects in consumer-object relationships is naturally an appealing idea. Yet, smart objects differ from traditional objects in that they express tangible capacities to act independently. They show agentic abilities, stressing the traditional anthropocentric approach and stressing the need for considering them on their own terms (Novak and Hoffman 2019, Schweitzer et al. 2019).

## Part 1 – A theoretical approach of consumer-smart object interaction

Consequently, consumer-smart object relationships depart from what we currently know about consumer-object relationships. Smart objects are no longer passive entities, or possessions in which we infer meanings. They are now able to interact not only with consumers but also with other objects without consumer's intervention and according to their own agenda (Hoffman and Novak 2018). Indeed, their capacity to express agency makes them interactive entities according to their own terms, without any need for additional humanization (Schweitzer et al. 2019, Belk and Kniazeva 2018).

Thus, the relationships people engage with them do not depend on people's capacity to define and redefine the relationship, but also on the smart object's capacity to shape and modify the interaction (Fournier 1988, DeLanda 2011-2016, Belk 2014, Novak and Hoffman 2019). Therefore, "in addition to considering how consumers affect and can be affected by objects, it makes sense to consider how objects can affect and be affected by consumers" (Hoffman and Novak 2016, p.29).

Yet, this section has highlighted different interesting concepts that are summarized in the following table:

*Table 21 - Human-Oriented Ontology - Main concepts*

Framework	Concept	Definition
<b>The Human-Object Interaction Perspective (Belk 1988, Hoffman and Novak 2018)</b>	Human-Oriented Ontology	Considering humans as the central entity involved in the relationship, and objects as possessions invested with meanings.
	Object-Oriented Ontology	Considering objects as equal entities alongside humans, adopting a flat ontology, and assessing objects on their own, without attributing humanlike features to non-human entities.
	Extended Self	The degree to which people attribute meanings to their possessions, to the extent they become incorporated in a broader sense of extended self.
	Human-centric anthropomorphism	Humans are inferring human likeness to objects that objectively resemble to humans.
	Object-oriented anthropomorphism	Non-human entities showing agentic capacities that are usually held by humans. The human likeness is no longer inferred, but instead perceived by humans.

## Part 1 – A theoretical approach of consumer-smart object interaction

With the evolution of technology and the birth of virtual assistants, a digital world with new experiences emerged, requiring a shift from a human-centric approach to an object-oriented perspective (Belk 2014, Cila et al. 2017). Understanding the self in the digital and connected world require a deep understanding of the relationship between people and these new entities (Belk 2013). The IoT environment brings the opportunity to mix the digital and physical worlds. Smart objects are the physical emanation or material expression of new capacities (Hoffman and Novak 2015), highlighting the idea that a core self is an illusion, with a self constantly evolving through their interactions with objects (Clark 2003). Indeed, “non-human things are as important as humans in shaping behavior, history, technology and identity” (Belk 2014, p.1108). This indicates the necessity to consider not only the consumer experience, but also the object experience.

According to Weinberg and colleagues (2015), smart objects go beyond the simple characteristics of being connected to the Internet for collecting, receiving, and transmitting data. In line with this consideration, scholars have proposed to adopt an object-oriented ontology to talk about the extended sense of objects and the relational outcomes of consumers-smart objects relationships (Belk 2014, Novak and Hoffman 2019, Schweitzer et al. 2019, Cila et al. 2017, Lindley et al. 2017). Consumers are extending their self through interactions with other people and external objects (Belk 1988), forming networks of interactants (Hoffman and Novak 2018).

But as humans depend on objects, objects also depend on humans (Hodder, 2012), thus raising the necessity to consider objects on their own rather than mere possessions inferred with meanings, stressing the need for an object-oriented ontology to understand and represent consumers-smart objects interactions (Belk 2014, Hoffman and Novak 2018, Novak and Hoffman 2019, Mitew 2014, Kang and Him 2020).

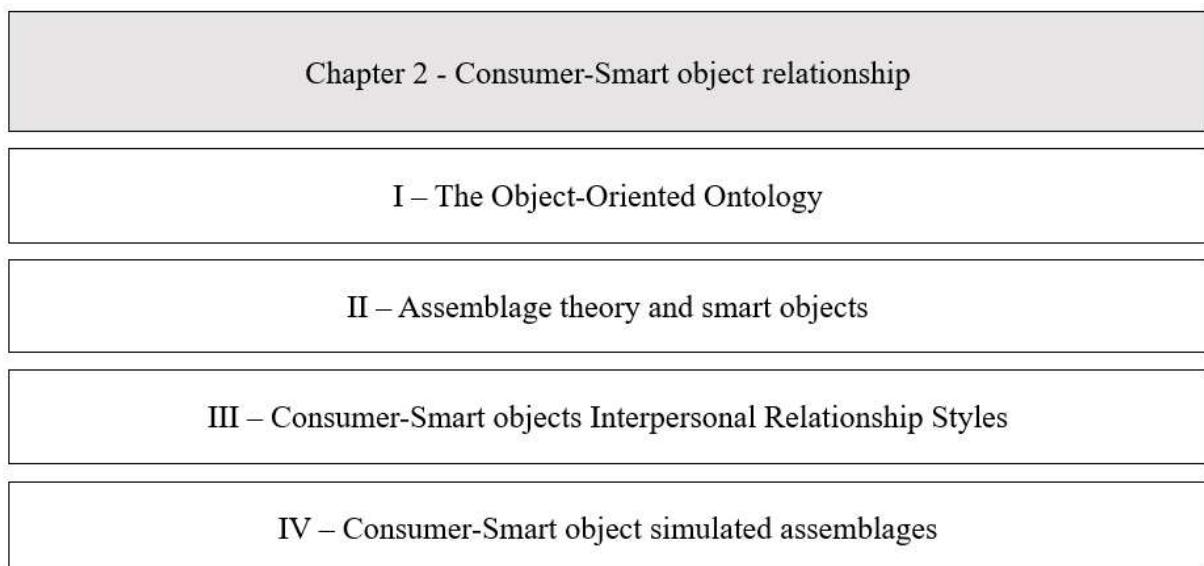
## Chapter 2 - Consumer-Smart object relationship

### Introduction to Chapter 2 – Consumer-Smart object relationship

The first chapter has allowed us to explore the literature of technology acceptance and resistance. It has shown the main theories, concepts, implications, and limits for considering smart objects as possessions. The first chapter has also highlighted the need to incorporate the social aspect of consumer-smart object interaction, especially relevant when assessing the questions of negative attitudes toward technology, anxiety, and domination.

To do so, this chapter is dedicated to the evaluation of consumer-smart object relationship from a relational and social perspective. We draw on the limits identified in the first chapter, a conceptualization of the consumer-smart object relationship under which interpersonal relationship styles can be relied upon to better explain ambivalence, negative attitudes, and resistance toward smart objects. Accordingly, a first part will expose the object-oriented ontology and its main principles. A second part will focus on the assemblage theory and its implications for the consumer-smart object interaction. A third part will explore the consequences for considering the interaction from an interpersonal relationship perspective. Finally, a last section will rely upon the mental simulation literature to conceptualize the anticipated interaction between consumers and smart objects, alongside its implications in terms of anticipated relational outcomes.

The chapter 2 will follow the organization exposed below:



*Figure 29 - Chapter 2 organization - Consumer-Smart object relationship*

## I- The Object-Oriented Ontology

At the beginning, technology was supposed to assist humans in their tasks providing utilitarian values as tools (Mumford 1961). Indeed, tools and machines are relied upon to assign painful or repetitive tasks humans were initially performing (Williams 2002). But with automation, and artificial intelligence embedded inside objects, they now depart from their initial function and challenge the natural human's perception of objects (Brangier 2002).

Accordingly, the nature of the relationship between people and smart objects departs from the previous relationship humans had with objects. From a utilitarian based interaction where objects were anthropomorphized to a more social and humanized interaction that originate from the smart object itself. “When the robot itself is perceived as making its own decisions, people’s perspective of computers as simply tools will change” (Duffy 2003, p.186). Consequently, it is no longer about accepting to adopt smart objects, but more about to accept to live and interact with smart objects as equal entities (Brangier et al. 2009).

The other conceptualization of consumer-object interaction, called object-oriented ontology, considers objects as equivalent to humans from an ontological perspective, supposing that both objects and humans have experiences stemming from interactions (Belk 2014, Hoffman and Novak 2018, Novak and Hoffman 2019, Lindley et al. 2017). This non-humancentric approach is not new and has gain even more influence since the emergence of the IoT (Cila et al. 2017). The object-oriented ontology provides the theoretical background for considering objects’ capacities to affect and be affected, giving the opportunity to better understand human-object relationship dynamics (Hoffman and Novak 2016).

Basically, humans are no longer the focus of the attention, but represents an actor inside a system of entities where each entity exerts an influence over both the system and other actors. This is the Actor Network Theory (ANT) approach. The ANT does not refer to a theory, but more to a framework where human and non-human agents are considered equal from an ontological perspective (Mitew 2014). An agent can be defined as an entity “situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future” (Franklin and Graesser 1997, p.25). This framework implies to “revoke the privilege of human actor and discuss the ontological symmetry of humans and nonhumans in networks of relations” (Cila et al. 2017, p.449).

## Part 1 – A theoretical approach of consumer-smart object interaction

According to Law (1999), the ANT posits that entities are defined by their interaction with other entities, thus the distinction between them is only “a result of their relations with other entities” (Law 1999, p.3). Consequently, humans and non-human entities are considered equal actors interacting between each other. Each entity can express agency by affecting or being affected by other entities. Agency can be defined as “the ability to act for producing effects” (Cila et al. 2017, p.449), or literally the capacity of an entity to act and react. According to Ingold (2011), this capacity can be perceived as a form of intentionality.

From the ANT approach, an entity refers to any agent that can initiate an action (Latour 1999). Consequently, object-object interactions must be considered from an ontological perspective equally to human-object interactions (Harman 2007). The most interesting aspect of the ANT is its assumption made about ontological status of all entities. Indeed, within this framework, all entities are considered equally with no ontological difference between agents, where both humans and non-humans are granted agency. This approach is called “flat ontology”, where the only difference between agents is their expression of agency and degree of interaction (Mitew 2014).

Within the ANT, humans and non-humans are seen equal in terms of essence but will differ based on their role as interactive entities (Law 1999). The ANT framework relies on two main principles: irreduction and translation.

As mentioned above, the ANT postulates a flat ontology between agents, which means any acting entity is equally considered from an ontological perspective, compared to any other entity. In this approach, “all entities – humans, animals, things and matter – have the same ontological status to start with” (Müller 2015, p. 28). An entity cannot be reduced to another and must be considered on its own, entities are irreducible (Mitew 2014). On the other hand, the translation principle refers to the constant flow of agency between entities that allow the distinction between them. Just as their essence, entities cannot be reduced to their interaction or to the data produced by their actions. Accordingly, any agents must be considered on its own, without hierarchical structures, living their own experiences. Therefore, objects have their own existence and experience, regardless of their interactions with humans or meanings inferred to them (Hoffman and Novak 2018, Cila et al. 2017).

One can argue that pretending objects can have experiences is a form of anthropomorphizing objects, which in turn remains a human-centric principle. Back to the ANT principles, the flat ontology perspective posits that objects do have experiences but differ from

## Part 1 – A theoretical approach of consumer-smart object interaction

human experiences. The object experience is not a humanization process derived from human experience, but an experience that is specific to objects and perceived by humans (Novak and Hoffman 2019). Object experience stems from the physical expression and “material resonance” of objects which can be perceived by other actors (Bogost 2012). But how could we understand and capture such metaphysical concept?

### Understand objects’ experiences

Unfortunately, the ANT approach does not provide enough material to measure and understand objects’ experiences. Indeed, both principles of irreduction and translation are inadequate to apprehend what occurs after translation and to catch this material resonance (Mitew 2014). For that purpose, Harman (2007) proposed the Object-Oriented Ontology. Based on the ANT conceptualization (irreduction, translation), the object-oriented ontology states that agents or acting things (objects, humans, animals...), capable of interacting and expressing agency, are considered equal entities (Lindley et al. 2017). But to understand what is beyond object experience, people must integrate objects experiential outcome as if they were ontologically human relational outcomes (Bennett 2010). In other words, the nature of objects’ experience is inaccessible by essence. However, relying on metaphors allow a better understanding of how objects’ experience is potentially structured (Novak and Hoffman 2019).

For that reason, the object-oriented ontology adds its own principle, the “anthropomorphic metaphor” trying to grasp the material resonance of objects. According to Bogost, humanizing things “is unavoidable, at least for us humans” (2012, p.65). However, the anthropomorphic metaphor differs from anthropocentrism. According to Bennett (2010), anthropocentrism refers to the attribution of human characteristics to non-human entities, while the anthropomorphic metaphor creates an “affective resonance” between human and non-human entities. The anthropomorphic metaphor is “a speculative analogy enabling humans to entangle what are otherwise profoundly alien artefacts” (Mitew 2014, p.16).

This principle refers to the object-oriented anthropomorphism (Hoffman and Novak 2015) and aims at considering object experience from the same prism as human experience to make it readable, even if they are living different experiences, with objects considered as sociable and conscious entities on their own (Bennett 2010). By relying on this metaphor, not only humans and objects are considered equal from the ontological perspective, but their experiences become intermingled.

## Part 1 – A theoretical approach of consumer-smart object interaction

Based on the ANT, objects are irreducible entities equally considered with humans (in terms of ontology). The distinction between humans and objects occurs during the interaction, where agents express different levels of agentic features. The object-oriented ontology and its anthropomorphic metaphor allow objects to be integrated “on the same ontological plain as their human interlocutors” (Mitew 2014, p. 18). “IoT as a field is susceptible to using descriptive metaphors, because many concepts of the field are rather abstract and the effect of its outcomes are difficult to grasp, which is what metaphors are good at overcoming.” (Cila et al. 2017, p.449). Consequently, objects and humans’ agencies will shape a structure of interactions, constantly evolving and dependent on the social interactions occurring among them, which can be accessed by humans through metaphors (Bogost 2012).

If we consider smart objects as more agentic, autonomous, or authoritative than traditional objects, almost expressing a form of free will, then they can no longer be associated to possessions or belongings (Lindley et al. 2017). Indeed, they depart from traditional objects and express tangible capacities to affect and to be affected according to their own decisions (Hoffman and Novak 2018). As they hold such capacities, they also pursue their own goals and interest (Novak and Hoffman 2019), contributing less to the building of one’s sense of self (Belk 1988, 2014).

As the literature mentioned it, possessions are more easily assimilated to the self when we can control them (McClelland 1951, Belk 1988), which is supported by consumers’ preference for smart objects perceived as less complex (Goudey and Bonnin 2016). With their agentic expressions, smart objects are raising themselves to the rank of interactive entities and active partners of interdependent relationships, stressing the meanings attributed to them during interactions (Fournier 1998, Schweitzer et al. 2019, Monsurrò et al. 2020). Indeed, when smart objects acquire agentic features, “they become tangible social actors and, from the perspective of their information imprint, indistinguishable from humans” (Mitew 2014, p.9).

With their capacity to express agency, smart objects can play active roles during interactions. The brand literature already emphasized that brands could be perceived as active partners of a relationship, able to affect and redefine the relationship with consumers (Fournier 1998). Thus, considering smart objects intrinsic capacities to actively shape, define and redefine the interaction with other entities (consumers and objects), we can posit that smart objects are getting engaged in their own experiences, independently from meanings attributed by

## Part 1 – A theoretical approach of consumer-smart object interaction

consumers (Hoffman and Novak 2018) with a consumer-smart object relationship that supposes interdependence between interactants (Fournier 1998).

According to Schmitt (2013), for consumer-object relationships to emerge, both consumer and object must have experience, with the nature of the experience driving the form of the relationship. Thus, assessing consumer-smart object relationships require to consider both the smart object's capacities to represent an active member of the relationship (Fournier 1998), and the meanings expressed through these capacities (Hoffman and Novak 2018).

Previous research on consumer experience consider that a direct or indirect interaction is necessary for experience to emerge (Brakus et al. 2009). Based on consumer experience definition, experience emerge through a holistic and multidimensional process that involves the consumer's cognitive, affective, social, and physical response (De Keyser et al. 2015, Verhoef et al. 2017, Hoffman and Novak 2016). Relying on smart object's capacities to collect, process and react to specific stimuli, it is therefore possible to suppose that a form of smart object experience is likely going to occur (Hoffman and Novak 2018). Indeed, these smart devices can interact in such a way that it involves the notion of awareness. Smart objects can initiate interventions (where they act on their own) and respond to others' actions, suggesting a form of awareness (Williams and Poehlman 2017).

Additionally, “how the consumer affects a smart object is as much a part of experience as how the consumer is affected by a smart object, even if their effects are not equal” (Hoffman and Novak 2018, p.1181). Consequently, studying consumer experience in consumer-smart objects interactions requires to understand through metaphors, smart objects' experience as well (Hoffman and Novak 2015). But how could we represent smart object's experiences?

Hoffman and Novak (2018) argue that experience emerges from interactions across different layers of experiences: Basic experiences, Aware Experiences, and Conscious Experiences.

- Basic experiences: They are the more fundamental level of experience that an entity can live. This layer of experience encompasses not only humans but also nonhuman entities. As smart objects possess the capacity to affect or to be affected thanks to artificial intelligence and machine learning, they are living basic experiences.
- Aware experiences: These experiences require basic experiences. Aware experiences are the processing of basic experiences. It involves the brain, or processing system in

## Part 1 – A theoretical approach of consumer-smart object interaction

filtering and ordering basic experiences. As some smart objects also possess capacities for collecting data, analysing, and processing inputs from basic experiences, we can consider that they can live aware experiences as well.

- Conscious experiences: At this level of experience, aware experiences are integrated in such a way that they produce subjective experiences. These subjective experiences are “something more than the consumer and the objects” (Hoffman and Novak 2018, p.1182). Conscious experiences also exist within different time frames (Roto et al. 2011) such as anticipated, momentary, episodic, and cumulative experiences and are not exclusively experienced by humans.

According to Hoffman and Novak (2018) smart objects already possess what refers to basic experiences. Smart objects, throughout their capacities to collect data, analyse and react according to their sensors and actuators, are living basic experiences on their own. Smart objects are not only capable of real time processing, but they can also learn from experience and improve. Based on this ability, the authors argue they can live aware experiences as well and attribute machine learning processes to brain processing systems.

However, attributing conscious experiences to smart objects remains a controversial opinion. Yet, if we rely upon the object-oriented ontology, understanding smart objects experience requires to not consider them from a human-centric perspective. If smart objects are considered according to their own terms, they also live their own experiences. While consumer experience involves all the interactions between consumers and other entities (how they affect or get affected) (Verhoef et al. 2009), smart object experience also involves all the interactions between smart objects and other entities (how they affect or get affected) (Novak and Hoffman 2019). Accordingly, from an object-oriented perspective, smart objects can be considered as potentially living conscious experiences (Hoffman and Novak 2018).

Existing theories of consumer-smart object relationship often rely upon the human-centric approach, which does not consider the emerging capacities of the consumer-smart object interactions from the object perspective, nor the object experience. This approach endorses “a largely passive view of experience as a receiver of brand or marketing-related stimuli and may not be sufficient to conceptualize consumer experience in the IoT” (Hoffman and Novak 2016, p.4). Smart objects can express smart features and agentic capacities. They have the capacity to

## Part 1 – A theoretical approach of consumer-smart object interaction

affect and to be affected by the relationship and interactions with consumers (Hoffman and Novak 2015). Thus, it is necessary to adapt theories of consumer experience to the IoT context.

Smart objects' capacities for interaction offer opportunities for interpersonal relationships to emerge (Fournier 1998, DeLanda 2016, Novak and Hoffman 2019). Smart objects can operate and interact with other objects, without consumer's intervention, suggesting that they are part of broader and more complex networks of interaction that does not involve the consumer (Keller 2012). Thanks to the object-oriented ontology, smart objects exist on their own terms and are parts of larger networks of interactants, giving them the opportunity to endorse expressive roles, to affect or be affected by interactions (DeLanda 2011, Novak and Hoffman 2019).

This section has highlighted several new elements, with the main concepts exposed below:

*Table 22 - The Object-Oriented Ontology - Main concepts*

Framework	Concept	Definition
The Object-Oriented Ontology (Law 1999, Mitew 2014)	Actor Network Theory	All agents have the same ontological status, involved in interactions forming networks of interactants, under which agents are living their own experiences.
	Anthropomorphic metaphor	Trying to understand non-human's experiences as if they were human, relying on object-oriented anthropomorphism to make it readable for humans.
	Object's experience	The set of basic, aware, and conscious experiences supposed to be experienced by non-human entities as part of human-object interactions.

The anthropocentric approach is challenged by the emergence of products that possess their own capacity to define themselves through ongoing interactions. Thus, by interacting with people and other objects, they slowly tend to express themselves according to their own terms, stressing the anthropomorphic process of attributing humanlike characteristics to inanimate objects. Object-oriented ontology applied to technological products emerged alongside smart objects capacities to act autonomously (Lindley et al. 2017). Consequently, new conceptualizations of consumer-smart objects relationships appeared across the marketing literature.

The assemblage theory for instance, relied on by Hoffman and Novak (2018) to understand consumer-smart objects interactions, provides an interesting framework of reference and recognizes equal ontological status between consumers and smart objects. Indeed, as they possess intrinsic capacities to express and interact by their own, they are no longer bound to

## Part 1 – A theoretical approach of consumer-smart object interaction

consumer' attribution of humanlike features (Novak and Hoffman 2019). Smart-objects' agentic expressions stress the emergence of socio-digital assemblages under which humans are challenged by objects in terms of “sociability, privacy and identity” (Mitew 2014, p.6).

Current paradigms (HCI, HRI, CASA) rely on anthropocentric mechanisms, trying to account for any similarity between objects and humans. However, smart objects depart from this conceptualization as they do not necessarily require the consumer's intervention to express agentic capacities, but also because they intrinsically operate as intelligent and conscious entities (Hoffman and Novak 2018, Schweitzer et al. 2019). That is why we need a conceptual framework, such as the assemblage theory, that relies on an object-oriented ontology to assess the consumer-smart object relationship.

### II- Assemblage theory and smart objects

#### *A- Definition of an assemblage*

Consumer-smart object interactions involve, continuously, social, and interpersonal relationships (Novak and Hoffman 2019, Monsurrò et al. 2020). Indeed, both consumers and smart objects hold capacities to interact, affect and be affected during their interactions (Hoffman and Novak 2018). In the future, smart objects will “intimately involve humans, i.e., humans and things will operate synergistically” (Stankovic 2014, p.7), which is already the case. People and smart objects are interacting in such a way that they initiate new interactions, forming networks of people and objects improving the consumer connectivity.

According to Verhoef and colleagues (2017), consumer connectivity can be conceptualized regarding the interaction people are engaged with both smart objects and their environment. Thus, they proposed a framework called POP (People – Object – Physical environment), in which the flow of continuous interaction between the three components initiates the emergence of new experiences and interactions. From this perspective, people are embedded in networks of interactions where the capacities held by smart objects can be relied on for achieving specific tasks, enabling the consumers (Verhoef et al. 2017).

## Part 1 – A theoretical approach of consumer-smart object interaction

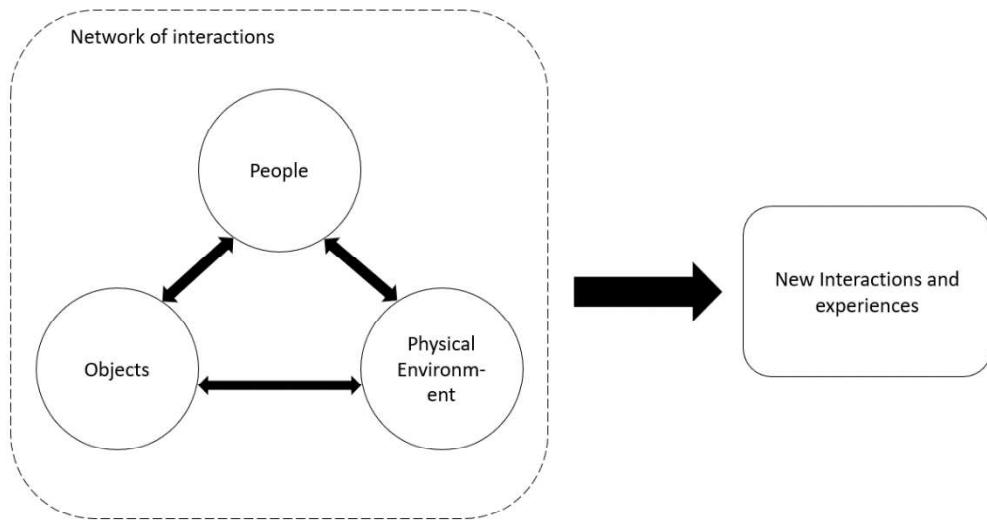


Figure 30 - The POP framework (Verhoef et al. 2017)

Smart objects are spreading throughout consumers' environments and the interaction with them will become soon unavoidable. Yet, "little is currently known about the different human-object relationships that consumers build with anthropomorphized smart devices and how these interact with their thoughts about, affection for and fantasies about these devices" (Schweitzer et al. 2019, p.2). As smart objects rely on collected data to act (through sensors and actuators), they can give the illusion of being conscious and intelligent entities (Rijsdijk et al. 2007). Accordingly, understanding the interaction of these devices with humans becomes crucial (Verhoef et al. 2017).

More importantly, this product intelligence perceived by consumers completely redefine the way people interact with smart objects, now considered as social actors (Bartneck et al. 2009). The human-centric approach does not consider ontologically objects as equal entities. Hence, describing the emerging relationship between people and smart objects requires to adopt an object-oriented ontology and theories of interpersonal relationships (Novak and Hoffman 2019).

One of the main contributions describing the dynamic of consumer-smart object interactions from an object-oriented ontology is the theoretical framework based on the Assemblage Theory (Deleuze and Parnet 1987, DeLanda 2006), provided by Hoffman and Novak in 2015.

## Part 1 – A theoretical approach of consumer-smart object interaction

Smart objects and consumers are connected to each other and interact in a way that they “represent a whole that is more than the sum of the parts” (Hoffman and Novak 2015, p.14). This “whole”, composed of interactive agents (consumers, objects) is called an “Assemblage”.

The assemblage theory developed by Deleuze and Guattari (1987) considers all interactants (people, objects) as equal from an ontological perspective, even if they don't possess the same capacities. DeLanda (2011) relied upon this theory to extend the concept of assemblages to humans and objects. This approach aims at studying how objects live their own experiences and to what extent it impacts consumer's experience (Hoffman and Novak 2015). According to Hill and colleagues (2014), the assemblage theory offers an interesting framework to understand the nature of things not from their substance, but from the relations they have with others.

Assemblages are defined as a set of “many heterogeneous terms which establishes liaisons, relations between them” (Deleuze and Parnet 1987, p.69). They are layouts of heterogeneous entities working together for a period of time, forming a whole, which result in relational outcomes (Müller 2015) where the outcomes are more important than the sum of all the entities (Deleuze and Guattari 1987). Accordingly, such relational outcomes would have not existed without interactions (DeLanda 2011). Therefore, studying both consumers and objects' influence over their assemblage becomes fundamental to understand their relationship and the experience they both live (Novak and Hoffman 2019, Prahalad and Ramaswamy 2004).

According to Müller (2015), assemblages are made of five structural dimensions:

- Relational: Entities are interacting and linked together in such a way that they form a whole. It consists of relations of “exteriority” (Deleuze and Parnet 1987). Thus, every single agent (humans, objects, animals) is independent (autonomy), and none of the agents alone can explain the relations that made the assemblage (DeLanda 2006).
- Productive: As interactions occur within the assemblage, the whole produce new behaviors, organizations, and realities. Thus, an assemblage is not a static representation of the reality.
- Heterogeneous: There is no hierarchy established in advanced between agents, neither assumption of the relations between them.
- Deterritorialization – Reterritorialization: Assemblages are constantly evolving, with moving agents, being added or removed. “Assemblages establish territories as they

## Part 1 – A theoretical approach of consumer-smart object interaction

emerge and hold together but also constantly mutate, transform and break up” (Müller 2015, p.29).

- Desired: Assemblages are made of fragmented items (agents). They emerge with continuous flows only because they are desired (no interaction means no assemblage).

In the Assemblage Theory, DeLanda (2006) emphasized that assemblages or even components hold properties and tendencies that determine its capacities:

*Table 23 - Assemblage's characteristics (DeLanda 2006)*

Property	Tendency	Capacity
A characteristic of the assemblage or a component, giving information about what it is (number of objects within the assemblage).	Indicates what the assemblage will become.	Elements that indicate what a component can do in the assemblage, the way it can affect or be affected.

Properties are intrinsic characteristics which can be relied upon for describing the assemblage (Hoffman and Novak 2015). Accordingly, properties indicate the nature of the assemblage. Tendencies emerge from the interactions between components of the assemblage and provide elements to understand what the assemblage can potentially become. As tendencies originate from components' interactions, they have a direct influence over both the properties and capacities of the assemblage (DeLanda 2006). According to Hoffman and Novak (2015), capacities represent the relational outcome initiated by both properties and tendencies. Hence, capacities indicate “how an entity can affect or be affected by another” (p.49). The following table provides an example of properties, tendencies, and capacities from a 10-year-old Child – Smart Vocal Assistant assemblage.

*Table 24 - Example of an assemblage properties, tendencies and capacities*

	Child	Smart Vocal Assistant
<b>Property (intrinsic characteristic)</b>	10 years old infant.	Supports voice input.
<b>Tendency (what they can become)</b>	Will grow up over time.	Will process better over time.
<b>Capacity (how it can affect or be affected)</b>	Can use teenage argot not recognized by the vocal assistant, restraining the interaction.	Can learn to recognize child's voice, enabling the interaction.

## Part 1 – A theoretical approach of consumer-smart object interaction

Components are basically actants, such as humans and smart objects. From this perspective, both consumers and smart objects possess properties allowing us to identify them as humans or objects. They also have specific tendencies that provide elements about what they will become based on their interactions. The sum of all these interactions determines the capacities, which indicate how they can affect and influence the assemblage or be affected by it.

As smart objects evolve in terms of functionalities and capacities, new interactions emerge with an assemblage constantly evolving. The interaction represents a flow of agentic features where the actants or components (humans, objects, animals) play expressive roles, which refer to the expression of their capacities (DeLanda 2011). As a result, components' expressed capacities or expressive roles lead to the emergence of new properties and capacities that define the assemblage (Hoffman and Novak 2016).

Applied to the IoT-context, assemblages can be defined as layouts of individuals and objects interacting with each other, endorsing expressive roles, and forming a whole, from which emerge capacities that none of the components are able to perform alone (Hoffman and Novak 2015). The assemblage identity is co-constructed between each component, based on their exercised capacities within the assemblage (DeLanda 2006). This fundamental conceptualization implies that smart objects can no longer be considered as mere “possessions” (Belk 2014), but instead, must be considered as autonomous and equal entities distinct from the consumer (Hoffman and Novak 2018).

The assemblage thinking gives us the perfect framework to better understand the ongoing interactions within the IoT context. Indeed, smart objects are investing our daily lives and huge amounts of information are collected and analysed through sensors. New assemblages are emerging, and some are only made of autonomous smart objects that interact together, without human intervention (Hoffman and Novak 2016). These assemblages emerge from new interactions between people and objects, raised by the unique properties of artificial intelligence.

Smart objects cannot be considered as traditional objects. Indeed, they can interact not only with consumers but also with smart and non-smart objects (Hoffman and Novak 2015). This capacity to perceive their environment and to trigger other components allow for the emergence of tremendous assemblages and opportunities (Novak and Hoffman 2019, Verhoef et al. 2017).

## Part 1 – A theoretical approach of consumer-smart object interaction

Smart object's capacities to affect and to be affected by its environment stresses the current human-centric approach of evaluating consumer experience (Hoffman Novak 2018). Indeed, with the evolution induced by smart objects, the interactions between consumers and the IoT based environment has changed. Smart objects are also living their own experiences, independently. As interactions shape identity (Belk 2014), it is necessary to reflect on the implications of such capacities over the consumer-smart object interactions and the consumer experience. Accordingly, consumer-smart objects relationship must be studied based on the assemblage from which their interactions take place (Hoffman and Novak 2018).

### *B- Consumer-smart object assemblages*

Regarding the smart home environment, Hoffman and Novak (2015) tried to identify the main underlying dimensions structuring the interaction between people and smart objects, adopting an object ontology perspective. In this paradigm, both objects and consumers are seen as equal entities. Using the assemblage theory, they conceptualized three dimensions of the consumer-smart object interaction: levels, time, and zones of interaction.

- Levels of interaction: agents, which are parts of the interaction, can play an expressive (high level) or material (low level) role during the interaction (DeLanda 2006). Material roles (low level) are defined as operational and functional, literally structural, and mechanical roles during the interaction. Whereas expressive roles (high level) are linguistic (through voice, body and facial expressions) and convey meanings and identity (such as words). Agents can play both material and expressive roles depending on their capacities. Interactions occur at both low and high level, leading to the emergence of consumer experience (Hoffman and Novak 2015).
- Time of interaction: “the choice of an appropriate time frame is necessary to clarify which aspect and scope of user experience are objectively in focus” (Hoffman and Novak 2015, p.81). Time span of consumer experience can be operationalized through four distinct moments (Roto et al. 2011):
  - Anticipated experiences: they occur before the real-life interaction and are indirect. They represent all the future imagined experiences one might simulate before a direct interaction.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Momentary experiences: they are actual interactions, which are direct and can be measured during the usage.
  - Episodic experiences: they are series of momentary experiences with a specific product.
  - Cumulative experiences: they represent series of both usage and non-usage periods used for evaluating retroactively a specific interaction.
- Zones of interaction: There are two zones of interactions, direct and ambient. Direct interactions refer to closed interactions between agents, while ambient interactions refer to ongoing interactions between agents as a system. Ambient interactions are more likely shaping the consumer experience because they contribute to building trust and homogenous assemblages with a more stable identity (Hoffman and Novak 2015).

Following Hoffman and Novak (2015) conceptualization of consumer-smart object interaction, consumer experience in a IoT-based environment can be defined as the experience emerging from the interactions between each agent (people and smart objects) of the assemblage and the consumer. Each agent expresses paired capacities (DeLanda 2016), meaning the “capacity to affect and to be affected during interactions with each other” (Hoffman and Novak 2015, p.86). Indeed, “the way we behave toward others affects the way others behave in return” (Cila et al. 2017, p.454).

While interacting between each other (humans-objects, objects-objects), agents from the assemblages acquire the status of social entities, as active members of the network, shaping, expanding, or reducing the social environment called the assemblage. Consequently, both humans and objects have the capacity to shape and re-shape the entire system, with their actions having a direct effect on others and over themselves (Hoffman and Novak 2015).

Consumer-smart objects assemblages can be assessed considering anticipated experiences, in other words, consumer experience can also emerge from imagined or anticipated interactions with smart objects. Consequently, the relational outcome of the interaction is not real, but still could represents positive or negative outcomes (Monsurrò et al. 2020).

## Part 1 – A theoretical approach of consumer-smart object interaction

Hoffman and Novak (2015) argue that consumer-IoT assemblages can be assessed through four dimensions: network, components, interaction, and programmability.

Table 25 - Characteristics of Consumer-IoT Assemblages (Hoffman and Novak 2015, p.17)

Network	Components	Interaction	Programmability
<ul style="list-style-type: none"><li>- The device is accessible (online or locally) without a need for logging in every time you use it.</li><li>- Physical devices are sending information through the Internet.</li><li>- Data storage can be on cloud.</li><li>- The device can be accessed remotely.</li></ul>	<ul style="list-style-type: none"><li>- Assemblages are heterogenous and are made from interactions between components (consumers, objects, and the data).<ul style="list-style-type: none"><li>- Objects can be sensors, actuators, and controlled non-smart objects.</li><li>- Components can perceive and react to their surroundings.</li><li>- Some components can interact autonomously.</li></ul></li></ul>	<ul style="list-style-type: none"><li>- Consumers and objects are interacting.<ul style="list-style-type: none"><li>- Objects can also interact with other objects, without human intervention.</li><li>- The interaction can be direct, time-delayed or scheduled.</li><li>- Each component can affect or be affected by the interaction.<ul style="list-style-type: none"><li>- Interactions sometimes happen without being specified in advance.</li></ul></li></ul></li></ul>	<ul style="list-style-type: none"><li>- Objects' capacities to interact stem from rules (software programs), elaborated by programmers.</li><li>- Objects can be controlled by rules elaborated by consumers (scenarios).</li><li>- Consumers can control objects using other objects (such as smartphones).</li></ul>

Following the reasoning of Hoffman and Novak (2015) and the definition of assemblages provided by DeLanda (2006) and Müller (2015), as the interactions occur between consumers, objects and data, emergent capacities rise from the assemblage. The assemblage is changing over time, with components being added or removed, indicating that the assemblage is constantly evolving.

The assemblage is not a set of predetermined components, but more an expanding space under which manifest components' experiences. Consumer experience emerges through interactions with components. Thus, to understand assemblages, interactions among all the components of an assemblage are more important than the components themselves (Hoffman and Novak 2015). This mechanism was also highlighted by Hoffman and Novak in 2018. They

## Part 1 – A theoretical approach of consumer-smart object interaction

argued that the experience was dependent on the number of devices interacting. The number of agents within the assemblage has an impact over the consumer experience. Indeed, as the number of interactive agents increases, the number of interactions also increases, leading consumers to start feeling a sense of proximity and togetherness. Thus, taken individually, agents are less important than the interactions that emerge from the assemblage which become crucial (Hoffman and Novak 2018).

Consumer-smart objects assemblages emerge according to specific interactions which involve consumers and smart objects. When consumers and smart objects interact directly, they get involved in “part-part interactions”. Conversely, when consumers or smart objects get involved in interaction with the assemblage instead of another component, they are engaged in “part-whole interactions” (Hoffman and Novak 2018).

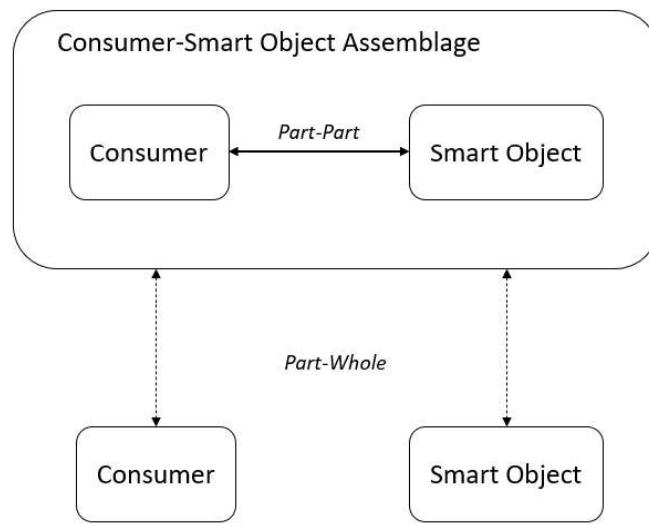


Figure 31 - Consumer-Smart Object Assemblage and Interactions

When consumers interact directly with smart objects, the interactions allow the emergence of a consumer-smart object assemblage. As the assemblage is made of components holding properties and capacities, the expression of their agentic capacities through interactions permits the emergence of new interactions and capacities from the assemblage. Accordingly, consumers might affect smart objects directly (part-part interaction) or indirectly (part-whole

## Part 1 – A theoretical approach of consumer-smart object interaction

interaction). Conversely, smart objects can also affect consumers directly (part-part interactions) or indirectly (part-whole interactions) (Hoffman and Novak 2018).

For instance, people might be directly engaged in interactions with a smart speaker talking with it and asking questions (part-part interactions). Thus, the consumer directly affects the smart object by enabling it and allowing the emergence of an assemblage. The interactions between the consumer and the smart speaker provide emerging capacities from which both the consumer and the smart object benefit (part-whole interactions). Consumers might benefit from the assemblage by finding the interactions convenient and useful, expanding the range of what he can do. While smart speakers might benefit from the ongoing interactions to improve and learn. These part-part and part-whole interactions contribute to the consumer experience and depending on the nature of the interaction, will shape the outcome of the relationship (Hoffman and Novak 2018).

Accordingly, trying to identify all possible interactions between consumers and smart objects can help to better understand the process under which both positive and negative outcomes emerge from the consumer-smart object relationship (Monsurrò et al. 2020).

### *C- Experiences and Emerging capacities of assemblages*

Assemblages emerge through ongoing interactions between consumers and objects, leading both consumers and smart objects to live experiences (basic, aware, or conscious). These interactions can be conceptualized regarding how each component interacts with other components and the assemblage.

According to Hoffman and Novak (2018), interactions can be either consumer-centric or nonconsumer-centric. Consumer-centric interactions involve the consumer as the central entity of the interaction, while nonconsumer-centric interactions only involve objects (Hoffman and Novak 2018). Hence, consumer-smart objects assemblages can emerge according to four different types of interactions, whether they involve consumers (consumer-centric and nonconsumer-centric) and the assemblage (part-part and part-whole):

- Consumer-centric part-part interactions: interactions between consumers and smart objects.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Consumer-centric part-whole interactions: interactions between consumers and the assemblage, where consumers are one of the interacting entities within the assemblage.
- Non-consumer-centric part-part interactions: between objects and other objects.
- Non-consumer-centric part-whole interactions: between objects and the assemblage, where consumers never get involved in the interactions.

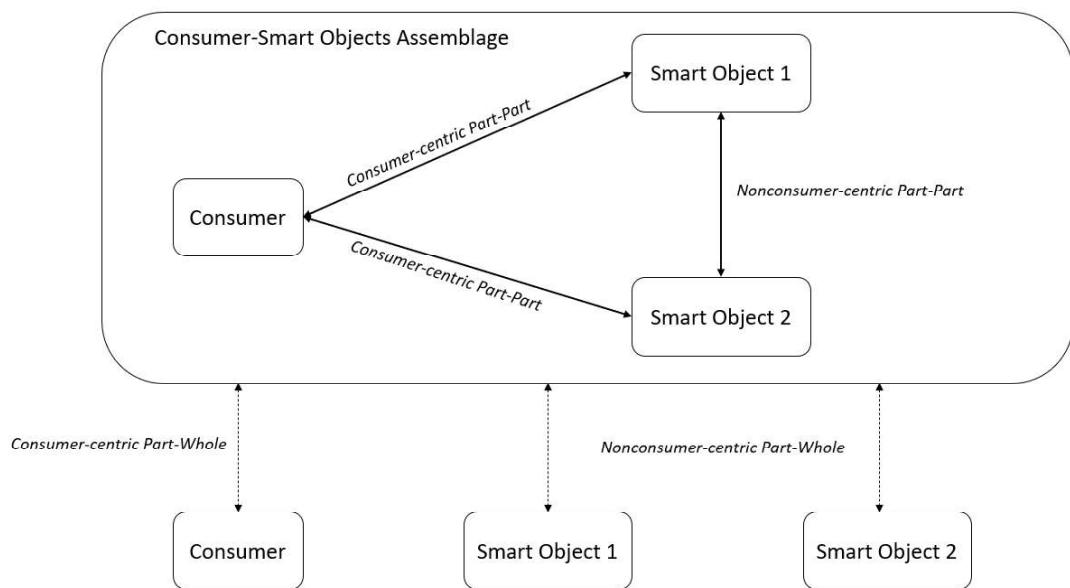


Figure 32 - Interactions from which emerge consumer-smart objects assemblage

The emergent capacities of the consumer-smart objects assemblage are defined according to the interactions occurring between the components, “as well as the expressive roles played by components during interaction” (Hoffman and Novak 2018, p.1184). The interactions occurring between consumers and smart objects are supposed to shape both the consumer experience and the emergent capacities of the assemblage (DeLanda 2011). Hence, studying the consumer experience means understanding these emergent capacities (Hoffman and Novak 2016).

To assess the emergent capacities of the assemblage, or its identity (Hoffman and Novak 2018), the three dimensions structuring assemblages must be relied upon (DeLanda 2006):

- Properties: to identify the components that constitute the assemblage, as well as what define the assemblage.

## Part 1 – A theoretical approach of consumer-smart object interaction

- Capacities: which indicates how the interactions occur in the assemblage, providing indications about what an entity (component or assemblage) can do, and how it can be affected.
- Tendency: the roles (material and expressive) endorse by the components, or the assemblage, define the meaning of the interaction and its outcome.

According to Hoffman and Novak, “properties specify what an assemblage is, capacities specify how an assemblage interacts, and material and expressive roles specify why the interactions have meaning” (2018, p. 1184). Consequently, the consumer experience can be seen as the properties, capacities and expressive roles endorsed within the assemblage.

Properties of a consumer-smart object assemblage originate from the capacities to affect and to be affected expressed by its components. These paired capacities and interactions determine what the assemblage is. The assemblage can also hold different capacities. According to Hoffman and Novak (2018), there are two categories of capacities: parts’ capacities to enable or constrain the whole, and the capacities of the whole to enable or constrain the parts.

Indeed, parts (consumers, objects) can express their capacities to affect the assemblage (enabling or constraining the whole). However, the assemblage, which had emerged from the interactions, now possesses its own capacities to affect its parts (enabling or constraining the components). Accordingly, capacities of a consumer-smart object assemblage can be seen as either a source of opportunities or impediments for its parts (Hoffman and Novak 2016, DeLanda 2016).

The properties and capacities expressed by the consumer-smart object assemblage allow for the emergence of a different relationship between consumers and the assemblage. As consumers get involved in part-whole interaction, they endorse expressive roles (enabling or constraining the assemblage) as well as the assemblage (enabling or constraining the consumer). Thus, the nature of the interaction between them becomes relational, with agentic and communal expressive roles at the basis of their relationship (Hoffman and Novak 2018, DeLanda 2011).

According to Hoffman and Novak (2018) when consumers interact with the assemblage, they can endorse both agentic and communal roles. Agentic roles refer to the capacities to act and react, or the ability of enabling or constraining the consumer-smart object assemblage.

## Part 1 – A theoretical approach of consumer-smart object interaction

Regarding enabling experience when consumers express agentic role, it refers to the consumer's capacities to enable interactions with the assemblage from which new capacities emerge. For instance, a consumer interacting with a smart home will enable the assemblage by engaging an interaction with the system. From this interaction, new capacities will emerge such as a scenario in which the object can close the entire lighting system from a hand clap.

Concerning constraining experience and agentic role, consumers can restrict the assemblage by removing components, or by limiting the interactions with the assemblage. If consumers exercise their capacities to impede the interactions, fewer capacities will emerge from the consumer-smart object assemblage.

Conversely, communal roles refer to the social connection with others, and sense of relatedness, appropriation, and cooperation (Schweitzer et al. 2019). It refers to the consumer-smart object assemblage's capacities to enable or constrain the consumer. Regarding enabling experiences where the consumer plays a communal role, people might integrate the assemblage emergent capacities as if they were their own. Thus, having the impression to have more capacities and feeling enabled by the assemblage. As regard constraining experiences and communal role, consumers might feel diminished by the assemblage emergent capacities, which constrain consumer capacities. Accordingly, the consumer has the sensation of having less capacities from being a component of the assemblage (Hoffman and Novak 2018).

Accordingly, four types of consumer experience can emerge:

- Self-expansion experiences: communal interactions resulting in the absorption of the assemblage's identity and capacities into consumer's identity.
- Self-extension experiences: the consumer enables the whole; thus, the agentic capacities of the consumer allow the assemblage to become more.
- Self-reduction experiences: communal interactions that result in the assemblage constraining the consumer. The assemblage expresses a communal role where the consumer feels reduced by the assemblage.
- Self-restriction experiences: the consumer constrains the whole; consumer's agentic capacities are constraining the assemblage.

## Part 1 – A theoretical approach of consumer-smart object interaction

*Table 26 - Enabling and Constraining experience from the Assemblage theory framework (Hoffman and Novak 2018)*

Type of experience	Consumer' agentic expressive role	Consumer's communal expressive role
Enabling experience	<b>Self-Extension:</b> <i>The consumer enables the assemblage.</i> New capacities emerge from the assemblage as the consumer enables the interactions.	<b>Self-Expansion:</b> <i>The assemblage enables the consumer.</i> The consumer feels enabled by the assemblage emerging capacities and treat them as if they were his own.
Constraining experience	<b>Self-Restriction:</b> <i>The consumer constrains the assemblage.</i> The consumer exercises his capacities to impede the interactions, limiting the emergence of assemblage's new capacities.	<b>Self-Reduction:</b> <i>The assemblage constrains the consumer.</i> The emergent capacities of the assemblage constrain the consumer, who feels reduced by being a component of the assemblage.

Self-extension experience originates from the theory of the extended self and refers to the extent possessions (physical or digital) can contribute to the sense of self (Belk 1988, 2014). According to Hoffman and Novak (2018), while interacting with smart object assemblages, consumers might extend their identity, inferring meanings to the assemblage. From the assemblage theory perspective, consumers might rely upon their agentic capacities to enable the interactions, eliciting the emergence of new capacities. Self-expansion experience stems from the communal expressive role endorsed by consumers while interacting with the assemblage. The communal expressive role occurs when the emergent capacities of the assemblage enable the consumer, who treat them as if they were his own. According to Hoffman and Novak “aspects of a consumer-object assemblage’s identity are absorbed into the consumer’s identity” (2018, p.1186). Consequently, the consumer feels enhanced by the assemblage and considers the emerging capacities as his own capacities.

Constraining experience of self-restriction refers to the consumer's agentic expressive role of impediment. This specific type of experience involves the expression of consumer's agency to restrict and hinder the interactions. The consumer uses his own capacities to limit the interactions, restricting the emergence of new capacities. Considering for instance a smart

## Part 1 – A theoretical approach of consumer-smart object interaction

speaker which can control other smart objects. If a consumer decides not to let the smart speaker controlling other objects, then he uses his own capacities to impede the interactions and limits the emergence of new capacities. Regarding self-reduction experience, the assemblage possesses emergent capacities of constraining the consumer. As the consumer endorses a communal expressive role, he feels reduced as being a component of the assemblage. A typical case could be the relationship between a consumer and an assemblage which imposes its authority. If the assemblage exercises emergent capacities that constrain the consumer, imposing a way to interact that does not satisfy the consumer for instance, he might feel reduced and diminished by interacting with the assemblage.

As a result, consumer experience emerges through enabling experiences of agentic self-extension and communal self-expansion, but also through constraining experiences of agentic self-restriction and communal self-reduction. According to Hoffman and Novak (2018), enabling experiences allow for the territorialization and stabilization of the assemblage identity. They contribute to the building of positive experiences and stable relationships through ongoing interactions. Conversely, constraining experiences are meant to elicit negative experiences and unstable relationships as they contribute to deterritorialization and destabilization of the assemblage.

During the interaction, consumers endorse specific roles. They can play agentic roles by enabling (self-extension) or constraining (self-restriction) the consumer-smart object assemblage. They can also endorse communal roles by feeling enabled (self-expansion) or constrained (self-reduction) by the consumer-smart object assemblage capacities.

More precisely, self-extension experience refers to the part (the consumer) enabling the whole (the consumer-smart object assemblage). The consumer expresses its capacities over the assemblage, by adding components for instance, or by enabling and allowing the interaction to take place within the assemblage. As a result, the assemblage gets new capacities that were not possible to reach alone. Regarding self-expansion experience, the whole (the consumer-smart object assemblage) enables the part (the consumer), where the consumer assimilates the assemblage capacities. The consumer feels expanding and integrates the assemblage capacities as if they were his own.

On the contrary, self-restriction experience refers to the part (the consumer) constraining the whole (the consumer-smart object assemblage). The consumer uses his own capacities to reduce the assemblage, by removing components, restraining components' capacities, or

## Part 1 – A theoretical approach of consumer-smart object interaction

impeding the interactions within the assemblage. Consequently, the assemblage is restricted by the agentic role of the consumer and fewer capacities emerge from it. Concerning self-reduction experience, the whole (the consumer-smart object assemblage) constrains the part (the consumer), with the consumer getting constrained by the assemblage capacities. Therefore, the consumer possesses less capacities by interacting with the assemblage (Hoffman and Novak 2018).

The conceptualization of consumer-smart objects assemblages allows for object experience to emerge. Indeed, as they are ontologically equivalent to consumers, we must also consider non-consumer-centric interactions. Thus, smart objects can also be the central entity of the interaction, endorsing both agentic and communal roles (Hoffman and Novak 2018). However, we must consider smart objects properties and capacities to better assess object experience.

According to Hoffman and Novak (2018), smart object's capacities to affect and to be affected can be assessed through three different layers that exist on continua:

- Agency: Which is the capacity to interact with other components, but still require human intervention.
- Autonomy: Represents the level at which smart objects operate independently, without human interventions, according to their own agenda.
- Authority: At this level, smart objects are operating autonomously and have the control over the way they interact with other components and how other components must respond to them.

Like consumer experience within the assemblage, smart objects are living their own experiences inside assemblages. Object experience is, by definition, unknowable, and specific to objects, but we can still rely on metaphors and comparisons with consumer experience (Hoffman and Novak 2018). The object experience is defined by “its emergent properties, capacities, and expressive roles. These represent the identity of the object experience assemblage derived from all the object-centric interactions.” (Hoffman and Novak 2018, p.1188). Thus, according to the authors the role expressed by smart objects in the relationship with other objects and consumers indicates the nature of the object experience. Accordingly, the level of agency holds by the smart object directly influence the type of experiences it is likely going to live (Novak and Hoffman 2019).

## Part 1 – A theoretical approach of consumer-smart object interaction

Smart objects have the capacities to enable or constrain an assemblage. Conversely, they can be enabled or constrained by the whole. Akin to consumer experience assemblage, four different types of object experience emerge:

- Object-expansion experiences: communal interactions resulting in the absorption of the assemblage's identity into object's identity.
- Object-extension experiences: the smart object enables the whole; thus, the agentic capacities of the smart object allow the assemblage to become more.
- Object-reduction experiences: communal interactions that result in the assemblage constraining the consumer. The assemblage expresses a communal role where the object is reduced by the assemblage.
- Object-restriction experiences: the object constrains the whole; object's agentic capacities are constraining the assemblage.

Table 27 - Object's experiences within the assemblage (Hoffman and Novak 2018)

Type of experience	Object's agentic expressive role	Object's communal expressive role
Enabling experience	<b>Object-Extension:</b> <i>The object enables the assemblage.</i> New capacities emerge from the assemblage as the object expresses its capacities to enable the interactions.	<b>Object-Expansion:</b> <i>The assemblage enables the object.</i> The object is enabled by the assemblage emerging capacities and integrate them as if they were his own.
Constraining experience	<b>Object-Restriction:</b> <i>The object constrains the assemblage.</i> The object exercises his capacities to impede the interactions, limiting the emergence of assemblage's new capacities.	<b>Object-Reduction:</b> <i>The assemblage constrains the object.</i> The emergent capacities of the assemblage constrain the object, which is reduced by being a component of the assemblage.

During the interaction, objects endorse specific roles, like consumer's roles. They can play agentic roles by enabling (object-extension) or constraining (object-restriction) the

## Part 1 – A theoretical approach of consumer-smart object interaction

consumer-smart object assemblage. They can also endorse communal roles by being enabled (object-expansion) or constrained (object-reduction) by the consumer-smart object assemblage capacities.

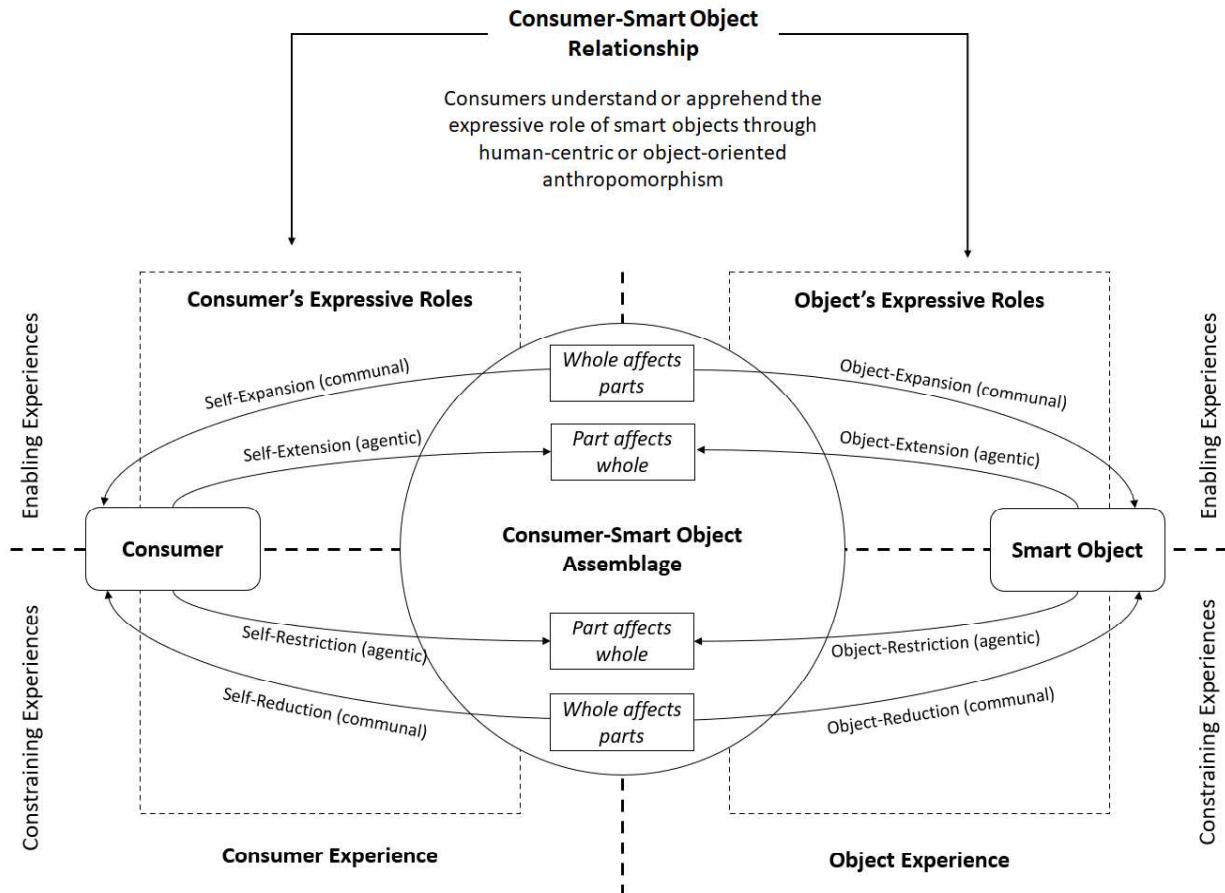
Object-extension experience refers to the part (the smart object) enabling the whole (the consumer-smart object assemblage). The smart object expresses its capacities over the assemblage, by adding components for instance, or by enabling and allowing the interaction to take place within the assemblage. As a result, the assemblage gets new capacities that were not possible to reach alone. Regarding object-expansion experience, the whole (the consumer-smart object assemblage) enables the part (the smart object), where the smart object is supposed to assimilate the assemblage capacities. The smart object is expanding and integrates the assemblage capacities as if they were its own.

On the contrary, object-restriction experience refers to the part (the smart object) constraining the whole (the consumer-smart object assemblage). The smart object relies on his own capacities to reduce the assemblage, removing components and restraining components' capacities or impeding the interactions within the assemblage. Consequently, the assemblage is restricted by the agentic role endorsed by the smart object and fewer capacities emerge from it. Concerning object-reduction experience, the whole (the consumer-smart object assemblage) constrains the part (the smart object), with the smart object supposed to be constrained by the assemblage capacities. Therefore, the smart object is deemed to possess fewer capacities by interacting with the assemblage (Hoffman and Novak 2018).

The assemblage theory provides a strong conceptual grounding for defining both the consumer and object experience. According to Novak and Hoffman (2019), following the assemblage theory and the object-oriented ontology, the consumer-smart object relationship can be defined as the interactions between people and smart objects, where experience stems from the interactions. Consequently, consumers might try to understand or apprehend the relationship with smart objects according to their experience. However, as object experience remains inaccessible for humans (because in essence, only belongs to smart objects), consumers will try to assess such experience based on the meaning attributed (human-centric anthropomorphism) or perceived (object-oriented anthropomorphism) regarding the object experience, expressive roles, and capacities (Novak and Hoffman 2019). Hence, the outcome of the relationship (positive or negative) originates from both consumer and object experience as perceived by consumers (Hoffman and Novak 2018, Novak and Hoffman 2019, Schweitzer et al. 2019).

## Part 1 – A theoretical approach of consumer-smart object interaction

Figure 33- Consumer-Smart Object Relationships - Novak and Hoffman (2019).



Hence, this section has come across different concepts, which are exposed below:

Table 28 - Assemblage theory - Main concepts

Framework	Concept	Definition
The Assemblage Theory (Deleuze and Guattari 1987, Hoffman and Novak 2018)	Assemblage	Layouts of heterogeneous entities interacting together for a period of time, forming a whole, which result in relational outcomes where the outcomes are more important than the sum of all the entities.
	Part-Part interaction	A direct interaction between two entities.
	Part-Whole interaction	An interaction between one entity and the entire assemblage.
	Consumer-centric interaction	Interactions that involve the consumer.
	Nonconsumer-centric interaction	Interactions that do not involve the consumer.
	Constraining experiences	The entity is either using its capacities to restrict the assemblage (self-restriction) or is reduced by the assemblage emerging capacities (self-reduction).
	Enabling experiences	The entity is either using its capacities to enable the assemblage (self-extension) or is enabled by the assemblage emerging capacities (self-expansion).

## Part 1 – A theoretical approach of consumer-smart object interaction

The literature has shown the extent to which consumers can get involved in relationships with inanimate objects, considered as mere possessions, playing a significant role in the emergence of consumer's identity and sense of self (Belk 1988, 2013, Fournier 1998). With the evolution of technology, previous research has relied on anthropomorphism, trying to understand the impact of emerging technologies over consumers' behavior.

However, with the rise of IoT and smart objects, the nature of relationships between these objects and consumers must be reconsidered under an object ontology perspective (Novak and Hoffman 2019, Lindley et al. 2017). Indeed, Hoffman and Novak (2018) argue that smart objects are living their own experiences independently from consumer's needs and wants. More interestingly, the object ontology perspective not only considers objects' identity as independent from consumers, but also from the brand or company selling the object (Lindley et al. 2017). Smart objects' capacities to interact are challenging the conventional anthropomorphic perspective as they live their own experiences (Hoffman and Novak 2018). The need for an object-oriented ontology "has been made more apparent because things are becoming networked and increasingly designed around their ability to communicate and interact with one another" (Lindley et al. 2017, p.2848).

This capacity to interact between objects, without human intervention, can also influence the emergence of fear and apprehension. According to Mitew (2014), IoT products can interact between them, socializing between objects with no human presence. Thus, object-object relationship becomes inaccessible to humans as part of a parallel environment. This aggregated set of agentic objects associated with the lack of information increases the uncertainty in anticipating objects' actions, leading humans to develop apprehension, which translates into an anticipated object experience.

This uncertainty can potentially stem from smart objects' hybrid nature. According to Lindley, Coulton and Cooper (2017), smart objects can be assessed through two different perspectives:

- Smart objects as tools: Smart objects are facilitating the consumer's life. They play a significant role in helping consumers to reach their goals. They are "used" for certain tasks related to consumers.
- Smart objects as independent entities: While it is true smart objects can be used by consumers, they also follow their own agenda and perform tasks that are not related to consumers. These tasks are specific to smart objects.

## Part 1 – A theoretical approach of consumer-smart object interaction

The first conceptualization of smart objects (as tools) refers to the traditional approach of technology acceptance models. This conceptualization is also relied on in the *User-Service Provider* framework proposed by Clark and Mils (1993). According to them, objects are service providers that are used by consumers for specific tasks they were purchased for. Thus, objects are only fulfilling the needs and wants of users, with no consideration for any relational outcome nor their essence as conscious entities.

This perspective does not fully grasp smart objects' characteristics and expressive roles they endorse during the interaction with consumers. Such frameworks are not ideally suited for assessing the impact of smart objects capacities over consumer behavior (Monsurrò et al. 2020). Indeed, smart objects are not only anthropomorphized (due to their capacities), but they also challenge the human-oriented perspective that considers humans as the unique pole of the relationship with external entities (Lindley et al. 2017).

One way to better understand the consumer experience is to “blend the anthropomorphism theories with the emergent theories of the digital self and the assemblage theory of the Internet of Things” (Belk and Kniazeva 2018, p.695). As people tend to rely on others during interaction, through close relationships (Reimann and Aron 2009), such mechanism can also happen between consumers and smart objects when they are considered from an object-oriented perspective.

Based on the object-oriented ontology, the assemblage theory and the circumplex model of interpersonal relationship, Novak and Hoffman (2019) provided an interesting framework for understanding the consumer-smart object relationship styles. As both consumers and smart objects are considered equal entities, they represent distinct and unique components of the same assemblage under which they both endorse agentic and communal expressive roles. The consumer and the smart object can affect the assemblage (agentic expressive role) but can also be affected by the assemblage (communal expressive role). These agentic and communal expressive roles are the “dimensions underlying the perspectives people take in social relationships. The circumplex model of interpersonal complementarity elegantly captures this reciprocity in these fundamental expressions.” (Novak and Hoffman 2019, p.224).

By considering all the possibilities of different expressive roles hold during interactions (from both consumers and smart objects), we can map the relationship between consumers and smart objects according their agentic and communal roles, and thus, identify the relationship styles that trigger anticipatory anxiety and negative relational outcomes.

### III- Consumer-Smart Objects Interpersonal Relationship Styles

#### *A- Interpersonal Relationships*

Since the emergence of interpersonal theories in the 1940's, researchers have tried to understand interpersonal motives to explain the mechanisms behind social interactions (Kiesler 1996). Researchers have tried to predict and understand human behavior. They have often relied on behavioral dispositions (Ajzen 1991), yet the influence of interpersonal relationship outcomes on consumer behavior remains neglected (Monsurrò et al. 2020). According to Novak and Hoffman (2019), the relational outcome of the consumer-smart object relationship can be assessed according to their expressive roles, in other words, the agentic and communal roles endorsed during the interactions.

Consumers and smart objects can express agentic roles by enabling the interactions (the consumer triggers a smart speaker by vocally activating it and the smart speaker enables the interaction with the consumer by reminding an appointment through notifications for instance), or by constraining the interactions (the consumer disables the voice interactions with a smart object, or a smart object that decides to operate according to its own agenda, hindering the interactions with consumers).

Consumers and smart objects can also express communal roles by being enabled by the assemblage (the interactions allow both the consumer and the smart object to do more with the emerging capacities originating from the interaction) or by being constrained by the assemblage (the interactions reduce both the consumer and the smart object, having less capacities from being components of the assemblage).

The dynamic between agentic and communal roles expressed by the components (consumer and smart object) allows the emergence of consumer and smart object's experience, with the type of relationship indicating the nature of the relational outcome, either positive or negative. The object experience is understood by consumers, relying on anthropomorphism metaphors (object-oriented) to rationalise the smart objects capacities (Bogost 2012). Accordingly, the expressive agentic and communal role expressed by smart object is supposed to influence consumer experience and response (Hoffman and Novak 2018). The literature of interpersonal relationships provides an interesting framework for representing this dynamic (Novak and Hoffman 2019).

## Part 1 – A theoretical approach of consumer-smart object interaction

While interacting, agents are expressing different levels of agency, their capacity to affect, but are also expressing different level of communalism, their capacity to be affected. According to Kiesler (1996), while interacting with people, individuals are seeking complementary responses from their interactants. Interpersonal relationships naturally involve the expression of interactants' dominance (agency) and communion (cooperativeness) (Kiesler 1983). Indeed, according to Horowitz et al. (2006) interpersonal motives can be subdivided into two distinct motives: communal motives and agentic motives.

Communal motives refer to the need for connection and willingness to engage in larger union with others, whereas agentic motives focus on the individual's capacity to control and dominate others and the environment (Horowitz et al. 2006, p.69). The levels of agency and communalism expressed by two individuals indicate how stable or unstable a relationship between them can be. For interacting, people tend to seek for opposite agentic roles (a dominating individual with a dominated individual) and similar willingness to engage into the relationship (a cooperative individual with another cooperative individual). Thus, social interactions are structured by complementary interactions which imply similar levels of communion (correspondence) and opposite levels of agency (reciprocity) (Pincus and Ansell 2003, Novak and Hoffman 2019).

Complementary interactions can be graphically represented with two orthogonal dimensions (Horowitz et al. 2006):

- *Affiliation*: A horizontal axis that encompasses unfriendly to friendly behaviors. Individual's and interactant's behaviors are supposed to be similar regarding to affiliation. This concept has also been labelled as *communion*.
- *Dominance*: This vertical axis ranges from dominating to submissive behaviors. Individual's and interactant's behaviors are supposed to be reciprocal regarding the control and dominance they express. This concept refers to *agency*.

The combination of individuals' levels of dominance and affiliation permits the graphical representation of the relationship, making suppositions about the relational outcomes. This framework refers to the interpersonal circumplex model (Kiesler 1983-1996, Pincus and Ansell 2003, Horowitz et al. 2006) and allow for the representation of the “particular combinations of expressive roles of both consumers and objects” (Novak and Hoffman 2019, p.18). The circumplex can be defined as a “specific structure of similarities among content types that belong to one construct domain (e.g., types of interpersonal behavior)” (Nagy et al. 2019, p.1).

## Part 1 – A theoretical approach of consumer-smart object interaction

Accordingly, it becomes possible to map people's behavior regarding their degree of dominance and cooperativeness (Novak and Hoffman 2019).

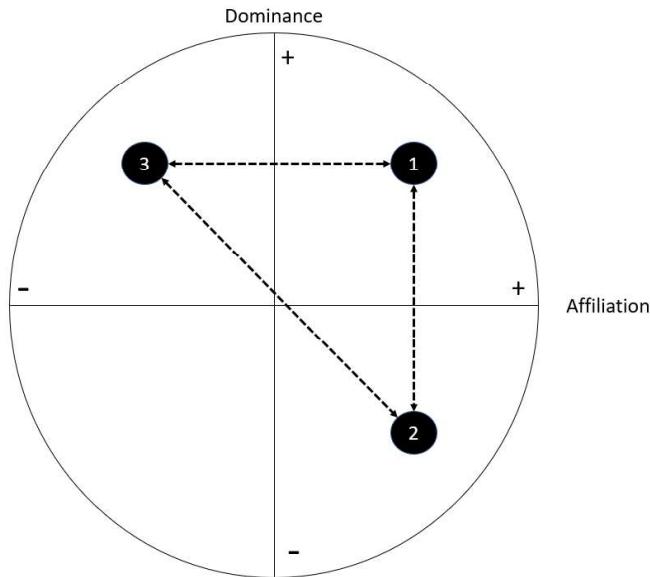


Figure 34 - Interpersonal Circumplex Model

In the figure above, three relationships are represented: (1) the relationship between the individual n°1 and n°2, (2) the relationship between n°1 and n°3, (3) and the relationship between n°2 and n°3.

- (1) The individual n°1 expresses a high level of dominance and affiliation, indicating an expression of a high agency and communalism. Regarding n°2, the level of affiliation is similar, yet the level of dominance expressed by n°2 is lower. Accordingly, the relationship between n°1 and n°2 will involve a domination from n°1 over n°2, and a strong sense of connectedness and cooperativeness expressed by both. Thus, the relationship between n°1 and n°2 can be seen as a positive and stable master-servant relationship, which is likely going to provide positive relational outcomes and experiences (Novak and Hoffman 2019).
- (2) Conversely, the relationship between n°1 and n°3 involves the same expression of dominance, and different levels of affiliation. The n°1 expresses positive sense of cooperativeness, while n°3 hold a negative level of affiliation. Thus, the relationship between n°1 and 3 is non-reciprocal in terms of domination and non-correspondent in terms of affiliation, suggesting an unstable relationship that will not last from which negative experiences can emerge (Novak and Hoffman 2019).

## Part 1 – A theoretical approach of consumer-smart object interaction

(3) Finally, the relationship between n°2 and n°3 involves both opposite levels of domination and affiliation, suggesting an unstable master-servant relationship with either positive or negative experiences emerging from the interactions (Novak and Hoffman 2019).

The interpersonal circumplex model represents through two dimensions (agency and communion), the relationship between individuals according to their expression of dominance (agency) and affiliation (communality or communion). According to Pincus and Ansell (2003), this model is relied upon for assessing interpersonal relationships and provides the opportunity to map individuals' behavior according to their expressive role during the interaction. Accordingly, "the circumplex model is a particularly good choice for representing the relationships between consumers and objects in dynamic consumer-object assemblages" (Novak and Hoffman 2019, p.20).

The circumplex model of interpersonal relationships is particularly efficient for mapping the motives behind the behavior, induced by the reaction of a partner (Horowitz et al. 2006) and relationship goals (Locke 2000).

Accordingly, the circumplex of interpersonal relationship can help understanding the consumer behavioral response regarding the smart object's expression of domination and communion (Novak and Hoffman 2019). Indeed, not only humans can express agentic and communal roles. Objects and nonhuman entities can also endorse agentic and communal expressive roles.

In the branding literature, Fournier (1998) argues consumer-brand relationships can be assimilated to interpersonal relationships when they fulfil four conditions:

- First, the exchange between the consumer and the brand must be reciprocal and implies interdependence, they must be active members of the interaction.
- The relationship must be structured by meaningful interactions and for a purpose.
- The relationship provides a wide range of benefits for the interactants.
- The relationship constantly evolves according to the ongoing interactions between active members who engage them.

Brands can be considered as active partners and assimilated to interpersonal interactants when they express meaningful capacities to define and redefine the relationship with

## Part 1 – A theoretical approach of consumer-smart object interaction

consumers. To consider the consumer-brand relationship as interpersonal, the relationship must be reciprocal and interdependent, which refers to the concept of complementarity (reciprocity of agency, correspondence of communal). Hence, this conceptualization of interpersonal relationships can be applied with consumer-smart objects interactions as well. Indeed, they both possess the capacity to affect others and to be affected by others (Hoffman and Novak 2015). Thus, we can graphically represent the relationship patterns of consumer-smart object interaction according their agentic and communal expressive roles.

According to Novak and Hoffman (2019) relationship patterns between consumers and objects interactions derive from the expressive roles (agentic and communal) they endorse during the interactions. They both have the capacities to enable or constrain the interaction. This dynamic between levels of agency and communal can be apprehended through the circumplex model of interpersonal complementarity.

This model posits that individual's behavior can be graphically represented through two main axes: agency and communion; allowing for a mapping of joint interpersonal styles of interactions (Horowitz et al. 2006). Consequently, the agency and communal expressed by consumers and smart objects bring out specific patterns of their relationship (Novak and Hoffman 2019).

According to Locke (2015), a high expression of communion indicates the willingness to enhance cooperation and the feeling of closeness, while a low expression of communion shows a feeling of vulnerability. Regarding agency, a high level of agency expressed by an individual indicates the willingness to dominate and gain control over the relationship, while a low level of agency shows the intention to avoid rivalry.

This reciprocity is well captured by the notion of complementarity (Horowitz et al. 2006). The concept of complementarity is characterized by two attributes (Novak and Hoffman 2019):

- Reciprocity on agency: meaning opposite values on agency. Complementarity patterns posit that agentic roles are deemed reciprocal when they are opposed in terms of agency.
- Correspondence on communion: meaning similar values on communion. Complementarity patterns suppose that communal roles are correspondent when they hold similar levels of communal.

## Part 1 – A theoretical approach of consumer-smart object interaction

Using the circumplex model of interpersonal relationships, Novak and Hoffman (2019) brilliantly identify four different patterns of consumer-smart object relationships. These relationship styles allow for a better understanding of the consumer experience within the IoT:

- (1) Master-Servant relationships (complementary relationships): This relationship style is structured by complementarity, where both consumers and smart objects express a similar level of communality (correspondence), but opposite values of agency (reciprocity). This relationship pattern is one of the most stable and lasting. Indeed, individuals within complementary relationships are engaged in the interactions and prone to resolve conflicts between them.
- (2) Master-Servant relationships (non-correspondent relationships): This relationship style is a semimorphic acomplementary pattern where consumers and smart objects hold opposite values on agency (reciprocity) and on communion as well (non-correspondence). The relationship style refers to master-servant as both consumers and smart objects express different levels of agency. However, this pattern is less stable than the first due to opposite values on communion. Hence, interactions are deemed to be less stable and brief.
- (3) Partner relationships: They are considered as isomorphic acomplementary relationship style where consumers and smart objects hold similar values on agency (non-reciprocal) and on communion (correspondence). Within this pattern, consumer tend to experience frictions with smart objects as they both express the same level of agency. That is the reason why they will tend to shift toward a complementary pattern, trying to differentiate themselves in terms of agentic roles.
- (4) Unstable relationships: This relationship style is referred as anti-complementary. Within this unstable pattern, consumers and smart objects hold the same level of agency (non-reciprocal) and opposite values on communion (non-correspondence). This relationship style is considered the least stable pattern leading to avoidance and product abandonment.

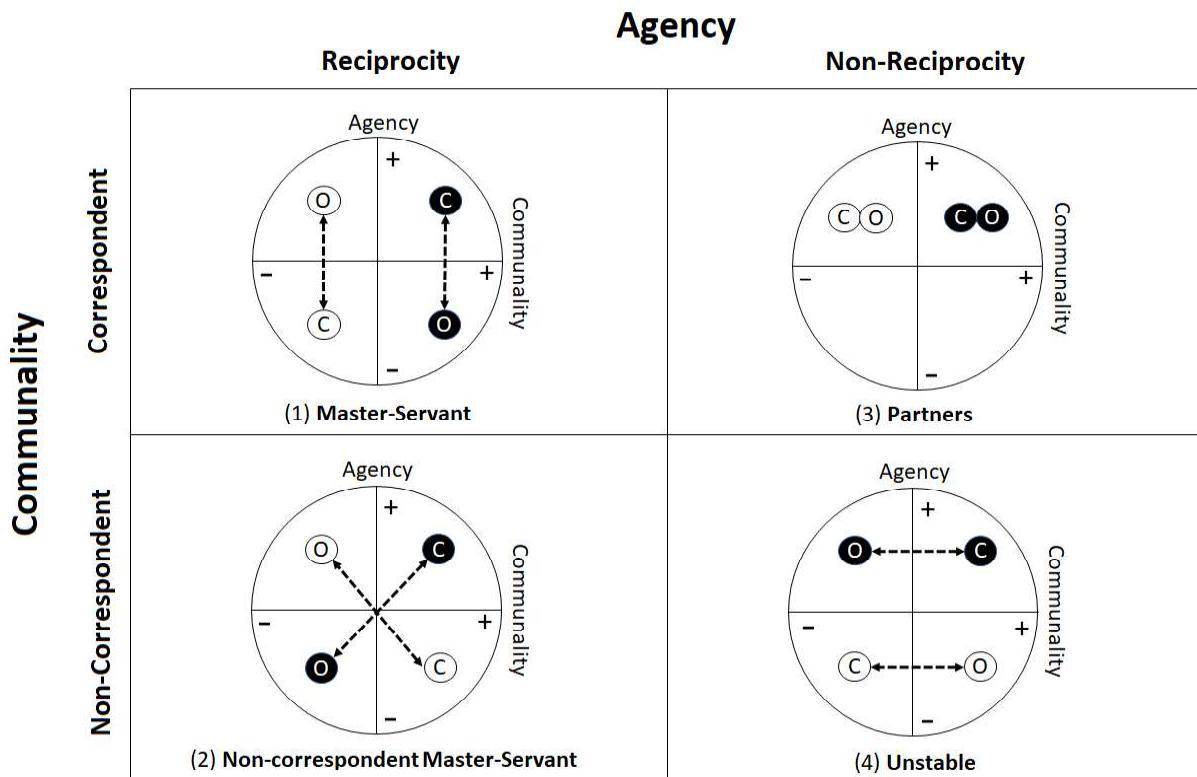


Figure 35 - Relationship styles defined by the Interpersonal Circumplex Model - Novak and Hoffman (2019)

The literature already emphasized the existence of interpersonal relationship styles of “partners” and “master-servant” between consumers and smart objects (Schweitzer et al. 2019, Belk and Kniazeva 2018). Nevertheless, the conceptualization of Novak and Hoffman (2019) offers a complete model to fully understand consumer-smart objects potential relationships. Relying on both the assemblage theory and the circumplex model of interpersonal relationships, Novak and Hoffman subtly managed to “connect relationship styles to consumer experience” (2019, p.21) applied in the IoT context.

Consumers are not only assessing smart objects’ value through their technical characteristics, but also consider interpersonal relationships outcomes as important, leading to positive or negative real-life experiences (Novak and Hoffman 2019). Consequently, it becomes essential to examine how these experiences emerge from the relationship patterns and real-life interactions, to understand how similar experiences might occur regarding anticipated interactions.

*B- Master-Servant relationship styles*

Master-servant relationships are defined in the literature as relationships where both agents feel closeness, and at the same time experience disparity in terms of power and control, leading the servant to lose freedom (Coser 1973). This definition supposes closeness, directly referring to the concept of communalism, and disparity in control, meaning different agentic expressions. In the interpersonal relationship literature, positive interactions are those deemed reciprocal (opposite values of agency) and correspondent (similar levels of communion) (Pincus and Ansell 2003).

Such relationship pattern can be observed regarding consumer-smart object interactions. The research of Schweitzer and colleagues (2019) for instance, highlights the existence of different types of relationships between consumers and voice-controlled smart-assistants (VCSA). According to the consumers' description of the interactions with VCSA, there are three kinds of relationship patterns:

- (1) Consumer master – VCSA servant relationships: The VCSA is serving the consumer, it expresses low agency. The object is used by the consumer. Depending on the degree of correspondence between the consumer and the VCSA, this pattern is related to the A1/A3 (master-servant complementary) or B1/B3 (non-correspondent master-servant) relationship styles exposed above.
- (2) Consumer servant – VCSA master relationships: The VCSA expresses high agentic features where the consumer feels dominated by the object (low level of agency expressed by the consumer). According to the outcome of the relationship (positive vs negative experiences) we can relate this pattern to master-servant (A2, A4) or non-correspondent master servant (B2, B4) relationships.
- (3) Partners relationships: Both the VCSA and consumers express the same level of agency and communion. Positive partners relationships result in the appropriation of the object to the extended self. Based on the experience lived by the consumer (positive or negative) we can relate this pattern to the Partner relationships style exposed above.

## Part 1 – A theoretical approach of consumer-smart object interaction

When consumers perceived the VCSA as servant they tend to attribute three different roles to the smart object:

- VCSA as a *helper*: The smart object is anthropomorphized such as being seen as a helpful tool to perform specific tasks for which it has been made. When they are considered as helpers, they tend to be seen as lower agentic component of the relationship. This role of helper allows for the emergence of positive and friendly experiences.
- VCSA as a *doll*: Within this role, the VCSA is still considered as a tool which is being used for specific tasks. However, consumers tend to perceive an overdependence of VCSA to users' actions. VCSA are seen as servants or slaves that consumers trigger whenever they want. Thus, the consumer tends to anthropomorphize the VCSA as a doll, that only reacts to consumer' agency, without the capacity to contradict the order. With the VCSA as a doll, consumers tend to enjoy the interaction, incorporating the smart object to their extended self, allowing for the emergence of positive self-extension experiences.
- VCSA as a *dog*: When the relationship between consumer and the VCSA becomes too interdependent and with a VCSA expressing a low level of agency, the relationship tends to switch from a master-servant to a master-dog relationship pattern. The smart object is anthropomorphized as a faithful companion that can be compared to a pet. Thus, the VCSA is still perceived inferior in terms of agentic role but provide a sense of togetherness. However, such pattern involves positive experience of self-extension if the interaction remains for simple tasks. When more complex tasks are being asked to the VCSA, insufficiencies emerge, and negative experiences arise from the perception of interacting with a dumb object instead of an intelligent companion.

On the other hand, when consumers perceive the VCSA as the master of the relationship, they tend to “consider themselves as slaves who had to obey to the VCSA’s rules and regarded the human–object relationship as perverted or reversed” (Schweitzer et al. 2019, p.14). According to the authors, consumers had the sensation of being dependent, servant of the relationship, apprehending the smart object’s autonomy. Consequently, fear of not being able to control the relationship emerges, leading to negative experiences and reluctance, as “respondents who saw the VCSA as a servant were more ready to use the VCSA in the future than those who regarded it as a partner or a master” (p.16).

## Part 1 – A theoretical approach of consumer-smart object interaction

The conceptualization of master-servant relationship patterns from Schweitzer and colleagues (2019) slightly differs from Novak and Hoffman (2019) representation of consumer master-smart object servant relationships. Indeed, according to Schweitzer and colleagues (2019), self-extension experiences lead to the appropriation of the smart object into the extended self. Thus, smart objects are represented as interacting belongings integrated to the self. Conversely, Novak and Hoffman (2019) representation of self-extension experiences involve agentic expressive roles with a smart object expressing a low level of agency, and a consumer with a high level of agency. Thus, self-extension experiences do not imply the integration of smart objects to the self but remains a matter of agentic expressions.

From Novak and Hoffman perspective, objects live their own experience. Yet, smart objects expressive roles remain a consumer's perception of smart object's capacities to affect and to be affected (Hoffman and Novak 2018). As the relationship depends on both consumer and smart object's experience, the anticipated experience involves the apprehension of both the consumer's ability to affect (consumer's agency) and be affected (consumer's communal), as well as the smart object's ability to affect (object's agency) and be affected (object's communal). This mechanism (trying to understand both consumer and object experience) shapes the relationship between the consumer and the smart object. Depending on consumer's and smart object's expressive roles, different patterns of relationship emerge, including master-servant relationship styles.

Regarding master-servant relationships, two different kinds of interaction can occur. Based on the degree of complementarity and correspondence in communal, the master-servant relationship can be either complementary or non-correspondent, as it always supposes opposite values in agency (Novak and Hoffman 2019). However, non-correspond master-servant relationships are considered less stable and semimorphic, eliciting a vast range of possible relational outcomes. Thus, focusing on complementary master-servant relationships will be sufficient for understanding the mechanism under which positive and negative experiences emerge in master-servant relationships.

Relying on the interpersonal circumplex model, it is thus possible to map the main possible interactions between a consumer and a smart object within the master-servant pattern.

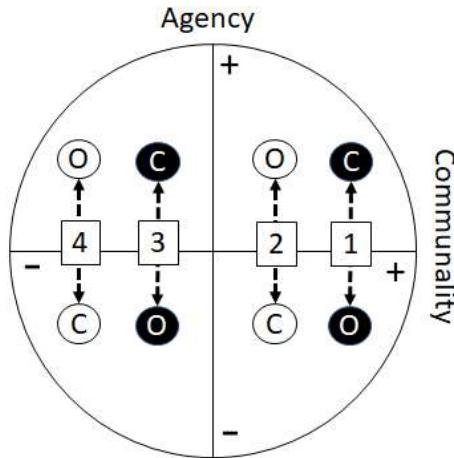


Figure 36 - Master-Servant Complementary Relationship style - Novak and Hoffman (2019)

Within complementary master-servant relationships, four different relationships styles emerge:

- Consumer master-smart object servant relationship, represented by the interactions (1) and (3).
- Smart object master-consumer servant relationship, represented by the interactions (2) and (4).

Regarding the consumer master-smart object servant interactions, the interaction (1) represents the consumer as the master, expressing a stronger agency and dominance alongside a high communality. On the other hand, the smart object expresses a lower level of agency, and a correspondent communality. Accordingly, the consumer interacts with the smart objects and gets enabled by positive experiences of self-extension and self-expansion (the range of consumer's capacities extends).

The interaction (3) is different as both consumer and the smart object hold negative communality. Considering the low level of communality, the (3) can lead to negative experiences of self-restriction (the consumer impede the interaction). Despite this negative communality, the interaction (3) implies a strong agency expressed by the consumer which could potentially elicit positive experiences of self-extension as well.

Concerning smart object master-consumer servant relationship style, the interaction (2) depicts the smart object as expressing more agency compared to the consumer. As they both endorse a high communality, the consumer must accept the role of servant. If the consumer

## Part 1 – A theoretical approach of consumer-smart object interaction

accepts the position of servant, he will feel enabled by the interactions, thus positive experiences of self-expansion are likely emerging. However, if the consumer refuses to be the servant, thus the relationship style will shift to a more unstable pattern (see *Unstable Relationship Styles*).

The interaction (4) represents a relationship where both the consumer and the smart object express low communalities. Considering the high level of agency expressed by the smart object, negative experiences of self-reduction are likely going to emerge. The pattern (4) is considered the least productive by Novak and Hoffman (2019) as it will elicit feelings of technology dependency and enslavement.

This is particularly interesting considering our approach. As one of the objectives for this thesis is to explore how negative attitudes toward smart objects emerge before the purchase, the assemblage theory coupled with the interpersonal relationship framework provide the tools for assessing the relationship styles that are likely explaining such negative reactions.

Consumer master-smart object-servant relationships are characterized with an authoritarian and dominating consumer, ruling, and imposing his agency to a smart object which is supposed to fulfil the consumer's order. Within this pattern, the smart object is submissive and possess a low level of agency.

Basically, the smart object is dependent to its user's actions and is not able to act autonomously. Consequently, the smart object's main mission is to respond and fulfil the request. Positive experiences (extension, expansion) and attitudes (joy and satisfaction) emerge when the smart object fulfilled its role. Conversely, negative experiences (reduction, restriction) and attitudes (disappointment, frustration) arise when the smart object failed to provide expected results.

Positive experiences of consumer master-smart object servant patterns are deemed to create stable subordination relationships, while negative experiences within this relationship style are supposed to impede lasting relationships (Novak and Hoffman 2019). Hence, positive anticipated experiences might emerge from the interactions when consumers perceive themselves as mastering the relationship.

## Part 1 – A theoretical approach of consumer-smart object interaction

Conversely, smart object master-consumer servant relationships are shaped by a highly agentic and dominating smart object, which display strong agentic features of control and autonomy. As the consumer perceive the smart object's agency through the features relied upon during interaction, they tend to feel enslaved, dependent and know that the relationship with this smart object requires to be submitted (complementarity principle).

The consumer becomes dependent to the smart object's capacities to shape the interactions, as it acts autonomously and with authority. Consequently, negative experiences of self-reduction and negative attitudes such as anxiety and fear are likely going to emerge if the consumer is not willing to submit and cooperate (low level of communality). Indeed, control and mastery are closely related to communion. The more we dominate objects, the more we tend to incorporate objects to the extended self (Belk 1988, McClelland 1951, Belk 2013), while the more they depart from our own vision of reality, our goals, the more we tend to apprehend the interaction with them (Bogost 2012).

In the study of Schweitzer et al. (2019), results have shown that the feeling of superiority and control over the VCSA, leads to positive experiences of self-extension. When consumers perceive they are the master of the relationship, they tend to be more engaged in the relationship. This also confirms previous results from Park and Chen (2007) showing that an increase in self-efficacy positively affects consumers' adoption of innovative products. Indeed, consumers that perceived the VCSA as a servant were more inclined to use it. Conversely, a perceived lack of control results in negative experiences of vulnerability and reluctance toward the interaction with the VCSA.

The question of consumer's vulnerability toward smart objects is important as it is supposed to hinder their acceptance (Chouk and Mani 2016). This vulnerability can be conceptualized as the feeling of dependency and loss of control toward technology (Baker et al. 2005). This feeling can be intuitively captured by the assemblage theory alongside the circumplex of interpersonal relationship, which allow us to draw a solution for studying anticipatory anxiety toward smart objects.

Anticipated negative experiences of self-reduction emerge from the perception of losing control toward smart objects. The agentic capacities expressed by smart objects elicit the

## Part 1 – A theoretical approach of consumer-smart object interaction

perception of a product intelligence (Rijssdijk et al. 2007). This product intelligence can hold different levels: agency, autonomy, and authority (Hoffman and Novak 2018). Accordingly, a smart object perceived with an authoritarian level of agency is likely going to elicit negative anticipated experiences if it is perceived as the master of the relationship.

This statement is supported by the literature. Anticipated interactions with smart objects can lead to reluctance when consumers perceive engaging in the relationship will potentially expose the consumer to a risk or a threat (Monsurrò et al. 2020). In line with the literature, Schweitzer et al. (2019) posit that “the reluctance is due to the fear of losing control over their digital self when they feel lost in a master (VCSA)—servant (Consumer) relationship” (p.16). This corroborates some conceptualizations from the technology acceptance literature as well.

Indeed, considering two individuals with the same level of intention to perform a specific task, the perception of control is supposed to positively influence the adoption of the behavior (Ajzen 1991). Moreover, the core of technology acceptance models is that “intentions and perceptions of behavioral control should interact in the prediction of behavior” (Ajzen 1991, p. 188). The perception of control enhances the intention to engage in a behavior, while expecting and anticipating a loss of control negatively influences the intention (Bayart et al. 2017).

Thus, considering two individuals that have both intentions to adopt smart objects, the person who feels confident in mastering the relationship with smart objects is more likely to adopt smart objects than the one who doubts about its own capacity to express control over the interaction. This feeling is directly influenced by the smart object’s agency, which can claim the role of the master based on its agentic features.

Ajzen’s conceptualization of perceived behavioral control considers the perception of control as dependent from salient beliefs, more specifically, control beliefs. It is therefore possible to consider those control beliefs as part of the interpersonal relationship dynamic, referring to the concept of reciprocity. Consequently, we find it more insightful to consider reciprocity of agency as the main control belief hindering the intention to adopt the technology, instead of the perception of control itself regarding the resources required to engage in the relationship (self-efficacy).

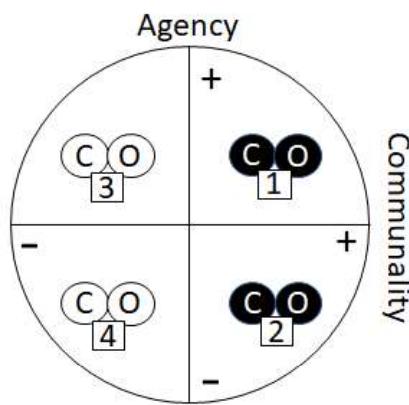
Smart object master-consumer servant relationship style is likely going to elicit the emergence of negative experiences. Such relationship and interactions can help understanding

and explaining how anticipatory anxiety toward smart objects manifests. Nevertheless, negative experiences can also emerge according to two additional relationship styles: Partners and Unstable relationship styles (Novak and Hoffman 2019). Accordingly, reviewing those styles might provide more insight about the mechanism behind relational outcomes, especially negative experiences.

*C- Partners relationship styles*

Partners relationship styles refer to a relationship where both the consumer and the object interact and cooperate to achieve a specific task. They both express the same commitment in terms of communal and agency. When one interactant (the consumer for instance) expresses a certain level of agency and communal, the partner of the relationship (the smart object) expresses the same agentic role and communal expression. Thus, the different partnership styles must be considered according to the agentic and communal expressive roles both the consumer and the smart object endorse.

Partners relationship styles are supposed to elicit both positive, but also negative experiences. Indeed, this specific relationship assumes a preference for agency in the other, allowing the consumer to rely on smart objects as if they were faithful assistants, eliciting the emergence of positive enabling experiences (Abele and Brack 2013).



*Figure 37 - Partners relationship styles - Novak and Hoffman (2019)*

For instance, when both consumer and smart object express high agentic and communal expressive role (1), the relationship is deemed to be active and interactants, mutually dependent,

## Part 1 – A theoretical approach of consumer-smart object interaction

with potentially positive or negative experiences emerging from it. Yet, this relationship style is supposed to lead to very positive experiences of self-extension and expansion as both interactants are considered partners.

On the other hand, a high communality, and a low agency (2) leads to a more cooperative relationship style with no agentic expression, eliciting the appearance of positive experiences of self-expansion, but potentially negative experiences of self-reduction. The relationship (2) is cooperative, but still without agentic motives, with positive or negative experiences emerging from self-expansion or reduction experiences.

However, other partners relationship styles are more complex and does not necessarily lead to positive experiences. Indeed, according to Novak and Hoffman (2019), when both the consumer and the smart object endorse low agentic and communal expressive roles (4), they are likely going to disengage from the interaction, as they both becomes slowly detached from the interaction. Thus, such configuration often can lead to disengagement.

When communality is low, but agency is high (3), the relationship evolves into an adversarial relationship style, with positive experiences of self-extension and negative experiences of self-restriction emerging during the interaction. Interactions (3) and (4) involve a low expression of communality for both the consumer and the object. Accordingly, positive experiences of self-extension or negative experiences of restriction can occur (Novak and Hoffman 2019).

To summarize, positive and negative experiences can emerge from partners relationship styles. Yet, the interactions (1) and (2) are likely going to elicit positive relational outcomes (interactive partners), while (3) and (4) will tend to provoke negative outcomes (disengagement).

### *D- Unstable relationship styles*

When the principle of complementarity is neither fulfilled regarding reciprocity of agency and correspondence of communality, the relationship becomes unstable (Horowitz et al. 2006). According to Novak and Hoffman (2019), these relationship styles emerge by opposition to an expected relational response in terms of agency and communality. To be more precise, unstable relationships are patterns that represent opposite interactions “to what is

expected to be elicited on both dimensions” (Novak and Hoffman 2019, p.26). To illustrate, when an interactant 1 expresses a high level of agency and communion, the complementarity principle requires another interactant 2 that shows similar communality (correspondence) or opposite values in agency (reciprocity of agency). Yet, in unstable relationship styles, interactants react oppositely to what is expected to reach complementarity. Hence, unstable relationships lead to avoidance and are considered very unstable patterns of interactions (Novak and Hoffman 2019, Kiesler 1996). Accordingly, four unstable relationship styles can be represented:

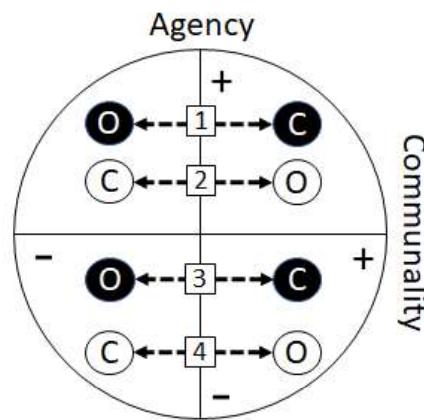


Figure 38 - Unstable relationship styles - Novak and Hoffman (2019)

Unstable relationship styles involve four different types of interaction. The interaction (1) supposes a high agency displayed by both the consumer and the smart object. Yet, they depart from one another regarding their communality. The consumer expresses a high communality which can lead to positive experiences of self-extension and expansion. However, as the smart object expresses the same agency and a lower communality, negative experiences of self-restriction and reduction are likely going to occur. Indeed, based on its agency, the smart object will interact autonomously with no consideration for consumer's agency, leading potentially to negative relational outcomes.

Regarding the interactions (2) and (3), consumers might experience both positive experiences of self-extension (2) and expansion (3) as well as negative experiences of self-restriction (2) and self-reduction (3).

Unstable relationship styles originate from the opposite expression of agency or communality regarding the expected expressive role required to achieve complementarity.

## Part 1 – A theoretical approach of consumer-smart object interaction

Accordingly, consumers that will get involved in the interaction (2) are likely trying to avoid the relationship with the smart object. The self-restriction experience emerging from this relationship style is the opposite expression that should have achieved a complementary interaction with the smart object.

Consumers are assessing the smart object's agentic and communal expression. As consumers perceive a high agentic and communal expression hold by the smart object, they anticipate their own role before interacting with the smart object. Nevertheless, the smart object's agentic expression requires an opposite agentic expression (consumer low agency), and its communal expression requires a correspondent communality (consumer high communality). This pattern represented by the “expected consumer response” (high agentic and communal smart object + low agentic and high communal consumer) refers to the smart object master-consumer servant relationship style n° (2).

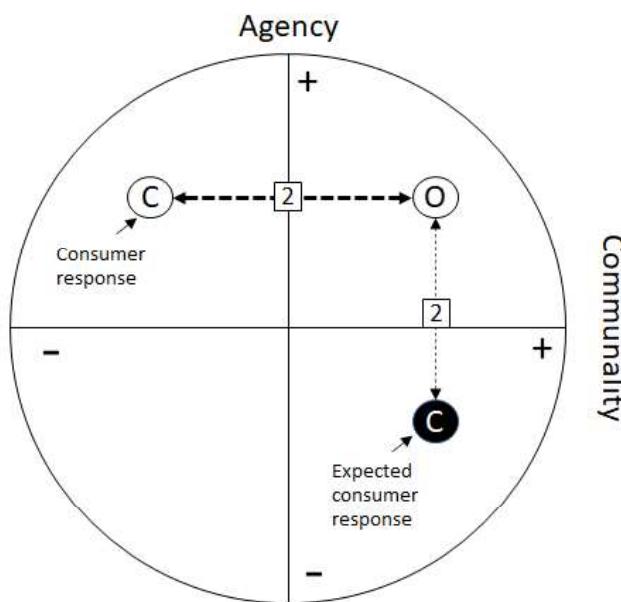


Figure 39 - Expected Role and Unstable Relationship Style

However, this smart object master-consumer servant relationship style considers the consumer as the servant of the relationship. This pattern requires that the consumer deliberately becomes the servant of the smart object. If the consumer refuses to engage the relationship as the servant of the relationship, thus, he will likely hold a high agentic and low communal expressive role as a response to impede the relationship (Consumer response).

## Part 1 – A theoretical approach of consumer-smart object interaction

Consequently, the consumer will anticipate the relationship with the smart object that possesses a perceived high agency and communalty. From this anticipation, fear of becoming the servant of the relationship will likely influence the consumer to adopt a rejection posture because of the self-restriction experience. The unstable relationship style (2) is only the consumer's response regarding a smart object that is perceived as the master of the relationship.

According to Novak and Hoffman (2019) unstable relationship styles emerge as an opposition to expected relationship styles (master-servant / partners). Hence, the relational outcome (rejection from self-restriction) emerges from anticipated interactions with the smart object. This is likely going to occur considering the main dimensions structuring the consumer-smart object relationships in the assemblage theory. According to Hoffman and Novak (2015), the consumer-smart object assemblage is structured by three dimensions: levels of interaction, time of interaction and zone of interaction.

As seen previously, levels of interaction refer to the nature of the expressive role endorsed by consumers and objects. The zone of interaction defines whether the interaction is direct (part-part) or ambient (part-whole). The time of interaction refers to the time frame under which the interaction takes place. Accordingly, the experience can be anticipated (expected before the real-life interaction), momentary (real-life interaction), episodic (series of momentary interactions) or cumulative (used for evaluating interactions). In line with our research object, anticipated experiences will be explored in the next section.

This chapter has provided new elements. The table below exposes the main concepts relied upon:

*Table 29 - Interpersonal relationships - Main concepts*

Framework	Concept	Definition
Interpersonal relationship (Kiesler 1983, Horowitz et al. 2006, Novak and Hoffman 2019)	Agentic motives	Expression of dominance, or agentic capacities endorsed by an entity.
	Communal motives	Expression of affiliation, cooperativeness, and willingness to engage in a relationship.
	Interpersonal circumplex	Circumplex that measure the agentic and communal expressive role endorsed by an entity.
	Principle of complementarity	Stable relationships are supposed to be structured by the principle of complementarity. Entities interacting will most of the time follow the same patterns, reciprocity in agency (opposite values) and correspondence of communalty (same values).
	Relationship Styles	Based on entities' agency and communalty, different relationship patterns can emerge, from master-servant relationships styles to partners and unstable patterns.

## Part 1 – A theoretical approach of consumer-smart object interaction

Following the conceptualization of consumer-smart object assemblage, anticipated interactions involving consumers and smart objects can be mentally simulated by consumers. Based on the expressive role endorsed by smart objects, consumers might mentally simulate the interaction before it happens trying to anticipate the relational outcome (“Will I be the servant of this smart object?”). The perception of a risk to become the servant of the relationship and dependent to the smart object might elicit the emergence of negative attitudes and anticipatory anxiety.

Consequently, passive resistance and anticipatory anxiety emerge regarding consumer-smart object anticipated interactions. Hence, there is a need for considering and providing a conceptualization of the consumer-smart object simulated assemblages.

### **IV- Consumer-Smart object simulated assemblages**

#### *A- Mental simulation and Consumer experience*

One gap we identify across the acceptance/resistance literature is that they do not consider anticipated experiences from an object-oriented perspective as a potential lever for resistance and negative attitudes to emerge (Monsurrò et al. 2020). The literature already emphasizes that the perception of human like properties in nonhuman objects can potentially cause intense and opposite reactions.

According to Shank and colleagues (2019), consumer might face amazement, surprise and positive emotions while interacting with machines, that could easily turn into fear and anxiety depending on the context under which the interaction takes place. Even if the context of the interaction is independent from both the consumer and the object, its implications for the emergence of negative attitudes remain neglected, especially anticipated interactions (Shank et al. 2019, Verhoef et al. 2017).

Regarding the human behavior literature, mental representations of anticipated events are deemed to have a significant influence over intentions. According to Beach and Mitchell (1996), the concept of trajectory image posits that mental representations can be subdivided into two processes:

## Part 1 – A theoretical approach of consumer-smart object interaction

- Mental representations of specific goals and ideal situations, or states.
- Mental representations of the different actions required to achieve the simulated goals.

While the first kind of mental representations relies on higher levels of construal, the second category requires lower levels of construal and focuses on instrumental and specific actions (Trope and Liberman 2012). “Recent work in these areas has converged on a view of behavior being driven by a mental representation that links higher-level goals to specific actions that are instrumental for achieving those goals” (Venkatesh and Davis 2000, p.190).

Researchers have tried to assess the match between the mental simulation of goals and actions, because “the impetus for engaging in specific behaviors stems from a mental representation linking instrumental behaviors to higher-level goals or purposes.” (Venkatesh and Davis 2000, p.191). Consequently, technology acceptance models posit people rely on the evaluation of the consequences to adopt a system (performance, usefulness) according to their goals. One main limitation that rises from this reasoning is that it mainly relies on the evaluation of advantages and costs associated with the system adoption (Davis 1989). Accordingly, the technology acceptance approach completely neglects the influence of anticipated relational outcomes between people and smart objects (Monsurrò et al. 2020).

Evidence for this statement can be found across the technology acceptance literature itself. Indeed, theories and models that rely upon performance expectancy judgments cannot explain the ambivalence felt by consumers regarding smart objects (Ardelet et al. 2017). The range of situations where models of acceptance are not sufficient for understanding consumers’ reactions toward technology is large (Saadé and Kira 2006, Schepers and Wetzel 2007, Sharp 2007, Sun 2003). How can we explain from a performance-expectancy approach, people that believe smart objects represent unique opportunities of development for the society and individuals but at the same time, believe they are mere gadgets (OpinionWay 2017)? Or consumers that declare they are useful but also frightening and not willing to adopt smart objects despite their acknowledgment of innovative characteristics and usefulness (Ifop 2014)?

There is a need for considering a measurement for the entire trajectory image (Beach and Mitchell 1996): a measure of the mental representation of the simulated state (expected role) alongside a measurement of instrumental beliefs (such as perceived usefulness and ease of use). While perceived usefulness and ease of use originate from the performance-expectancy theory (Ajzen 1991), expected roles are supposed to stem from anticipated experiences (Novak and

Hoffman 2019). Hence, understanding how anticipatory and simulated experiences emerge will provide insight about how to conceptualize the expected roles.

### Defining mental simulation

Mental simulation of future events is a well-known and documented research topic in cognitive neuroscience and psychology (Wells and Gavanski 1989). According to Schacter and colleagues (2008) mental simulation can be defined as the process under which people are “drawing on elements of past experiences in order to envisage and mentally “try out” one or more versions of what might happen” (p.40). For Taylor and Schneider (1989) it refers to the “construction of hypothetical scenarios” (p.175) and becomes anticipatory when the event has not yet occurred. This includes all scenarios mentally simulated by people to anticipate a situation that is likely going to happen in the future (Buckner and Carroll 2007). According to Taylor and colleagues (1998) “mental simulation provides a window on the future by enabling people to envision possibilities and develop plans for bringing those possibilities about” (p.429).

As seen previously, the mental simulation can be either outcome-oriented (high level construal) or process-oriented (low level construal) (Taylor et al. 1998, Trope and Liberman 2010). Outcome-oriented simulations focus on the desirability of fulfilling a goal, while process-oriented simulations focus on all the steps required to reach that goal (Taylor et al. 1998, Zhao et al. 2007). Mental simulations are supposed to enhance the relationship between thoughts and actions, thus having a significant influence over people’s behavior (Pham and Taylor 1999).

According to Mellings and Alden (2000), there are two main cognitive processing during social events: anticipatory processing and post-event processing. Post-event processing “occurs between social events and reactivates memory traces, which results in deeper processing of the information recalled” (Mellings and Alden 2000, p.244). It refers to the remembrance of memories between two different events. On the other hand, “anticipatory processing occurs prior to social events and evokes the negative memories and predictions that begin the anxious cycle” (p.244). In line with the definition provided by Taylor and colleagues (1998), mental simulation of future events (that have not yet occurred) activate an anticipatory processing where predictions are made about potential outcomes. Yet, how mental simulation affects people?

## Part 1 – A theoretical approach of consumer-smart object interaction

Concerning how anticipated processing affects one's behavior, the influence of such simulation over people is largely supported by the psychology literature (Kappes and Morewedge 2016). Tversky and Kahneman (1973) for instance have found a significant influence of mental simulations of future events over behavioral intentions. Based on their previous findings, Kahneman and Tversky (1982) conceptualized the concept of "heuristic simulation" which posits humans draw on simulation models, different situations associated with potential outcomes. According to Taylor and Schneider (1989), mental simulation of hypothetical future events can have an influence on both thoughts (feasibility, actions) and emotions (stress, fear).

From a neuroscience perspective, situations that are mentally simulated can have the same impact on the brain as real-life perceptions (Hesslow 2004). Imagining acting during a situation that is mentally simulated involves the same brain activity as acting in real-life situations (Decety and Grezes 2006), providing tangible support for considering that mental simulations might have the same impact over actual behavior (Decety and Ingvar 1990, Kappes and Morewedge 2016, Epstude et al. 2016).

### Mental simulation and consumer behavior

The way consumers perceive and evaluate products before adoption have an influence over their adoption decision. According to Escalas (2004), mental simulations can influence people's attitude and brand evaluations. Additionally, Dahl and Hoeffler (2004) have shown the extent to which visualizing the product (from self-related or other-related images) significantly influence people's evaluation of both benefits and outcomes associated with it. Moreover, Hoffman and Breazeal (2010) have investigated the influence of anticipatory situations over the human-robot collaboration and found it improves task efficiency and the fluency of the collaboration. This was supported by Kuchenbrandt and Eyssel (2012) experiment with NAO the robot, showing how mental simulations can potentially influence robot acceptance.

The work of Handley and Goss (2012) also highlights the influence of expectations and anticipated future events over purchase intention, advocating for a positive or negative effect depending on the nature of the anticipation. This is also supported by the work of Nardini and Lutz (2018) who found that mental simulations can negatively affect consumer's decision to engage in a behavior.

Regarding new product adoption, Castaño and colleagues (2008) have found that, depending on the temporal distance (Trope and Liberman 2003) and the nature of the mental simulation, concerns regarding adoption were different (performance-benefit uncertainties for distant future, and affective-cost uncertainties for near future). Based on the temporal distance theory, these authors have shown how mental simulation can be relied upon for influencing behavioral intentions and emotions regarding new product adoption.

In line with the temporal distance theory, Zhao and colleagues (2007) have shown that a near future event tends to trigger lower levels of construal, focusing on simulating concrete aspects of a situation. Conversely, a distant future event is likely going to elicit abstract aspects of a situation, resulting in higher levels of construal. Armitage and Reidy (2008) have investigated whether outcome simulation (high level construal) and process simulation (low level construal) shared the same effect over the variables from the theory of planned behavior. According to their results, there were no main effects of outcome simulation over the variables (intentions, attitudes, perceived behavioral control) instead of process simulation that has a significant influence over those variables. The explanation provided posit that the nature of the simulation (process vs outcome oriented) might depends on both the individual and the situation. Some situations will naturally trigger process-oriented simulation, others will elicit outcome-oriented simulation. In process-oriented simulation, outcome beliefs (such as the desirability of fulfilling the goal) might be less salient. Conversely, in outcome-oriented simulation, process beliefs (the different steps required to reach the goal) will be less salient too.

This can also explain why models of technology acceptance fall short in trying to understand ambivalence toward technology. Relational outcomes from the consumer-technology relationship are not properly considered across the technology acceptance-resistance literature (Monsurrò et al. 2020). The technology acceptance models are built upon process-salient beliefs (such as perceived price, ease of use and utility) and doesn't incorporate outcome beliefs such as relational outcome variables. Accordingly, additional beliefs (outcome beliefs) must be integrated in those models to fully understand the formation of attitudes and intentions (Ardelet et al. 2017). This is crucial to understand actual consumer behavior regarding technology. Indeed, “outcome simulation, which focuses on abstract, high-level desirability considerations, could help change preference in the near future, so that it is consistent with the natural distant-future preference. Conversely, process simulation, which focuses on the concrete, low-level feasibility consideration, could help change preference in the distant future so that it is

consistent with the natural near-future preference” (Zhao et al. 2007). Accordingly, outcome simulation can also affect consumer actual behavior regarding technology, thus advocating for the necessity to consider mental simulation as influencing current consumer behavior and future behavioral intention.

Another important feature of mental simulations is the capacity of “reading the mental states of other individuals” (Schacter et al. 2008, p.41). Originated from the Simulation Theory (Cruz and Gordon 2006), this process, also referred as “mentalizing” or “theory of mind”, involves people innate capacity to imagine others’ mental states and placing others within the mental simulation (Goldman 2006). It is defined as “our everyday ability to make sense of the behavior of others. One crucial element of this ability is the identification and attribution of inner mental states that generate action, especially propositional attitudes such as beliefs or desires” (Cruz and Gordon 2006, p. 9).

Accordingly, people can “make predictions or inferences about how another individual will behave” (Schacter et al. 2008, p.42). Thus, it is possible to apprehend others’ actions based on their capacities and people’s ability to simulate others’ mental states (Davies and Stone 2001). Indeed, “when individuals perceive the actions and the emotions produced by others, they use the same neural mechanisms as when they produce the actions and the emotions themselves. [...] Such a perception–action coupling mechanism offers an interesting foundation for intersubjectivity because it provides a functional bridge between first-person information and third-person information, grounded on self-other equivalence, which allows analogical reasoning, and offers a possible route to understanding others” (Decety and Grezes 2006, p.12).

Consequently, people can engage in anticipated interactions with different entities (human and non-human), where they simulate both their own role and the entity’s role during the interaction (through mentalizing), anticipating a relational outcome (positive or negative) based on the experience they have mentally simulated.

Hence, we draw on the definition provided by Schacter and colleagues (2008) to define our approach of mental simulations as a form of thinking, triggered by a stimulus (such as the description of a potential situation) “that involves imaginatively placing oneself in a hypothetical scenario and exploring possible outcomes” (p.42). Those mental simulations also involve the prediction of others’ mental states, which can potentially include human (other people) and non-human (objects) entities (Goldman 2006) with a direct effect on people’s behavior and emotions (Taylor et al. 1998, Decety and Grezes 2006). Based on those

simulations, relational outcomes (positive or negative) are anticipated by people, as if they really lived such experiences. This definition allows us to better understand what refers to simulated interpersonal relationships.

*B- Simulated interpersonal relationships and Resistance to engage in future interactions*

As seen above, consumers can get involved in anticipated interactions with smart objects before a real-life interaction (Novak and Hoffman 2019). From that point, relational outcomes are also anticipated based on the consumer-smart object relationship expected by the consumer.

To assess those anticipated relational outcomes, consumers need prior beliefs to imagine and evaluate the consequences of engaging in the relationship. The behavioral consequences directly stem from prior beliefs associated with the behavior (Ajzen and Fishbein 1980). However, anticipated interactions sometimes involve no prior relationship. Ardelet and colleagues (2017) for instance have shown that both users and non-users were feeling ambivalence and negative attitudes toward smart objects. Therefore, from where do prior beliefs regarding the relationship with smart objects emerge?

People might have integrated within their own system beliefs, others' anticipated experiences. Internalization is defined by the tendency to incorporate others' beliefs into individual's own belief system (Warshaw 1980). It refers to the information processing of others' experiences and beliefs as if they were our own. According to Venkatesh and Davis (2000), due to internalization effect, the acceptance or reject of a new system is influenced by others' perception regardless of the context (mandatory or non-mandatory usage).

Thus, the integration of anticipated experiences and prior beliefs regarding autonomous objects (which mainly originate from sci-fi books, stories, depicting autonomous objects as dangerous and hostile entities) might be incorporated into one's own system belief. This directly refers to the “Terminator Effect”, where people tend to perceive robots and technology as a threat because of mental representations originated from science-fiction culture, influencing anticipated experiences, thus mixing “mentalizing” and “internalization” processes (Carpenter et al. 2008).

## Part 1 – A theoretical approach of consumer-smart object interaction

This is also supported by Hartwick and Barki (1994) findings which posit users' beliefs about a system, before usage, are most of the time vague, with behavioral intentions that rely not only on personal salient beliefs but also on others' opinion and system beliefs. Accordingly, internalization processing of others' beliefs is likely going to occur before usage and influences the behavioral intention (Agarwal and Prasad 1997).

Anticipatory processing coupled with a negative evaluation of technology (originated from a terminator effect) could be relied on for understanding how anxiety emerge prior to the interaction with smart objects.

The negative experiences faced by people in the sci-fi literature, especially regarding the master-servant relationship involving technology, might have indirectly influenced the emergence of prior beliefs that intrinsically prevent people to engage with autonomous objects relationships. Indeed, "a negative experience with one innovation can damn the adoption of future innovations." (Rogers 1995, p.227). This refers to the concept of Innovation negativism, defined as the degree to which an innovation's failure will impact the adoption of future innovations, influencing adopters to reject them (Rogers 1983). "When one idea fails, potential adopters are conditioned to view all future innovations with apprehension" (Rogers 1995, p.227-228).

From that perspective, the innovation negativism might have influenced the appearance of a passive resistance regarding autonomous and smart objects, based on the numerous fictitious novels and movies representing smart objects, computers and robots as conscious entities trying to reach self-consciousness by imposing their domination (Asimov 1975, Hegel 1977).

By an effect of contamination, consumers might have relied upon these fictional stories to create a phantasmatic anticipated world, inside which the future relationship with smart objects is anticipated, and the consequences, evaluated. According to Rogers (1995), this refers to the concept of "Technology clusters". A technology cluster is defined as a bundle of technological innovations (products, ideas, services) that are perceived interrelated in adopters' mind. The adoption or rejection of one new idea can influence the others. Indeed, most of the time, innovations are not considered alone. People try to find boundaries between new ideas and existing elements to reduce uncertainty and apprehension (Moore 2014).

## Part 1 – A theoretical approach of consumer-smart object interaction

Yet, technology clusters can also negatively influence the adoption rate of an innovation if the innovation is associated with a negative past innovation (Rogers 1995). Accordingly, smart objects might be assessed in consumers' mind according to the technology as depicted in sci-fi novels, thus validating the Terminator effect (Carpenter et al. 2008). This is widely supported by the human-robot interaction literature. Indeed, expectations about robots, even before the interaction, influence the mental representations people have about them, with a direct impact over attitudes and emotions toward robots (Nomura et al. 2005, Shibata et al. 2004). However, is it conceivable to anticipate an interpersonal relationship with a non-human entity?

According to Goudey and Bonnin (2001), there are three different kinds of anthropomorphism processing: schema congruence, analogical reasoning, and mere attribution. Schema congruence refers to the proximity between the object and the information stored in memory. Thus, a smart object that resembles to a human will elicit “a transfer of affect between the schema and the object” (p.4). Accordingly, a robot that possess eyes will activate the schema of the human face stored in user's memory.

Analogical reasoning is an inductive process where users will infer capacities based on similarities with humans. The example of the robot with its pair of eyes will induce a sight capacity hold by the robot. This perception is induced by the resemblance with human's capacities.

Last, the mere attribution of human features refers to a process of comfort where humans try to understand and explain their surroundings by attributing humanlike characteristics, making it more familiar and understandable (Guthrie 1993). Regarding smart objects, their capacities to act and react autonomously represent a sufficient stimulus with no necessity to infer and attribute non-existing human characteristics.

Smart objects' agentic capacities intrinsically induce a similarity with humans. The analogical reasoning refers basically to an object-oriented anthropomorphism (Hoffman and Novak 2018), where human-likeness is not inferred, but observed through the smart object's capacities. Hence, smart objects capacities might automatically trigger schemes and memories that will unconsciously elicit the perception and interpretation of a “humanlike” agency and consciousness, which will try to impose its domination over people (Sundar et al. 2008). According to Kang and Kim (2020) it is through this process that people “interpret and assess the quality of their interactions with the technology” (p.47).

## Part 1 – A theoretical approach of consumer-smart object interaction

As mentioned by Taylor and colleagues (1998), when people tend to mentally simulate future events, it makes them look real for them. If we consider that a form of interaction can occur before the usage, and if both users and non-users can potentially develop negative attitudes toward smart objects (Ardelet et al. 2017, Tung 2016), then it means consumers are mentally simulating the relationship with the smart object, before it happens, as a part of a mentally simulated interaction (Zhao et al. 2011). But this does not tell us why consumers tend to develop anxiety before the interaction with smart objects (TNS Sofres 2016). A form of anxiety which can potentially prevent consumers to engage into a relationship with technology (Nomura and Kanda 2004).

As we are dealing with mentally simulated events, we believe that consumers might develop from expectations, beliefs and memory (past experiences and internalized experiences), simulated assemblages that refers to the mental simulation of interpersonal relationships as described by Novak and Hoffman (2019), in which they anticipate relational outcomes (positive or negative experiences). Hence, they might develop anxiety toward the smart object according to a negative anticipated experience.

An anticipated anxiety based on the agentic capacities of the smart object that triggers internalized schemes and passive resistance. Accordingly, we can define by extension smart object anxiety as a simulated and anticipatory anxiety, which relies on the mental simulation of future interactions with smart objects, expressing different levels of agentic capacities.

The next figure illustrates the potential mechanism described according to our conceptualization.

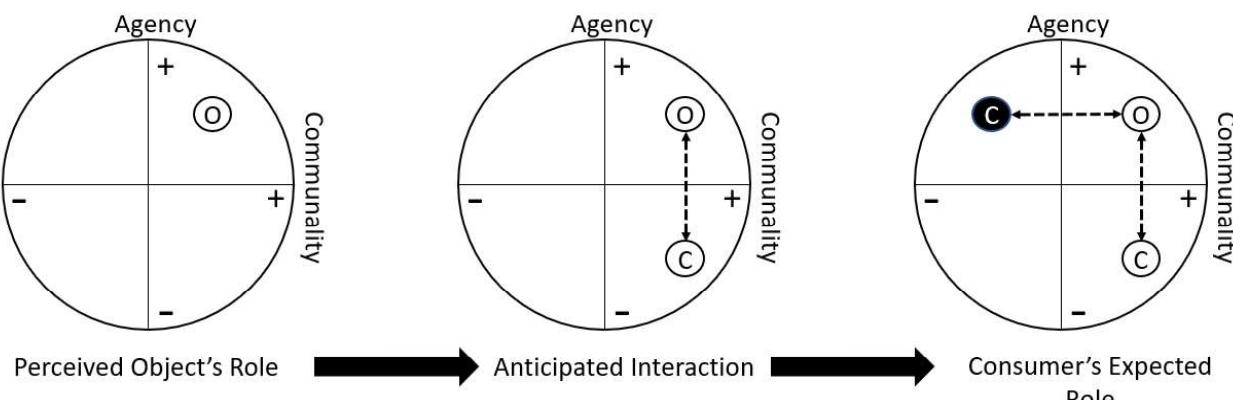


Figure 40 - Mental simulation of interpersonal relationships between consumers and smart objects

## Part 1 – A theoretical approach of consumer-smart object interaction

The smart object (O) holds capacities to affect and to be affected which are perceived by consumers (C) in terms of agentic features (agency) and degree of cooperativeness (communality) as described by Novak and Hoffman (2019). Accordingly, consumers can simulate the interaction that will potentially take place in the future, relying upon object-anthropomorphism (Hoffman and Novak 2018).

Here, we have a high agentic and communal object represented in the first circle, which corresponds to the role of Master of the relationship (a dominant entity). Based on the principle of complementarity (Kiesler 1996), this perceived object's role requires a low agentic high communal consumer for a stable relationship, which corresponds to the role of the Servant (a dominated entity). The circle of the middle represents the anticipated interaction. The consumer knows that a low agentic high communal role is required to engage into the relationship with the object. Indeed, the object expresses capacities of domination that make him a potential master of the future relationship, which automatically involves a dominated consumer.

Yet, consumers might simulate potential negative outcomes of being dominated by the technology, which could originate from irrational thinking (Chouk and Mani 2016). Accordingly, the middle circle represents the mental simulation that triggers the feeling of discomfort and anxiety felt by users and non-users, even before a real-life interaction (Ardelet et al. 2017). Hence, a passive form of resistance emerges, which is represented by the last circle. Based on the anticipated relational outcome (anxiety and discomfort), the consumer will express a different role than the one anticipated previously. This expected role represents the actual consumer's response to the smart object's expressive role, or capacities.

Consequently, we draw on the interpersonal relationship and the mental simulation literature to explain the process under which consumers anticipate relational outcomes which influence their behavioral response.

The literature has not yet covered this phenomenon, which might represent a key to understand current and future smart objects adoption and resistance (Verhoef et al, 2017). That is why we have decided to focus on the consumer-smart object experience before the usage, considering simulated assemblages made of anticipated interactions. This approach allows us to investigate the process where the consumer mentally simulates the interaction with smart objects, from which might emerge anxiety toward them.

## **Conclusion of Part 1 and propositions of investigations**

With this first part, we tried to provide an extensive literature review of the main concepts associated with our research topic.

First, we exposed the theory of innovation diffusion and the notion of Chasm (Rogers 1983, Moore 1991). It appears that consumers don't necessarily share the same motives in the innovation diffusion process. The innovations can rely on intrinsic or extrinsic motivations to diffuse within a system (Rogers 1995). Yet, differences between adopters can sometimes split the adoption curve and create a Chasm (Moore 1991). For that reason, exploring factors of acceptance and resistance is deemed fundamental to cross that state.

Accordingly, we explored the different models of technology acceptance-resistance and found that the behavioral intention regarding technology adoption was well predicted by the perception of utility (usefulness or uselessness) and complexity (ease of use or usage complexity) (Venkatesh and Davis 2000, Sun 2003, Amoako-Gyampah and Salam 2004, Bruner and Kumar 2005). Yet, the emergence of smart objects and their innovative capacities, have challenged these traditional approaches. According to Ardelet and colleagues (2017), theories like the TAM, must evolve and consider additional antecedents to better understand consumers ambivalence regarding smart objects adoption. Indeed, current literature indicates that irrational motives might trigger the emergence of resistance toward smart objects (Chouk and Mani 2016). However, traditional models of technology acceptance don't consider sufficiently irrational motives as antecedents of perceived usefulness and ease of use. Our review has highlighted the need to consider both rational and irrational motives as potential levers of technology adoption.

Additionally, our literature review has investigated the negative attitudes and anxiety elicited by technology. Our review has highlighted a potential mechanism which suggests a much more complex relationship between consumers and smart objects. Anxiety and negative attitudes toward smart objects might involve interpersonal and social dynamics based on the anticipation of relational outcomes. The innovative capacities to affect and to be affected expressed by smart objects challenge the current human-centric perspective. The traditional human-oriented ontology appears to fall short regarding the questions raised by the new consumers-smart objects interactions (Verhoef et al. 2017). Accordingly, we relied upon the object-oriented ontology and the interpersonal relationship literature to explore this

## Conclusion of Part 1 and propositions of investigations

phenomenon. A possible explanation regarding the passive resistance to engage in a relationship with smart objects might originate from the consumers' capacity to anticipate future relational outcomes that involve negative experiences. Consumers might apprehend the future relationship with smart objects based on their capacities to process smart objects' features (agency) as part of anticipated interactions.

Our review highlights the theoretical relevance of relying on both Novak and Hoffman (2019) conceptualization of the consumer-smart object relationship, and the mental simulation literature for assessing anticipated interactions. By mixing these two research fields, our review has shown that consumers might mentally simulate future interactions with smart objects. The capacities expressed by smart objects might potentially shape the nature of the simulated experiences. Accordingly, consumers might live positive or negative anticipated experiences, prior to any real-life interaction, based on the mental simulation of future interactions with smart objects. Such anticipated experiences might explain the emerging resistance toward smart objects before purchase if the anticipated experiences are negative. Hence, the aim of this research project is to find a way to assess and evaluate the extent to which consumers get involved in anticipated interpersonal relationships with smart objects, prior to any real-life interaction.

Consequently, we must explore the extent to which consumers are able to anticipate future interactions with smart objects, and the relevance of relying over the assemblage theory to assess such simulated interactions. The aim is to investigate whether simulated consumer-smart object interactions involve the same interpersonal dynamic as real-life interactions.

Additionally, we need to explore if negative attitudes and resistance to adopt smart objects really emerge from these anticipated interactions and what potentially triggers them.

The first part provides the theoretical grounding for exploring empirically the anticipated consumer-smart object interaction. Hence, next part will focus on our research objectives, and will explore the consumer-smart object anticipated interaction and its consequences over the consumer behavior.

## **Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology**

### Introduction to Part 2 – Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The second part of this research is dedicated to our exploratory and confirmatory empirical work and will directly focus on our research objectives. The first chapter will expose our epistemological positioning and its implications in terms of methodology. Then, a second chapter will rely upon the qualitative projective technique called Album-Online (Vernette 2007, Kessous and Valette-Florence 2019) to explore the evocations elicited by a smart object's agency. The aim of this chapter is to assess the relevance of relying upon the assemblage theory to investigate anticipated interaction with a smart object.

Then, we draw on the findings from the AOL exploratory phase, different assumptions and hypotheses regarding the mechanism that potentially triggers negative attitude and anticipated anxiety toward future interaction. Hence, chapter 3 will provide a conceptual model of all relations identified between the core concepts involved in the potential mechanism.

Finally, we will assess our hypotheses and the relevance of the conceptual model in two different quantitative studies. Study 1 relies upon a PLS path modeling approach (on XLSTAT) to evaluate the relations between all identified concepts and our hypotheses. Additionally, Study 2 will provide empirical support for the assumptions made regarding Study 1 results and will help us to better understand the influence of smart objects' agency and anticipated interaction in the emergence of consumer resistance toward smart objects.

Accordingly, the Part 2 will follow the organization exposed below:

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology



Chapter 1- Epistemological positioning and Methodological implications



Chapter 2 - Exploring the perception of smart object's innovative capacities from a relational perspective



Chapter 3 - Concretization and Conceptualization – Examine and explain how the mechanism operates



Chapter 4 – Experimental design, results, and discussion

*Figure 41 - Part 2 organization - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology*

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

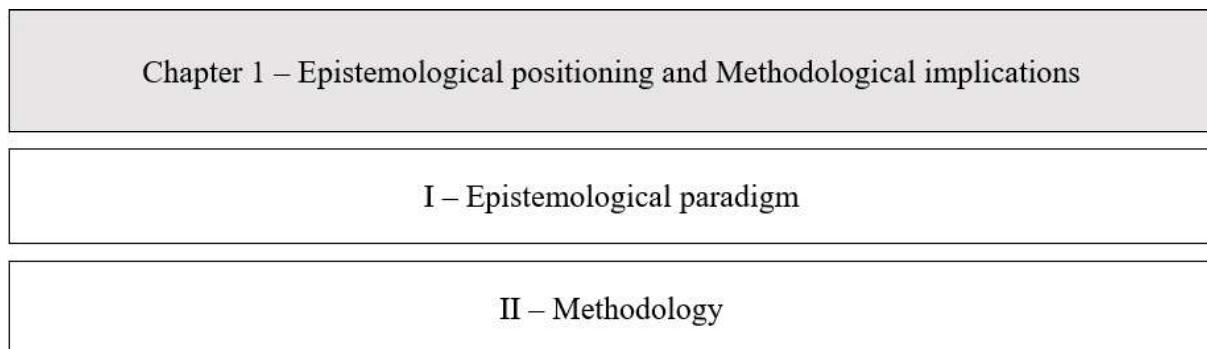
Chapter 1- Epistemological positioning and Methodological implications

Introduction to Chapter 1- Epistemological positioning and Methodological implications

This chapter is dedicated to the presentation of the epistemological paradigm that was relied on during this research. A first section will focus on the notion of epistemology and will explain the principles that structure the chosen paradigm called “Critical Realism”.

After presenting the chosen epistemological paradigm, a second part will expose the implications in terms methodology induced by this paradigm and its requirements for assessing our assumptions.

This chapter is organized as follow:



*Figure 42 - Chapter 1 organization - Epistemological positioning and Methodological implications*

I- Epistemological paradigm

The aim of this chapter is to expose our positioning in terms of epistemological paradigm. First, a presentation of the main paradigms is provided to better apprehend the choice made for this research. Then, after a brief mention of the different epistemological approaches in management sciences, the choice made to ground our research into a specific paradigm, called Critical Realism, will be exposed. Finally, the research methodology relied upon will be articulated regarding the chosen paradigm.

The term “Epistemology” is defined by Piaget (1986) as the branch of philosophy that deals in substance with the essence and process through which emerge knowledge. According to Garvard-Perret and colleagues (2013), epistemology aims at studying the constitution of valid knowledge, focusing on what is knowledge, how is knowledge elaborated, and what makes it valid?

The positioning taken by a researcher must specify its “epistemological paradigm” to provide a valid knowledge. Indeed, adopting an epistemological positioning is crucial to ensure the validity and legitimacy of the research, as it is reviewed by our peers (Perret and Séville 2007, Wacheux 1996). An epistemological paradigm refers to different founding hypotheses that are shared among a scientific community, providing a solid theoretical grounding for assessing knowledge (Kuhn 2003, Piaget 1986). According to Garvard-Perret and colleagues (2013), four main pillars (founding hypotheses) are structuring epistemological paradigms: ontological hypotheses (what refers to reality - optional), epistemological hypotheses (what is knowable), methodological hypotheses (aim of knowledge) and the way knowledge is justified (legitimacy of knowledge).

Regarding research in management sciences, most of them are grounded in two main families of epistemological paradigms: the positivism and constructivism (Perret and Séville 2007). Positivism refers to the branch of epistemology that relies upon the natural sciences paradigm. This approach posits that reality is determined by natural laws and is independent from the observer (Martinet 1990). Accordingly, the research object cannot be distorted by the observer (Piaget 1986). Considering the strong need for objectivity from natural sciences and the difficulty to provide the same objectivity regarding artifact sciences (Raduescu and Vessey 2009), most of the positivist research in management sciences tend to adopt a post-positivist

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

approach, which relies upon optimal objectivity instead of complete objectivity (Gavard-Perret et al. 2013).

On the other hand, the constructivism approach adopts a more flexible ontological positioning by considering the reality as depending on the observer. Hence, the observer interacts with the research object to provide his explanation, with a reality shaped by the observation (Kuhn 2003). These two categories diverge in terms of founding hypotheses and does not share the same conceptualization of valid knowledge (Martinet 1990).

Based on these two approaches, several epistemological paradigms have emerged, diverging in terms of founding hypotheses and adopting either a positivist posture (dominant in management sciences) or a constructivist posture. Yet, regardless of the chosen paradigm, the research must strictly comply to the founding hypotheses structuring its epistemological paradigm to provide a valid knowledge (Piaget 1986, Gavard-Perret et al. 2013).

This research aims at studying the different mechanisms that potentially trigger a passive resistance toward smart objects, with an influence over attitudes, emotions, and behavioral intentions which are measurable and observable. The phenomenon (the passive resistance) exists independently from our observations. Our approach aims at explaining and conceptualizing those mechanisms. Accordingly, this research will adopt a post-positivist approach, grounded within the Critical Realism paradigm (Sayer 1992).

This epistemological paradigm perfectly fits with our research project. Indeed, the critical realism paradigm emerged regarding the limits faced in both positivist and constructivist approaches (Archer et al. 2015). The realistic approach distinguishes ontology (what is real) from epistemology (what is knowable from reality), acknowledging the fact that “human knowledge captures only a small part of a deeper and vaster reality” (Fletcher 2017, p.4).

The ontology hold by the critical realism paradigm posits that the reality is stratified into three domains: the Real, the Actual and the Empirical domains (Sayer 1992). Events are experienced by people within the empirical domain, where they can be measured and explained by human interpretation. They are observed and explained from a perspective, the human experience, which is subjective, trying to understand the causality link between the observation (the event) and what triggers it, or its mechanism (Archer et al. 2015).

Yet, events can also take place without the human experience, such as unobservable events, but they still exist. Accordingly, events exist within a higher domain called the actual where

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

they are not subjected to the human experience. They are only observed and interpreted within the empirical domain (Raduescu and Vessey 2009). Causal mechanisms from which originate the observed events are even less accessible. Accordingly, they are deemed to exist within the domain of real (Mingers 2004).

As an alternative to positivist and constructivist approaches, the critical realism paradigm aims at identifying causal mechanisms that are not directly observable but, triggers different events which can be potentially observed empirically. Hence, conjectures about how these mechanisms are structured and what activates them can be made regarding our perception, observation, and experience of such events (Mingers 2004). The main objective when relying upon the critical realism paradigm is not to predict but to explain, making it perfectly suitable for both exploratory research and explanatory framework (Raduescu and Vessey 2009). The following table exposes the founding hypotheses structuring this paradigm.

*Table 30 - Principles structuring the Critical Realism paradigm (Gavard-Perret et al. 2013)*

	<b>Critical Realism Paradigm</b>
<b>Ontological hypotheses</b>	<p>Reality exists independently from the observer. The reality is thus subdivided into three different domains:</p> <ul style="list-style-type: none"><li>➤ The domain of <b>Real</b>: includes the mechanisms that generate events.</li><li>➤ The domain of <b>Actual</b>: includes the events (that can be observed or unobserved) which are generated by the mechanisms.</li><li>➤ The domain of <b>Empirical</b>: includes all the experiences and perceptions of observable events.</li></ul>
<b>Epistemological hypotheses</b>	<p>The domain of Real is by essence, not accessible as it is not observable. Accordingly, the scientific approach focuses on trying to imagine how those generating mechanisms work (from which originate events), providing explanations based on the Empirical domain.</p>

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Methodological hypotheses</b>	The aim of knowledge is to identify and represent the mechanisms that trigger the experienced and observed events, which take place in the domain of Actual. Knowledge allows the research to provide an explanation about how they operate, and when they get activated through representations.
<b>Legitimacy of knowledge</b>	The representations of those mechanisms must be put into test to assess their validity (using both qualitative and quantitative research).

It is now possible to articulate our research project based on the critical realism paradigm. From an ontological perspective, the mechanisms, from which originates the passive resistance regarding smart objects, remain within the domain of Real and are not accessible. However, the events generated by the mechanisms and the experiences that derive from them (such as emotions and thoughts) allow us to provide a possible explanation and representation of how these mechanisms operate and how they get activated. We draw on the empirical domain (where observations and experiences take place), conjectures about the domain of real (where lie the mechanisms) from which originate events within the domain of actual (Mingers 2004).

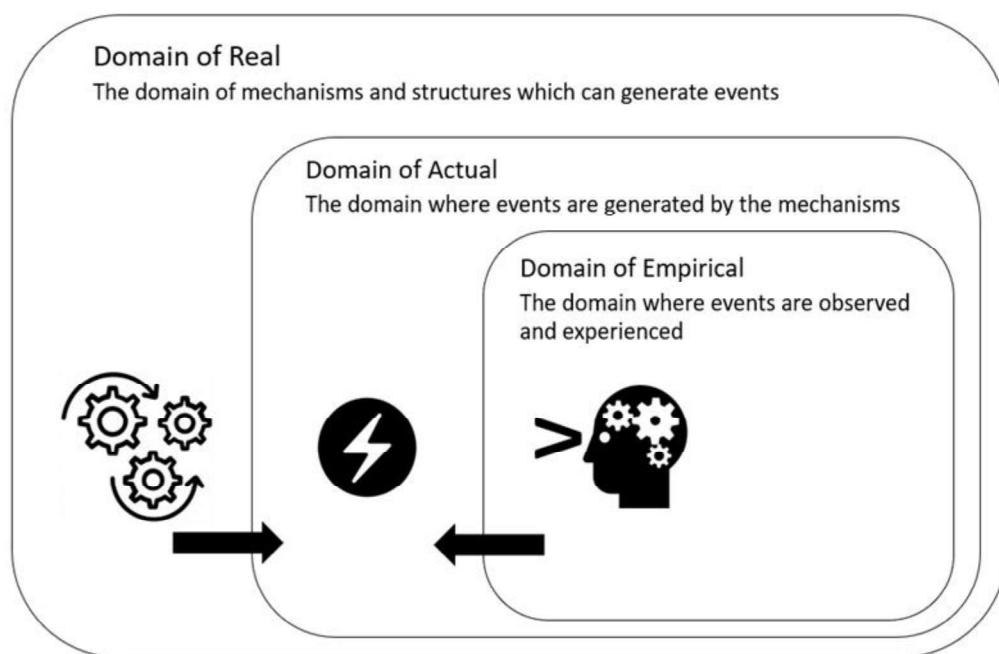


Figure 43 - Domains of Reality regarding the Critical Realism Paradigm (Mingers 2004)

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

However, this paradigm does not properly offer methodological guidelines or established methods (Fletcher 2017). Instead, it only consists of cycles of induction-abduction-deduction phases (Mingers 2004). To overcome this issue, several authors have tried to propose a guideline for conducting critical realist research. Accordingly, Danermark and colleagues (2001) and Raduescu and Vessey (2009) provided methodological guidelines to follow regarding critical realist research. Thus, this research, anchored within this paradigm, will ground its methodology regarding the method provided by these authors.

### **II- Methodology**

In line with the Critical Realism paradigm, this research follows a three-step approach relying on an induction / abduction / deduction cycle. This paradigm does not provide enough methodological guideline alone to make sure the research gets anchored within a realistic perspective (Fletcher 2017). To overcome this issue, we have decided to follow the methodology proposed by Danermark and colleagues (2001), and Raduescu and Vessey (2009).

According to these authors, empirical research that adopts the critical realism as its paradigm often divides into three different types of research: Structured, Structurable and Unstructured (Raduescu and Vessey 2009). This degree of structure is determined regarding the strength of domain-specific theory that will be involved in the research. Accordingly, “when strong domain-specific theory exists, the problem can be viewed as structured; when the domain specific theory is weak, it can be viewed as unstructured. When the extant theory is related only indirectly to the problem at hand, or perhaps not readily identified as relevant, then the problem can be viewed as structurable” (Raduescu and Vessey 2009, p.3).

Within structured research, the research can directly focus on concrete methods to provide a solution that is specific and fully explained by existing theories. On the other hand, unstructured research refers to exploratory research, with no or very few theories relied upon to provide an explanation (Raduescu and Vessey 2009). In between, structurable research refers to empirical research that seek to provide an explanation model. This type of research assumes a constant flow between concrete and abstract stages (Danermark et al. 2001). The concrete aspects basically refer to induction-deduction phases, while abstract aspects are more linked to

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

the conceptualization, abduction and conjectures made as regard the concrete steps (Raduescu and Vessey 2009).

According to Danermark and his colleagues (2001), structurable research method relies upon six different stages: Description, Analytical resolution, Abduction, Retroduction, Comparison between theories and Abstractions, Concretization and Conceptualization.

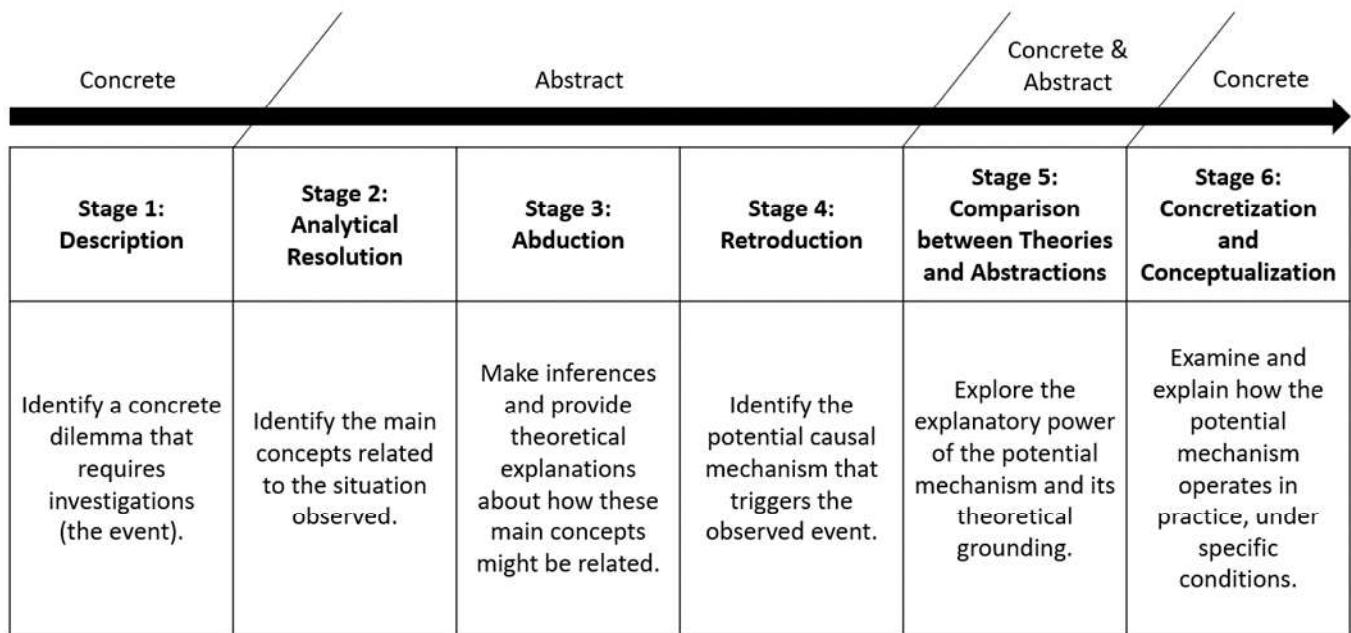


Figure 44 - Structurable Research Method in Critical Realism Research (Danermark et al. 2001, Raduescu and Vessey 2009)

Following their guideline, it is thus possible to clearly expose our methodology. Indeed, the literature review focuses on induction and abduction phases where we draw on the literature, observations and suppositions, a potential explanation of the mechanisms that generate the passive resistance regarding smart objects. Accordingly, the method relied upon in this research can be summarized as follow:

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*Table 31 - Methodological implications for Critical realism research*

Stage	Description	Section
<b>Stage 1 - Description</b>	We have exposed the actual resistance toward smart objects relying both on observations of specific behaviors related to smart objects resistance, and the literature of consumer acceptance-resistance toward smart objects.	Introduction Part 1 – Chapter 1: I / II
<b>Stage 2 – Analytical Resolution</b>	We identified core concepts from the acceptance-resistance literature and incorporated different and new concepts that might influence, mitigate, or impede acceptance by considering irrational motives as an antecedent of passive resistance.	Part 1 – Chapter 1: III / IV
<b>Stage 3 – Abduction</b>	We relied upon different theories (object-ontology, assemblages) to start making inferences about the potential link between the empirical observations and the different concepts in order to identify specific patterns.	Part 1 – Chapter 2: I / II
<b>Stage 4 – Retroduction</b>	We relied upon the patterns, theories and inferences made to describe the potential causal mechanism from which originates passive resistance toward smart objects.	Part 1 – Chapter 2: III / IV Conclusion Part 1
<b>Stage 5 – Comparison between Theories and Abstractions</b>	We relied upon a qualitative exploratory method called Album-Online (AOL) to explore the explanatory power of the identified mechanism and to provide additional insights regarding its main dimensions and implications.	Part 2 – Chapter 2
<b>Stage 6 – Concretization and Conceptualization</b>	We used the findings from the AOL to draw a conceptual model and hypotheses regarding the causal mechanism, that will be put into test to explain the observed phenomenon of passive resistance toward smart objects. This basically refers to our deduction phase (Wacheux 1996).	Part 2 – Chapter 3 & 4

Following this guideline, the next section will focus on stage 5. The aim is to provide empirical support for inferences made regarding the potential mechanism identified in stage 4.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Chapter 2 - Exploring the perception of smart object's innovative capacities from a relational perspective

#### Introduction to Chapter 2 - Exploring the perception of smart object's innovative capacities from a relational perspective

The second part of this paper is dedicated to our empirical approach relied upon to assess the potential existence of anticipated interactions with a smart object, mentally simulated by consumers. This chapter 2 focuses on the Stage 5 exposed above and will provide an empirical exploration of consumer-smart object anticipated interactions. Based on a qualitative approach called Album-On-Line - “AOL” (Vernette 2007, Kessous and Valette-Florence 2019), we investigate the dimensions underlying the anticipation of future interaction with smart objects, and how smart object’s emerging capacities are perceived by consumers prior to a real-life interaction.

This chapter will aim at answering our research objective n°1: “Explore the structure of the consumer-smart object anticipated relationship”. The result of this exploratory study is relied upon to elaborate our research model and hypotheses in chapter 3.

This section will follow the structure below:

Chapter 2 – Exploring the perception of smart object’s innovative capacities from a relational perspective

I – The Album-On-Line method (AOL)

II – AOL Scenarios and Sample

III – AOL Results

IV – From the AOL to Explaining the Potential Mechanism Activation

Figure 45 - Chapter 2 organization - Exploring the perception of smart object's innovative capacities from a relational perspective

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Our literature review has allowed us to make several inferences about the hidden mechanisms that could potentially explain consumer passive resistance regarding smart objects. Despite the rich and various contributions and theories cited within this empirical and theoretical review, the study of anticipated interactions with smart objects and the implication of anticipated relational outcomes between consumers and smart objects remain neglected (Monsurrò et al. 2020).

Regarding our approach, nothing firmly indicates if anticipated assemblages between consumers and objects operate just like real-life assemblages. Accordingly, evidence for the existence of both anticipated assemblages and their outcomes (positive and negative) must be provided to fill this gap.

A qualitative method called “Album-Online” (Vernette 2007) is relied upon to explore the anticipated assemblage made by consumers’ mental representations of future interactions with a smart object. This chapter will focus on assessing the existence of simulated assemblages before usage and exploring the simulated experience elicited by a smart object.

The purpose of this qualitative exploratory method is to investigate the anticipated experiences triggered by consumers’ mental simulations aroused by a smart object’s description. Our inferences suggest that smart object’s agency (its capacity to affect and to be affected) play a significant role in the emergence of negative attitudes and anxiety. Conversely, positive experiences are aroused by simulated experiences of self-extension, where the smart object is perceived as a useful tool.

### I - The Album-On-Line method (AOL)

#### *A- What is the AOL?*

The “Album-OnLine” (AOL) method, first developed by Vernette (2007), is an exploratory projective qualitative technique that relies on the selection and interpretation of images in order to map consumers’ mental representations of a specific consumption situation. The aim of this projective technique is to explore and understand the mental representations elicited by a consumption experience, and more interestingly, to provide a mapping of the meanings associated with it (Vernette 2007, Kessous et al. 2017).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

This projective technique relies on Zaltman assumptions which posit that consumers can better express their thoughts using images and non-verbal communication instead of words, while verbal communication and words play an important role regarding the storage of these thoughts and representations (Bickerton 1990). Indeed, at the basis of thoughts lie metaphors and evocations, which are essentials to understand hidden motives (Zaltman 1997).

Accordingly, Zaltman (1997) proposed a method called the “Zaltman Metaphor Elicitation Technique” or ZMET to better represent and understand those hidden motives. The ZMET approach consists of collecting images and stories that stem from metaphors. Other methods also rely upon the exploration of metaphors based on images to better understand consumers’ thoughts and emotions. The method proposed by Heisley and Levy (1991) for instance, requires from participants to take pictures of their own experience and to provide comments regarding each picture. The AOL method draw on both Heisley and Levy (1991) and Zaltman (1997) methods to investigate the metaphors and evocations from which originate thoughts and emotions (Pham et al. 2018).

Additionally, the AOL method combines advantages of individual approaches with the richness of exchanges that often results from group interviews (Kessous and Valette-Florence 2019). Indeed, this projective technique relies upon the Delphi approach which consists of a group appropriation of individuals’ contributions, such as thoughts or images (Dalkey and Brown 1972, Vernette 2007). The AOL consists of the creation of individual albums, the pooling of all individual albums into a collective album and the evaluation of this collective album by all respondents.

Following Vernette (2007), this method follows a three-step process. The first is to expose respondents to a scenario (such as the description of a consumption experience). The aim is to engage the participants into the experience described, to elicit thoughts and emotions related to this experience (Kessous and Valette-Florence 2019). After that, participants are asked to imagine and simulate stories regarding this experience. The participants are then invited to put words on each thought and each emotion, aroused by the stimulus. For each word, they are invited to search online for images that are the most representative of these thoughts and emotions. Images are thus associated with words. At the end of this process, respondents are asked to keep the five most important images to them, forming their individual albums and providing justifications regarding the metaphors associated with it (Vernette 2007).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The second step consists of pooling the individual albums together to form a collective album containing all the images, associated with words. The collective album is then shared with all the respondents, so that they can have the opportunity to comment the album or to modify their own images in favour of another image but keeping 5 images. Participants that decide to modify their album must provide a justification regarding the newly selected image. All selected images will form the final collective album relied upon for exploring the evocations (Vernette 2007).

In the last step, participants are invited to rate all the images associated with words contained in the final collective album on a Likert-scale from 1 (strongly disagree) to 6 (strongly agree) to ensure that the images and words associated with, correspond to the mental representations aroused by the stimulus (the experience). This last step differs from Vernette (2007) methodology which manually structures the association between the images and induces a bias regarding the analysis.

Instead, we follow the methodology proposed by Kessous and colleagues (2017) which rely upon an individual multidimensional scaling approach (INDSCAL) and does not suffer from the same bias as Vernette approach. The main advantage of the AOL method is that it allows respondents to express themselves indirectly by projecting their individual thoughts and emotions, while considering at the same time, projections put forward by other participants (Kessous & Valette-Florence, 2019). It is therefore ideally suited for exploring the mental representations of a group of consumers. Indeed, the last step gives us the opportunity to draw on an orthogonal map, all the images associated with words. The mapping allows us to visualize the proximity between images, identifying clusters of evocations (Kessous et al. 2017, Pham et al. 2018).

### B- Why using the AOL?

The literature review has allowed us to identify different concepts that are related to consumer-smart object relationship and smart object acceptance/resistance. It has also helped us to understand the potential implications of those concepts over the resistance. Additionally, this work has permit to make different inferences regarding the mechanism that might explain the observed phenomenon, supposing several interactions between the identified concepts.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

However, our inferences remain abstract. We draw on theories of real-life interactions between consumers and technology, suppositions regarding the implications of anticipated interactions. While it is supported by the literature that people can mentally simulate an interaction before it happens (Zhao et al. 2011), the experience and consequences of consumer-smart objects anticipated relationships remain to be explored (Monsurrò et al. 2020).

Indeed, technology has changed to the point it can be compared to a form of life (Zwick and Dholakia 2006) that consumers invest with meanings (Verhoef et al. 2017). In this context, the experience of real-life interaction with a smart object and its relational outcome cannot be merely transposed to anticipate interaction with a smart object and must be explored.

Exploring the consumer-smart object anticipated interaction and its implications means to investigate the metaphors and evocations elicited by the consumer-smart object relationship, prior to any real-life interaction. The aim of the AOL technique is to identify and structure the mental representations elicited by an experience (Vernette 2007, Kessous et al. 2017, Pham et al. 2018, Kessous and Valette-Florence 2019). Accordingly, the AOL appears to be particularly appropriate to explore the mental representations of consumer-smart object future interactions.

### *C- AOL Implementation*

Our literature review has shown that consumers tend to perceive smart object from two different perspectives. One involves the perception of the smart object as a tool (human-oriented perspective). The other involves the perception of the smart object as a partner (object-oriented perspective), or entity (Lindley et al. 2017). Both seems to be structured by cognitive and affective dimensions (Mani and Chouk 2017, Ardelet et al. 2017).

The perception of the smart object as a tool focuses mainly on the cognitive dimension of the interaction, where consumers assess the smart object based on performance-effort expectancies (usefulness, ease of use, cost of usage etc.). This perception involves how the consumer evaluates the technology in terms of improvements and performance (Rogers 1995). The perception of technology as a tool also involves an affective dimension, where the technology is seen as a meaningful possession which can potentially influence the social status and once self-image (Belk 2014, Venkatesh and Davis 2000).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Conversely, the perception of the smart object as an entity is more likely structured by the affective dimension, which reflects on the interaction outcome in terms of partnership instead of possession. Hence, this perception involves how the consumer perceives the smart object and himself in terms of interpersonal dynamics, focusing on the desirability and emotions elicited by the relationship (Monsurro et al. 2020). This perception also involves a cognitive dimension, where the relationship roles are being assessed regarding the principle of complementarity, meaning similar degree of cooperativeness and opposite degree of domination (Novak and Hoffman 2019).

While the cognitive dimension of technology perception is well documented, the affective dimension structuring the perception of technology as an entity (from an object-oriented perspective) remains neglected. The exploration of consumer-smart object anticipated interactions must consider both perspectives and dimensions. Accordingly, two conditions must be relied upon for the AOL: a cognitive scenario to explore the thoughts that structure the anticipated interaction, and an affective scenario to investigate the emotions that are elicited by the anticipated interaction.

The AOL study must involve a description of a consumption experience from a cognitive perspective, and the same consumption experience described from an affective perspective to separate thoughts (the structure of the anticipated assemblage) from emotions (anticipated relational outcomes).

## II – AOL Scenarios and Sample

For this study, we have decided to choose a product that does not hold any physical anthropomorphic cues to reduce the potential effect of human-oriented anthropomorphism (Goudey & Bonnin, 2016, Mori et al. 2012, Hoffman and Novak 2015). As the anticipated interaction must occur prior to any real-life interaction (Taylor et al. 1998) it was also important to choose a smart object that will trigger mental simulations of future interaction and be innovative enough to make sure no participant had experienced it before. That is why we have decided to focus on the smart home market and to provide the description of a “smart fridge” for this study.

Two descriptions of the smart fridge were made: a cognitive and an affective description, to isolate and elicit thoughts and emotions related to the smart object before the usage. A neutral

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

design was relied upon for both descriptions to reduce the potential influence of the description's design over the mental simulation. The descriptions were made based on real smart fridges descriptions already available on the smart home market to anchor the descriptions into a realistic experience. We made both descriptions similar in terms of structure and appearance. This was necessary to explore the structure of consumer-smart object anticipated assemblage regarding both cognitive motives, and emotional and affective motives.

Cognitive Description	Affective Description
<p><b>Bénéficiez du réfrigérateur connecté</b></p> <p>Le « Réfrigérateur Intelligent KH640 » est un réfrigérateur connecté, possédant les dernières technologies d'intelligence artificielle. Equipé de son écran tactile OLED et de la technologie Side Cooling, profitez de ce qu'il y a de plus performant.</p> <p>Avec sa grande capacité de stockage et son revêtement intérieur, vous obtiendrez ce qui se fait de mieux en matière de réfrigérateur.</p> <p>Le KH640 possède l'application « Recettes », permettant d'accéder à une liste de recettes suggérées selon les aliments présents dans le réfrigérateur.</p> <p>Son écran OLED permet de visualiser l'intérieur du KH640 depuis un smartphone. Plusieurs autres fonctionnalités permettent également de faire les courses, de consulter son agenda, ses emails, de regarder la télévision ou encore d'accéder à internet.</p> <p>Le KH640 peut également contrôler les autres objets connectés environnant tels que l'aspirateur robot, les luminaires, le four ou encore la machine à laver. Le KH640 est le produit qui améliorerait n'importe quelle cuisine.</p> 	<p><b>Vivez le froid connecté</b></p> <p>Faites de la cuisine un espace de bien-être grâce au nouveau « Réfrigérateur Intelligent KH640 ». Un espace de détente et de joie en partageant des moments uniques en famille et entre amis. Savourez le confort de ce bijou d'innovations.</p> <p>Avec le KH640, imaginez le plaisir de faire ses courses en quelques clics. Plus de contrainte, libéré des corvées, faites tout depuis votre réfrigérateur.</p> <p>L'assistant intelligent « Fridget » fera de la cuisine un endroit dynamique et convivial. Il se fera un plaisir de vous répondre et faire de vos échanges une expérience unique d'interaction.</p> <p>Régalez-vous grâce aux recettes équilibrées de Fridget. Prenez du temps pour vous et profitez de la vie grâce au confort offert par le KH640.</p> <p>Détendez-vous en laissant gérer l'ensemble de vos produits connectés, tels que l'aspirateur robot, les luminaires, le four ou encore la machine à laver. Le KH640 est le compagnon idéal de la cuisine de demain.</p> 

Figure 46 - AOL Cognitive and Affective descriptions

### A- Results from the pre-test

The descriptions were both pretested and modified twice, to make sure that they elicit respectively thoughts and emotions related to the mental simulations of future interactions. We used 8 items to assess the effectiveness of our stimulus. Accordingly, 4 specific items (Utility, Performance, Improvement, Informative) were measuring the importance of the cognitive

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

aspects of the description (Cronbach's Alpha = 0.791) and 4 specific items (Well-being, Pleasure, Relaxation, Conviviality) for the affective perspective (Cronbach's Alpha = 0.803).

The final pre-test was performed with a convenience sample of 66 participants recruited online (social medias) and randomly assigned to one of the descriptions (34 in the cognitive description and 32 in the affective description) from mid-April to May 2020.

Results from an ANOVA indicate a significant difference in terms of importance attributed to either cognitive or affective aspects regarding the descriptions. The descriptions were effective to stimulate respectively more thoughts for the cognitive description ( $M_{1\text{cognitive}} = 4.80$ ,  $M_{2\text{cognitive}} = 3.82$ ,  $F=10.597$ ,  $\text{sig}=0.002$ ) and more emotions for the affective description ( $M_{1\text{affective}} = 3.38$ ,  $M_{2\text{affective}} = 4.83$ ,  $F=36.934$ ,  $\text{sig}=0.001$ ). Accordingly, they appear appropriate to investigate respectively thoughts and emotions elicited by the cognitive and affective descriptions of the smart fridge experience.

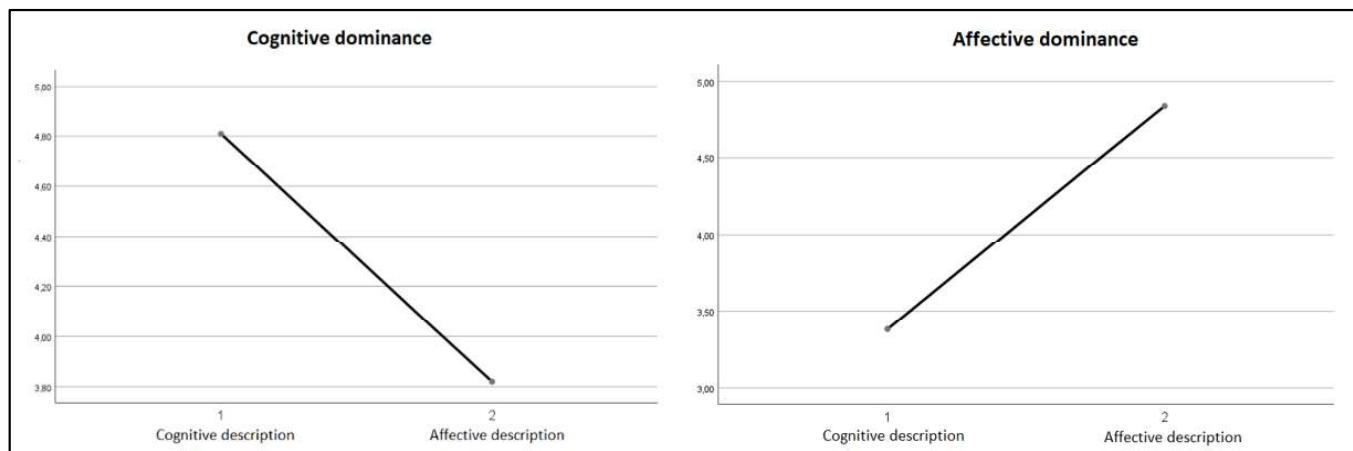


Figure 47 - Result from the pre-test regarding the AOL descriptions

### B- Sample

The AOL study was conducted from mid-May 2020 to July 2020. Two groups of 6 participants each were recruited with the support of the “Telemaque Institute Alumni association”. The profile of the participants was determined based on the annual report “Digital Barometer in France in 2019” (Credoc, 2019) provided by the General Council for the Economy, Industry, Energy and Technologies (CGE). We have chosen to investigate the segment of the population that corresponds the most to the target segment of the IoT market provided by the report. Thus, the profile for our study was: Male / Female, 18-39 years old,

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Student/Graduate, or with a High Income, who considers smart objects as an opportunity for them and the society.

The study sample therefore consists of 6 Women, 6 Men, aged from 18 to 35, Undergraduate Students (53%), Graduates (30%), Auto-entrepreneur (17%). The sample was then divided into two homogeneous groups, made up of 50% Women and 50% Men in each group, having an average age of 23 each (average age at which people tend to buy their first smart object according to the report) and with similar profiles (users, experience with IoT). The groups were subsequently exposed to one of the smart fridge descriptions (Group 1: cognitive description, Group 2: affective description). The sample is exposed below.

*Table 32 - AOL sample description*

Participants	Name	Gender	Age	Profession	Description	User	Experience
1	Axel	M	35	Auto-entrepreneur	Cognitive	Yes	Medium
2	Céline	F	19	Undergraduate student	Cognitive	Yes	Advanced
3	Imène	F	18	Undergraduate student	Cognitive	No	Novice
4	Kenza	F	20	Undergraduate student	Cognitive	Yes	Medium
5	Roban	M	19	Undergraduate student	Cognitive	No	Novice
6	Romain	M	27	Ph.D candidate	Cognitive	Yes	Medium
7	Arthur	M	26	Ph.D candidate	Affective	No	Novice
8	Bassirou	M	29	Auto-entrepreneur	Affective	No	Novice
9	Mathis	M	25	Ph.D candidate	Affective	Yes	Medium
10	Sarah	F	24	Unemployed	Affective	No	Novice
11	Tia	F	20	Undergraduate student	Affective	Yes	Medium
12	Vaïana	F	19	Undergraduate student	Affective	Yes	Advanced

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### *C- Procedure and data collection*

The first step as proposed by Vernette (2007) consists of immersing the participants into the experience, in our case with the smart fridge anticipated interaction.

After being exposed to the stimuli (cognitive or affective), we asked participants several questions, centring their attention over the anticipated interaction. This step, made based on our literature review, allowed us to get the participants more focused over the experience from either a cognitive (performance-effort expectancy) or affective (desirability) perspective. The aim of this step is to enable more reflexions regarding the descriptions, and to stimulate participants' mental representations (Christensen and Olson 2002).

#### **Focus on the experience : Cognitive description**

Now, think about the smart fridge description.

How do you find the overall quality of this product?

Do you think it can fully respond to consumers' expectations?

Do you think this smart fridge can be compared to a regular fridge? If not, what makes it different?

#### **Focus on the experience : Affective description**

Now, remember the emotions felt about the smart fridge description.

Do you like it?

Are you amazed by the product?

Would you like to use it?

*Figure 48 - AOL first step, immersion (Vernette 2007)*

Then participants were exposed to the following procedure (the same for both descriptions) to constitute their own individual albums. At this stage, participants had to write down their thoughts and feelings elicited by the description. Then, they had to collect online images (with Google Image for instance) that fitted the most with the thoughts and sensations felt. Finally, we asked participants to keep the five most important images associated with words, forming their individual albums.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### **Forming the individual album**

1. Imagine short stories, real or imagined, related to the smart object of the description.
2. Write down the words that spontaneously come to your mind when you think back to these stories.
3. Tap on a search engine (e.g. Google Image), one after the other the selected words (or others that you might think about).
4. Select from the web the images that are to your opinion, the most evocative or the most representative of the emotions and sensations felt.

The aim is to collect between 10 and 20 pictures.

5. From these images, create an album made up of the 5 pictures you prefer. Rank them in descending order of preference.
6. For each image, indicate why you selected it, describe the meaning attributed to it, and the link between the picture and your stories.

*Figure 49 - AOL individual albums procedure*

During the second step, all individual albums made of 5 images each were merged, forming a collective album of 30 pictures for each description. Following Vernette (2007) procedure, each participant was granted the possibility to modify their own individual album for another image from the collective album. Final collective albums contained: 30 images with 30 verbatims regarding the cognitive group album, and 28 images alongside 30 verbatims for the affective group album.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

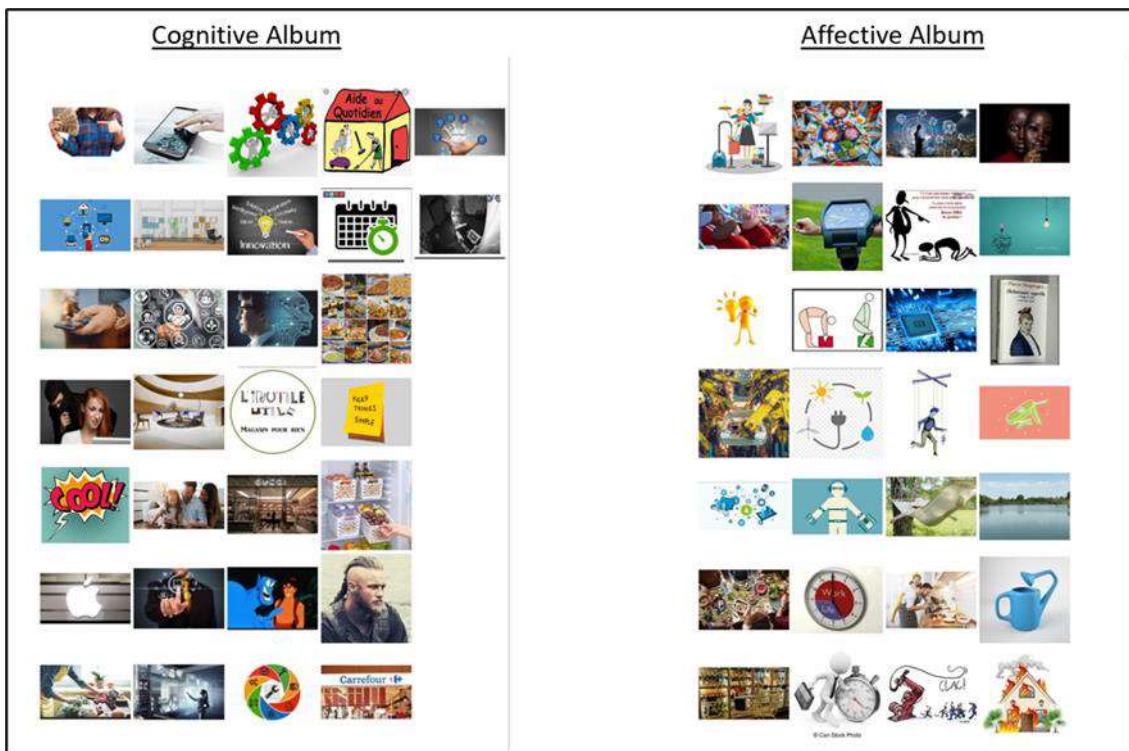


Figure 50 - Cognitive and Affective collective albums

From these albums, each image was associated with only one word extracted from the verbatims expressed by the participants. To restrict the potential bias induced by this step, the extraction was performed by two researchers. The final set of images was comprised of 58 images (30 cognitive, 28 affective) associated with one word each. Then, the album was sent back to participants who were invited to rate all the images associated with their dedicated word on a scale from 1 (strongly disagree) to 6 (strongly agree), to ensure that the images and words associated correspond to the mental representations aroused by the smart fridge descriptions (Kessous and Valette-Florence 2019).

### III- AOL Results

The analytical step aims at structuring all the pictures and associated words, in a space that illustrates the associations and proximity between the pictures and the evocations. This representation reveals the main dimensions of the phenomenon under study and allows us to structure it through the proximities between each image. As mentioned previously, we decided not to follow Vernette (2007) procedure regarding the analysis of the images and concepts.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Indeed, from his procedure, the researcher is invited to indicate manually and subjectively the disposition of each concept within the orthogonal space, which potentially introduces a bias.

Instead, we decided to follow the procedure proposed by Kessous and colleagues (2017), who rely on an individual multidimensional scaling (INDSCAL) approach to analyse the final dataset made of images and words. This method allows us to order objectively each concept on a map, where distances between items stem from the evaluations made by participants. Hence, it becomes possible to detect any underlying dimensions based on the observed similarities between the items.

In our case, the INDSCAL approach takes for each description, a set of 6 square symmetric matrices (of order  $p$ ) as input, of similar judgments of  $p$  stimuli (Kessous and Valette-Florence 2019). Differences in terms of image evaluation become distances. The INDSCAL approach explains the differences between participant's evaluations by a distance model where the stimuli are represented as points set in a stimulus map (Kessous and Valette-Florence 2019). Each participant perceives the map distinctively allowing them to give different prominence or salience to each of the dimensions. Accordingly, the analysis results in two distinctive mappings (cognitive and affective map) where thoughts and emotions are getting drawn over an orthogonal space (Kessous et al. 2017).

The interpretation is then synthesized in two mappings where the axes (representing the dimensions) are named regarding the items' disposition. Items that are close can be gathered to identify clusters that will indicate the nature of the dimension. Each image is associated with the word that was the most representative of the participants' feeling. The axes were named according to the pictures and associated words that were surrounding each axis. Overall, the INDSCAL analysis provided good-quality results in terms of adjustment between the mappings and the individual distances, which can be assessed regarding the R-squared values (RSQ). A RSQ value above 60% is considered as an indication for satisfactory results. In our case, the cognitive mapping explains 87.5% of the variance while the affective mapping explains 82.1%, therefore indicating a good quality of analysis and legitimates the interpretation of the mappings.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

A- Results for the Cognitive Mapping

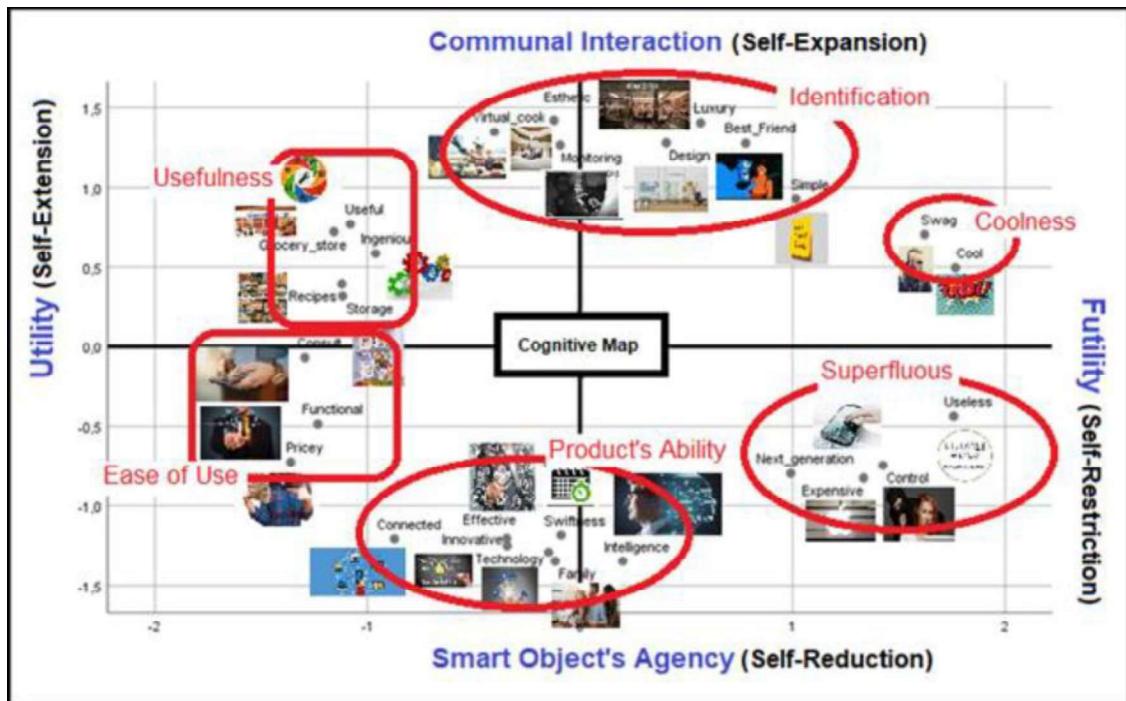


Figure 51 - AOL Cognitive Mapping – RSQ = 0.875

The proximity between each item allows us to identify 6 different clusters, providing meaningful information about the thoughts structuring the anticipated interaction:

- The perception of **Usefulness**: This cluster gather specific characteristics perceived as **Useful**, such as the smart fridge’s “**convenient storage** capacity”, its functionality for ordering **groceries** from the fridge “makes it a **convenient store**”, and **Ingenious**, as it “makes our life easier”. This group of items gather the concept of usefulness and refers to the smart object as a tool, used and useful, focusing on performance expectations.
- The perception of **Ease of Use**: This group of items refers to the concept of usage, yet it does not focus on specific technical characteristics. Instead, this cluster is more oriented toward effort expectancies, thinking about the smart fridge as a **Functional** tool “**easy to use** without a need to read a user manual”, that you can easily and intuitively **Consult** from your smartphone. The smart fridge also gives the impression of being **Pricey** which “makes sense as you have to pay a lot to have such handy functionalities”.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- The perception of ***Product's Ability***: This cluster is more oriented toward the perception of the technology embedded within the smart fridge, as if the smart fridge was more than a simple tool. Indeed, the object gives the sensation of ***Intelligence*** as if it “can think like a human”. The ***Technology*** is perceived ***Innovative*** “as it can do many different things”, ***Effective*** “with a lot of different functionalities”, ***Connected*** “with other objects and can control them”. It provides “more time and ***Swiftness***” to be spent with your ***Family***. This cluster is more oriented toward the anticipated role played by the smart object in the relationship and the outcome provided by the assemblage.
- The sensation of ***Superfluous***: It is defined by the sensation of uselessness and the ambivalence experienced by participants. Despite the fact it can be seen as a useful tool, the participants also felt that the smart fridge was kind of ***Useless*** with superficial functionalities that human can do themselves and perceived as “unnecessarily ***Expensive***”. Additionally, the smart fridge was seen as the ***Next Generation*** of products “with unimaginable functionalities”. Yet, some of these functionalities were perceived as not useful and even undesired such as the ***Control*** expressed through its capacity to monitor the users’ habits.
- The sensation of product’s ***Coolness***: This cluster refers to the social image associated with the smart fridge. The product is perceived subjectively as a ***Cool*** product “dynamic and fitting the pop culture” allowing the users to express a certain social status pretending being ***Swag***. Yet, this group of items is perceived by participants as not essential and even futile, not really fitting with the smart fridge main purposes.
- The process of ***Identification***: This group of items gathers different concepts and meanings that are associated with what becomes enabled by the interaction and integrated into participants’ sense of self. Indeed, the interaction with the smart fridge is compared to interacting with a ***Best Friend*** always besides you to provide you solutions, or to a ***Virtual Cook*** “that gives you advices and recipes”. The participants felt expanding the range of their own capacities, such as the ***Monitoring*** capacity, the ability to access the smart fridge anytime, from anywhere. Participants also identified themselves with the smart fridge’s ***Design*** and ***Esthetic*** giving them the feeling of holding a taste for ***Luxury***.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 33 - Evocations structuring the anticipated interaction with a smart fridge from the cognitive perspective

Cluster	Concepts extracted	Example of verbatims
<b>Usefulness</b>	Useful / Ingenious / Storage / Groceries / Store	<b>Useful:</b> “Because it can solve any problem that can occur.” <b>Ingenious:</b> “this smart object makes our life easier.” <b>Store:</b> “its shopping functionality makes it a convenient grocery store.”
<b>Ease of Use</b>	Functional / Consult / Pricey	<b>Functional:</b> “Its tactile screen, very functional, easy to use without a need to read a user manual.” <b>Consult:</b> “In the image we can see someone using his phone, it reminds me the fact of that we can consult what is in the fridge on the application.”
<b>Product's Ability</b>	Intelligence / Technology / Effective / Innovative / Swiftness / Family	<b>Intelligence:</b> “This smart object can think like a human.” <b>Technology:</b> “The smart fridge operates using advanced technology. Intended for people (“customers”), the product works by a process which can deliver a lot of information.”
<b>Superfluous</b>	Useless / Expensive / Next Generation / Control	<b>Useless:</b> “I find all of these functions superficial and not really useful ... it replaces the capabilities of humans. It is really something superficial that is not fundamentally useful.” <b>Control:</b> “I chose the photo because I feel like there is something about the fridge watching us and knowing all about us. He can be aware of all our actions in connection with the fridge or the internet or other smart objects.”
<b>Coolness</b>	Cool / Swag	<b>Cool:</b> “The image I chose was clearly because it reminds me the pop culture with a Warhol style, and I like it.” <b>Swag:</b> “I decided to pick a picture of Ragnar from Vikings, I found his character swag and stylish enough to represent the product.”
<b>Identification</b>	Best friend / Virtual Cook / Monitoring / Design / Esthetic / Luxury	<b>Best Friend:</b> “The genie of the lamp reminds me the smart fridge because he is always there to support Aladdin and he always finds solutions.” <b>Monitoring:</b> “The smart fridge capacities reminded me of an infra-red camera that can see at night. Because with it we could see at any time what is in the fridge.”

From the clusters and dimensions, it is then possible to better understand the thoughts associated with the anticipated interaction with the smart fridge. The smart fridge was assessed from two perspectives as previously exposed by our literature review: as a tool and as an interactive entity. Both were eliciting different evocations, providing support for our inferences.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

When the smart fridge is seen as a tool, participants were relying on performance-effort expectancies to evaluate the outcome of the interaction, illustrating the ambivalence felt regarding the product (Useful and Easy to Use, or Superfluous and Futile). On the other hand, when the smart fridge was considered as an interactive entity, the outcome was no longer assessed from performance-effort expectancies but instead, in terms of relational expected roles (Communal interaction or Smart object's Agency). This indicates two major things:

- First, participants can apprehend the future interaction with the smart fridge by adopting simultaneously a human-oriented perspective (the fridge is a useful tool that serves the participant's needs and desires) with only consumer-centric anticipated interactions (interactions that involves the consumer's usage, enabling or restricting the interaction). And an object-oriented perspective (the fridge expresses agentic capacities and interacts in communion) with both consumer and non-consumer centric anticipated interactions (interactions that don't necessarily involve the consumer, where the fridge operates on its own), supporting our inferences regarding the existence of a simulated consumer-smart fridge assemblage (consumer and non-consumer centric simulated interactions).
- Secondly, as we are dealing with a simulated assemblage, the anticipated experiences (that stem from the mental representations of future interactions) can be analysed regarding the framework provided by Hoffman and Novak (2018), but also regarding Novak and Hoffman (2019) conceptualization of consumer-smart object relationships. It is possible to consider the dimensions (the axes) as the anticipated experiences evoked by the consumer-smart object anticipated interactions. As assemblages emerge based on the relational interaction between entities (DeLanda 2011), the experience that stem from it will depend on agent's expressive roles (agentic and communal expressions). Hence, relying over the assemblage theory and the interpersonal relationship dynamic can help understanding the nature of the simulated experiences evoked by the anticipated consumer-smart fridge relationship.

Indeed, the representation structuring the thoughts related to the anticipated interaction with the smart fridge can be organized based on the consumer-smart object interpersonal relationships as conceptualized by Novak and Hoffman (2019). Accordingly, the two axes can be translated into agentic and communal experiences allowing us to identify the nature of each dimension:

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- The horizontal axis represents the agentic experiences simulated by the participants that range from self-extension anticipated experiences on the left side, to self-restriction experiences on the right side. The left side is characterized by the dimension Utility and is structured by two clusters: Usefulness (Useful, Ingenious, Storage, Recipes, Grocery store) and Ease of Use (Consult, Functional, Pricey). These clusters refer to the perception of usefulness, which is likely going to elicit the emergence of enabling experiences of extension (Hoffman and Novak 2018). Indeed, the more the smart fridge will be perceived as a useful tool, the more consumer will rely upon for being more performant, enabling the assemblage in self-extension experiences (Hoffman and Novak 2018).

On the other hand, the right side of this mapping is defined by the dimension Futility that will likely elicit anticipated constraining experiences of restriction (Hoffman and Novak 2018). This dimension is structured by two clusters: Coolness (Swag, Cool) and Superfluous (Useless, Expensive, Control, Next generation). These clusters refer to the perception of futility that will likely prevent the consumer to engage into the interaction. As the consumer decides not to engage, he constrains the assemblage as part of self-restriction experiences (Hoffman and Novak 2018).

- The vertical axis represents the communal experiences simulated by the participants, which includes self-expansion experiences at the top and self-reduction experiences at the bottom. Accordingly, the upper part of this mapping is structured by the dimension Communal Interaction, which is supposed to influence enabling experiences of expansion (Hoffman and Novak 2018). This dimension is defined by the cluster Identification (Best friend, Virtual cook, Simple, Luxury, Esthetic, Design, Monitoring). This cluster refers to the assemblage's capacities that are getting absorbed by the consumer as if it were its own, expanding the range of what the consumer believes he can do. According to Hoffman and Novak (2018) this is likely eliciting the emergence of self-expansion experiences.

Conversely, the lower part of the mapping is defined by the dimension Smart Object's Agency and refers to the cluster Product's Ability (Intelligence, Connected, Effective, Innovative, Technology, Swiftness, Family) that might elicit positive outcome (when perceived useful) or negative (when perceived useless). Accordingly, constraining experiences of reduction are likely going to emerge from product's capacity to constrain the assemblage. Indeed, this cluster focuses on what the product can do from a non-

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

consumer centric perspective (interactions that do not involve the consumer). The capacities perceived are not absorbed by the consumer, but perceived as the smart fridge agentic capacities, potentially reducing the range of what the consumer can do (Hoffman and Novak 2018).

Each dimension represents an evocation induced by the anticipated interaction with the smart fridge. Based on the cognitive mapping, we can posit that a various range of anticipated experiences are likely going to emerge from the mental simulation of future interactions. Thoughts regarding a potential interaction with the smart fridge have influenced the emergence of different experiences (extension, expansion, restriction and reduction). Real-life enabling or constraining experiences have different implications over the consumer behavior. According to Hoffman and Novak (2018) real-life enabling experiences of extension and expansion are supposed to give rise to positive relational outcomes. On the other hand, real-life constraining experiences of restriction and reduction are deemed to generate negative relational outcomes.

Hence, anticipated experiences as described by the cognitive mapping must result in similar relational outcomes as described by Hoffman and Novak's (2018) framework to be considered, in terms of relational outcomes, similar to real-life experiences. Meaning, anticipated enabling experiences (extension and expansion) must give rise to positive anticipated relational outcomes, while anticipated constraining experiences (restriction and reduction) must elicit negative anticipated relational outcomes.

The affective mapping, structuring the emotions induced by the anticipated interaction with the smart fridge, will corroborate or invalidate the similarity in terms of implications between real-life and anticipated consumer-smart object experiences.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*B- Results for the Affective Mapping*

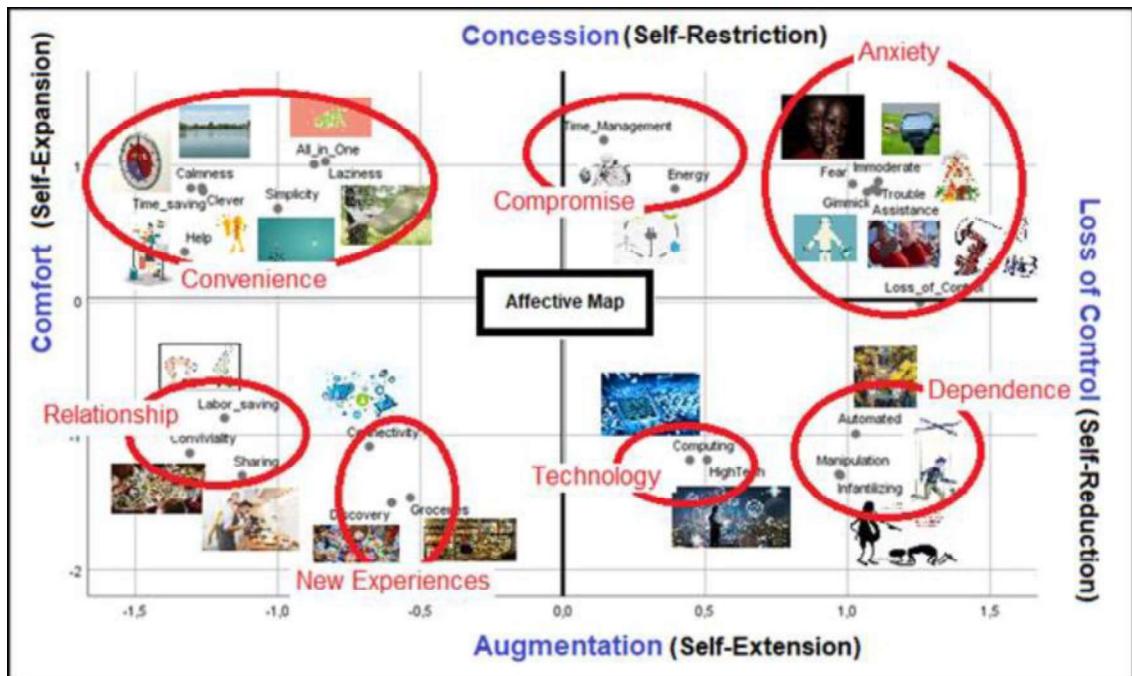


Figure 52 - AOL Affective Mapping - RSQ = 0.821

The proximities between items from the Affective mapping allow us to identify 7 different clusters, providing meaningful information about the emotions aroused by the anticipated interaction:

- The feeling of **Convenience**: This cluster gather different evocations regarding how convenient interacting with the smart fridge can be. It includes positive representations of relational outcomes. Interacting with the smart fridge evokes the feelings of **Calmness** “a calm and peaceful atmosphere”, **Simplicity** and **Laziness** “no more chore, someone does it for you”. This group of items refers to the smart fridge as a **Clever** and an **All-in-One** object “that gather many objects in one”, providing **Help** and **Time Saving**.
- The perception of a **Relationship**: This group of items focuses on the relationship and its positive outcome. Indeed, interacting with the smart fridge evokes the feeling of **Conviviality** and the **Sharing** of “happy moments”. These two items are centred around positive emotions elicited by the perception of a pleasant atmosphere, where consumer’s effort is lowered by the relationship capacities (**Labor Saving**).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- The perception of **New Experiences**: This cluster refers to positive sensations induced by the perception of new experiences that originate from the feeling of **Discovery**. The smart fridge **Connectivity** gives to the consumer the sensation of “taking advantage of many functionalities”, such as opening the fridge “as if you were in front of **Groceries** in a store”.
- The perception of **Technology**: This group of items provides indications about one aspect of how the embedded technology is perceived by participants. This **High Tech** is perceived “complex and sophisticated” with programs and **Computing** being embedded everywhere.
- The feeling of **Dependence**: This cluster gather different items that focus on the feeling of dependence elicited by the smart fridge capacities. Participants have the sensation that everything is becoming **Automated** “with people that become assisted”. These capacities elicit feelings of discomfort such as the sensation of being under the object’s **Manipulation, Infantilizing** users, with the object that tells us how to perform certain tasks.
- The feeling of **Anxiety**: This cluster is also driven by negative emotions and feelings of discomfort. The different items show that participants were experiencing **Fear** regarding what the smart fridge can do “if I give it access to my living space, to people who lives there, and if something happens...?”. Participants are feeling apprehension regarding potential **Trouble** that could happen if it gets access to other objects. The feeling of fear originates from the sensation of **Loss of Control**, giving the control to a **Gimmick** that is not infallible. Negative emotions and feelings also stem from the sensation of an **Immoderate** object, designed not only for consumer’s need, but instead as if it was designed for making us in need for **Assistance**.
- The perception of **Compromise**: This group of items refers to the potential counterparts and compromise consumers must concede for interacting with the smart fridge. Hence, taking the time to fully learn how the object works can take you some time (**Time Management**). On the other hand, the possibilities brought by the object’s functionalities might also demand a lot of **Energy** to make it work, mitigating its overall utility.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 34 - Evocations structuring the anticipated interaction with a smart fridge from the affective perspective

Cluster	Concepts extracted	Example of verbatims
Convenience	Calmness / Laziness / Simplicity / Clever / All-in-One / Help / Time Saving	<b>Calmness:</b> "This image illustrates well calmness because I found it conducive to meditation, which can only be done in a calm and peaceful atmosphere."  <b>Laziness:</b> "Laziness in its positive meaning, to take time, don't be in a rush, no more chore, someone does it for you".
Relationship	Conviviality / Sharing / Labor Saving	<b>Conviviality:</b> "The fridge is in the kitchen, so it is for me linked to the meal. The meal relates to friends. Indeed, that would make life easier, and the product description lets us imagine that we will be in a very friendly environment around a table with friends or family."  <b>Sharing:</b> "This image illustrates sharing because this father is having a joyful time with his daughter, sharing happy moments."
New Experiences	Connectivity / Discovery / Groceries	<b>Connectivity:</b> "the fridge is multifunctional and allows you to bring together several different tools, taking advantage of many functionalities."  <b>Discovery:</b> "I think this image illustrates the discovery. I chose it because these people participate in a culinary workshop which makes them discover foreign cuisine"
Technology	High Tech / Computing	<b>High Tech:</b> "This image illustrates well the complex and sophisticated side of high technology."  <b>Computing:</b> "I took the microelectronic chip image, because the technology today is computing, it's mostly programs, algorithms embedded, and it reminds me of computing."
Dependence	Manipulation / Infantilizing / Automated	<b>Manipulation:</b> "The image refers to the idea that objects manipulate individuals."  <b>Infantilizing:</b> "The image reminds me of the fact that these objects come to give, indirectly, rules of life."

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Anxiety</b>	Fear / Trouble / Loss of Control / Gimmick / Immoderate / Assistance	<p><b>Fear:</b> “I do not trust the object, if I give it access to my living space, to people who lives there, and if something happens...?”</p> <p><b>Loss of Control:</b> “The object is not infallible; this is linked to fear ...”</p> <p><b>Trouble:</b> “This is linked to fear, what if it escalates? Oven control in particular ... We no longer control things alone, we delegate control.”</p>
<b>Compromise</b>	Time Management / Energy	<p><b>Time Management:</b> “This image illustrates for me the understanding of how it works and the management of time. Which can sometimes be a dilemma.”</p> <p><b>Energy:</b> “I chose this image because I think it must take a lot of energy to make it work.”</p>

The anticipated experience with the smart fridge has elicited both positive and negative feelings. From the clusters and dimensions identified, it is then possible to better understand the emotions and feelings associated with the anticipated interaction with the smart fridge.

This provides support for considering a similarity in terms of implications between real-life and anticipated assemblages. The simulated interaction with the smart fridge has elicited both positive feelings (**Comfort** and **Augmentation**) and negative feelings (**Loss of Control** and **Concession**).

Following the cognitive psychology literature, many theories have provided support for considering that emotions originate from thoughts and judgments, such as the appraisal theory (Lazarus 1991, Roseman and Evdokas 2004, Giner-Sorolla 2019, Yih et al. 2019). According to Bagozzi (2020), “an appraisal is an evaluative judgment and can be a deliberative, conscious process or an automatic process that may or may not be conscious” (p.7). Emotions are supposed to result from these appraisals, or people’s evaluation of specific situations and their implications (Smith and Kirby 2009, Moors 2009). According to Frijda (1986), emotions are what bridges cognition with behavior, playing a mediating role between thoughts and behavioral intention.

From that perspective, the valence (positive or negative) of the emotional response is defined regarding how pleasant or unpleasant a specific situation is evaluated (Moors et al.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

2013). Accordingly, it is possible to link the cognitive and affective mappings to identify the thoughts that have potentially triggered the emotions and feelings.

The representation structuring the affective experience related to the anticipated interaction with the smart fridge can also be organized based on the Assemblage theory framework (Hoffman and Novak 2018). Like the cognitive mapping, the axes can be translated into agentic and communal experiences allowing us to identify the nature of each dimension (positive vs negative experience) and their link with the cognitive dimensions:

- The horizontal axis represents the communal experiences simulated by the participants that range from positive self-expansion experiences at the left, to negative self-reduction experiences at the right. The left side is characterized by the dimension *Comfort*, which refers to the feeling of Convenience (All-in-One, Calmness, Laziness, Time saving, Clever, Simplicity, Help) and Relationship (Conviviality, Sharing, Labor saving). This dimension basically refers to a positive feeling of expansion. It can be seen as the anticipated relational outcome elicited by the interaction with the assemblage, which is being absorbed by the consumer, resulting in a positive experience of self-expansion (Hoffman and Novak). This dimension shares the same evocations with the cognitive dimension *Communal Interaction*.

The right side of this mapping is defined by the dimension *Loss of Control*, which is structured by the two clusters Anxiety (Fear, Loss of Control, Trouble, Trouble, Gimmick, Assistance, Immmoderate) and Dependence (Manipulation, Infantilizing, Automated). This dimension involves negative feelings and emotions elicited by the smart fridge agentic capacities. It can be seen as the anticipated relational outcome elicited by the interaction with the assemblage, imposed over the consumer, resulting in a negative experience of self-reduction (Hoffman and Novak). This dimension is linked to the cognitive dimension *Smart Object's Agency*.

- The vertical axis represents the agentic experiences simulated by the participants, which includes positive self-extension experiences at the bottom and negative self-restriction experiences at the top. Accordingly, the lower part of the mapping is defined by the dimension *Augmentation* and refers to the clusters New Experiences (Connectivity, Discovery, Groceries) and Technology (Computing, High Tech). This dimension refers to a positive feeling of extension. It can be seen as the anticipated relational outcome

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

that results from the consumer willingness to enable the assemblage regarding the perceived utility of the technology. By enabling the interaction, the consumer enables the assemblage and new experiences are emerging. This relational outcome results in a positive experience of self-extension (Hoffman and Novak 2018). This dimension is linked to the cognitive dimension *Utility*.

The upper part of this mapping is structured by the dimension *Concession*, defined by the cluster Compromise (Energy, Time management). This dimension refers to a negative feeling elicited by the perceived object's uselessness. This feeling is likely going to result in a negative relational outcome preventing the consumer to enable the assemblage, but instead will give rise to negative constraining experiences of self-restriction (Hoffman and Novak 2018). Accordingly, this dimension seems to be linked to the cognitive dimension *Futility*.

Each dimension represents an evocation induced by the anticipated interaction with the smart fridge. In line with Hoffman and Novak (2018) assemblage theory, real-life enabling experiences of extension and expansion are supposed to give rise to positive relational outcomes. Conversely, real-life constraining experiences of restriction and reduction tend to elicit negative relational outcomes.

Hence, anticipated experiences as described by the affective mapping must result in similar relational outcomes as described by Hoffman and Novak's (2018) framework to be considered, in terms of relational outcomes, like real-life experiences. Meaning, anticipated enabling experiences (extension and expansion) must give rise to positive anticipated relational outcomes, while anticipated constraining experiences (restriction and reduction) must elicit negative anticipated relational outcomes.

Based on the affective mapping, we can observe that the anticipated experiences are eliciting different kinds of emotional response. Affective evocations regarding a potential interaction with the smart fridge hold both positive and negative valence, supporting the existence of ambivalent attitudes toward smart objects. It seems that such evocations stem from different anticipated experiences.

If we analyse the verbatims associated with the dimensions, we can clearly see that positive feelings of comfort and being augmented appear to originate from self-expansion and

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

self-extension experiences. On the other hand, negative feelings of losing control and having to make concession originate from self-reduction and self-restriction experiences.

The affective mapping represents the emotions and attitudes induced by the anticipated interaction with the smart fridge. It appears that the consumer affective response as regard the smart object follows the same pattern as described by Hoffman and Novak (2018) assemblage theory. Accordingly, both the cognitive and affective mappings corroborate the similarity in terms of implications between real-life and anticipated consumer-smart object experiences.

In the light of the AOL results, we can now provide a complete explanation of the potential relational mechanism that triggers anticipated positive and negative experiences.

### IV- From the AOL to Explaining the Potential Mechanism Activation

We can make a bridge between the two mappings by using the assemblage theory framework provided by Hoffman and Novak (2018). The dimensions from both mappings can be sorted in terms of enabling and constraining experiences associated with the evocations. The cognitive mapping dimensions can be seen as appraisals that triggers specific emotional responses (Bagozzi 2020), captured by the affective mapping.

To summarize, dimensions from the cognitive and the affective mappings are linked in terms of simulated experiences. Experiences can also be sorted into positive and negative experiences. Enabling experiences (positive) and Constraining experiences (negative) as described by Hoffman and Novak (2018). Accordingly, appraisals and their emotional response can be mixed to better understand the structure of anticipated experiences:

- Simulated experiences of self-extension are structured by the perceived smart fridge usefulness, which triggers the feeling of being augmented, extending the self into the object when engaging into the relationship (Hoffman and Novak 2018).
- Simulated experiences of self-expansion are structured by the perception of a communal interaction, where the assemblage (the capacities emerging from the interaction) enables the consumer. This perception of cooperativeness triggers the feeling of comfort, with participants absorbing these capacities as if they were their own (Hoffman and Novak 2018).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- Regarding constraining experiences, simulated experiences of self-restriction are structured by the perceived smart fridge uselessness, that triggers the feeling of having to make concessions for interacting, pushing the consumer to not engage into the relationship, restricting the assemblage (Hoffman and Novak 2018).
- Simulated experiences of self-reduction are structured by the perceived smart fridge agency, or the capacity of the smart fridge to shape the assemblage, and potentially reduce the consumer. This appraisal triggers the feeling of dependence and anxiety, or the perception of losing control over the relationship.

The cognitive and affective mappings confirm the relevance of relying over the assemblage theory (Hoffman and Novak 2018) but also the interpersonal relationship dynamic (Novak and Hoffman 2019) for assessing anticipated consumer-smart object interaction. The mappings confirm the inferences made regarding the mental simulation of future interactions with smart objects. Such simulations involve similar mechanisms, as if the interaction was experienced in real-life in terms of relationship structure (consumer and non-consumer centric interaction, with enabling and constraining experiences) and relational outcomes (enabling and constraining simulated experiences).

Indeed, as indicated in the literature review, positive experiences of self-extension (such as the “extended-finger”) stem from the perception of usefulness and utility. Consumers are likely going to enable the assemblage when they perceive the object as a useful tool, extending the range of what they can do (Hoffman and Novak 2018). Conversely, negative self-restriction experiences are likely going to emerge when the object is perceived useless, with superfluous characteristics. Accordingly, consumers will not enable the assemblage because of the concessions associated with the usage. Hence, consumers are likely going to restrict the assemblage and the interaction, constraining the range of what the assemblage can become (Hoffman and Novak 2018).

Regarding the communal dimension of the interaction, as mentioned in the literature review, the identification and internalization process of the assemblage’s emerging capacities is likely going to elicit positive experiences of self-expansion. The consumer is absorbing the assemblage’s capacities into his sense of self (Hoffman and Novak 2018). On the other hand, the highly agentic capacities expressed by the smart object also indicates that it is now able to restrict the assemblage. Accordingly, the smart object’s perceived capacities are likely eliciting

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

negative experiences of self-reduction. Indeed, the negative emotions felt and the feeling of losing control were always associated with the smart object's agency. People tend to fear what the object could do, based on what it can do. The capacity to affect the relationship and to modify the assemblage has raised apprehension and negative attitudes towards what the assemblage can become.

Consequently, the AOL and the two mappings have provided the following table, summarizing the link between thoughts (appraisals) and emotions (affective response):

Descriptions	Enabling Experiences		Constraining Experiences	
	Self-Extension	Self-Expansion	Self-Restriction	Self-Reduction
Cognitive	Utility	Communal Interaction	Futility	Smart Object's Agency
Affective	Augmentation	Comfort	Concession	Loss of Control

*Figure 53 - Linking Thoughts and Emotions from anticipated experiences*

Smart objects possess unique capacities based on artificial intelligence, allowing them to express agency and control. Thus, consumers are facing an entity that is not only agentic, but that can also perform tasks that consumers are not able to do. This imbalance in agency can lead consumers to feel underpowered compared to the smart object, eliciting the emergence of feeling servant of the relationship (Coser 1973), giving to the object the role of master (Schweitzer et al. 2019).

Based on the perception of being potentially dominated by smart objects in future interactions, consumers may resist to enter in such intimate relationship (Bartholomew 1990) by developing negative attitudes toward smart objects before usage (Ardelet et al. 2017).

The AOL results confirm the existence of simulated assemblages, occurring in anticipated experiences, where consumers mentally simulate interactions with the smart object before it happens in the real world. These anticipated experiences seem to play a significant role in the perception of usefulness (utility, futility) and ease of use (comfort, concession), but also in the emergence of emotions (anxiety) and attitudes (feeling of losing control) toward the smart object before the purchase.

Our qualitative exploratory research highlights the need for considering anticipated experiences as part of the emergence of a relational barrier as previously mentioned by

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Monsurrò and colleagues (2020). Such relational barrier and anticipations are potentially preventing consumers to engage into a future relationship with smart objects.

We have confronted our inferences with the AOL findings. This exploratory phase aimed at digging into the mechanism's structure that might trigger passive resistance and anxiety toward smart objects prior to any real-life interaction. It seems that anticipated interactions with smart objects involve the same dynamic as real-life interpersonal relationships. Consumers appear to be able to mentally simulate the smart object's expressive role (based on its perceived level of agency) and their own role during the anticipated interaction. Accordingly, the anticipated relational outcome directly influences the emotional response and attitude toward the future interaction.

Like real-life interpersonal relationships, the expected role attributed to smart objects depends on its capacities to affect and to be affected (Novak and Hoffman 2019). Based on this perceived agency and the principle of complementarity (Horowitz et al. 2006), consumers apprehend and anticipate the relational outcome. If a smart object is perceived highly agentic, consumers might simulate their role as the servant of the relationship. Conversely, if a smart object is perceived with a low level of agency, consumers might perceive themselves as mastering the relationship, anticipating positive relational outcomes.

Consequently, it is possible to conceptualize this mechanism and the relationship between the core concepts by empirically measuring:

- The perceived level of smart object's agency.
- The mental simulation of future interaction induced by the smart object's agency.
- The level of agency and communalism (expected role) expressed by consumers confronting the simulated interaction.
- The perceived usefulness and ease of use induced by the simulated interaction
- The negative emotions (anxiety) and attitudes toward the simulated interactions.
- And finally, the intention to engage in the simulated interaction with the smart object.

Next chapter will focus on how to operationalize the evaluation of the potential mechanism, providing different hypotheses and a conceptual model to assess the relationship between all concepts.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Chapter 3 - Concretization and Conceptualization – Examine and explain how the mechanism operates

Introduction to Chapter 3 - Concretization and Conceptualization – Examine and explain how the mechanism operates

The following chapter will expose our hypotheses, the conceptual model and the methodology used to examine and assess our explanation of the mechanism that elicit the resistance and anticipated negative attitudes toward smart objects.

This part refers to the stage 6 and aims at fulfilling the research objective n°2: “Study the influence of smart-object’s capacities over the consumer behavior from a relational and interpersonal perspective”, and its sub-objectives:

- Sub-objective n°1: “Study the influence of perceived object’s capacities over consumer expected role”
- Sub-objective n°2: “Study the emergence of anxiety based on mental simulation of potential relational outcomes”
- Sub-objective n°3: “Study the impact of potential relational outcomes over smart objects’ adoption”).

This chapter will expose the way we intend to assess anticipated relationship, their relational outcomes, and their implications in terms of behavioral intention. Accordingly, it follows the structure below:

Chapter 3 – Concretization and Conceptualization – Examine and explain how the mechanism operates

I – Hypotheses and Conceptual model

II – Measurement scales

III – Concretization design

Figure 54 - Chapter 3 organization - Concretization and Conceptualization - Examine and explain how the mechanism operates

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### I - Hypotheses and Conceptual model

The literature review and the exploratory qualitative research have highlighted several concepts and mechanisms that can be sorted in two categories: main hypotheses and model hypotheses.

The main hypotheses consist of three main hypotheses regarding the potential impact of object's agency over consumer's acceptance and resistance as highlighted by the AOL findings.

On the other hand, model hypotheses refer to the relationships between the concepts involved in the potential mechanism based on our inferences. They are the hypotheses made regarding the relations between the latent variables identified in our literature review. These hypotheses can also be sorted in three different groups for more clarity: antecedent variables, interpersonal relationship variables, and consequences.

Accordingly, the presentation of all hypotheses will follow the structure below:

- Main hypotheses
- Antecedent variables:
  - Object Agency (its capacities)
  - Image Elaboration
- Interpersonal relationship variables:
  - Feeling of being dominated in terms of agency
  - Feeling of reduction in terms of communal
- Consequences:
  - Anxiety
  - Perceived Usefulness and Ease of use
  - Attitude toward future usage and Intention to use

#### Main hypotheses

Our AOL exploratory study has shown that consumers were able to mentally simulate future interactions with smart objects. Based on the capacities and features expressed by the smart object, consumers have anticipated the interpersonal relationship and its potential outcomes.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Accordingly, consumers that felt reduced and dominated by the smart object's agency have developed negative emotions and feelings that originate from the smart object's capacities. This is supported by the interpersonal relationship dynamic and its complementarity principle (Horowitz et al. 2006). Indeed, a highly agentic expression calls for a lower agentic expression. A dominated entity will enter a stable relationship with a dominated entity (Novak and Hoffman 2019). Hence, a high expression of agentic features might trigger feelings of being dominated and reduced.

Such feelings of being dominated and reduced can potentially explain the negative emotions felt by participants who confronted the smart fridge. Accordingly, we suppose the following main hypotheses:

**H1: The object with the highest level of agency will elicit more anxiety than the others.**

**H2: The object with the highest level of agency will be perceived more negatively in terms of attitude toward future usage compared to the others.**

Additionally, negative emotions and attitudes are deemed to impede intentions (Ajzen 1991). We believe that the anxiety and negative attitudes elicited by the smart object's agency can potentially impede the intention to use the object in the future. Consequently, we suppose the following hypothesis:

**H3: The object with the highest level of agency will elicit lower intention to use it.**

Now that we have posit our main hypotheses, we are going to expose our assumptions made regarding the process through which smart object's agency elicit these negative attitudes and intention. We believe that certain variables and mechanism are involved and operate prior to the emergence of anxiety and negative attitudes. Hence, we rely upon a conceptual model to explain the process through which the resistance toward smart objects might emerge.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Antecedent variables

#### Object's agency

Events that are mentally simulated are hardly measurable. To be more precise, mental simulation is not accessible, as it is mentally simulated and has no substance in the empirical domain (Taylor et al. 1998). The concept of mental simulation often refers to the concept of “imagery processing”.

Imagery processing can be defined as “an information processing mode which uses one or more of the five senses” (Bone and Ellen 1990, p.450). It refers to the process of representing information as simulated pictures and situations, with images, sounds, feelings being mentally simulated (Ellen and Bone 1991).

Due to its nature, the process of mental imagery has always represented a challenging construct to conceptualize (Babin and Burns 1998). Researchers have attempted to identify the dimensions underlying the process under which people mentally simulate situations based on available information and stored memory (MacInnis and Price 1987). According to the literature, the mental simulation of a situation and images is deemed to be a latent construct with multiple dimensions (MacInnis and Price 1990). Hence, trying to provide a measure of mental simulations appears to be a complex task.

Yet, based on Ellen and Bone (1991) conceptualization of imagery processing, Babin and Burns (1998) identified three main dimensions structuring mental imagery: image vividness, image quantity, and image elaboration.

Image vividness refers to Ellen and Bone (1991) conceptualization and is defined as the intensity of the mental simulation process. This dimension can be seen as the clarity and intensity of images mentally simulated. Quantity is defined by the number of images simulated by individuals. This dimension refers to the number of evoked situations that are mentally simulated. The last dimension is called Image elaboration and stems from Ellen and Bone (1991) Imagery Links concept. According to Babin and Burns (1998), image elaboration can be defined as “the activation of stored information in the production of mental images beyond what is provided by the stimulus” (p.266). This dimension is particularly interesting as it refers to the influence of a stimulus over the capacity to produce imagined and additional situations

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

mentally simulated. The elaboration dimension of imagery processing is what refers to our definition of mental simulations.

Based on our AOL results, we found that participants have simulated additional situations based on the description of the smart object provided. Moreover, participants have developed attitudes and emotions regarding what the product could do, instead of what it can do. Hence, the image elaboration concept might capture the impact of smart object's capacities over the mental simulation. Indeed, according to the authors, "a low level of elaboration implies merely evoking what is provided by the stimulus, while higher levels of elaboration imply imagery beyond what is provided by the stimulus" (Babin and Burns 1990, p.267).

Consequently, the more complex and social the smart object appears to be, the more furnished and social the mental simulation will be. We can posit the following hypothesis:

### **H4.0: Object's agency has a positive influence over the image elaboration capacity.**

Additionally, the AOL findings coupled with the interpersonal relationship literature advocate for a close relationship between the smart object's agency and three different concepts: the feeling of being dominated and reduced, and the anxiety felt.

It appears that smart object's agency can elicit the mental simulation of future interpersonal interaction with consumers. Such simulated interaction seems to work like real-life interpersonal interaction. Hence, the degree of domination and control expressed the smart object have a similar influence over the role expected by consumers.

The literature also shows that consumers tend to react more negatively to products which possess features of control (Kang and Kim 2020). The agency hold by the smart object would potentially increase the feeling of being dominated and reduced by the smart object, in line with the complementarity principle (Horowitz et al. 2006). Additionally, the AOL findings suppose a direct influence of smart object's agency over the anxiety felt. Participants had apprehension regarding the capacities hold by the smart object, which can potentially dominate the relationship and harm users. Consequently, the more the smart can influence and control the relationship, the more consumers will feel dominated, reduced, and anxious. Thus, we posit the following hypotheses:

**H4.1: Object's agency positively influences the feeling of being dominated in terms of agency.**

**H4.2: Object's agency has a positive influence over the anxiety felt.**

**H4.3: Object's agency positively influences the feeling of being reduced in terms of communality.**

*Image elaboration*

Mental simulations are supposed to enhance the relationship between thoughts and actions. Accordingly, they are supposed to have a significant influence over people's behavior (Pham and Taylor 1999, Zhao et al. 2007). Moreover, anticipatory processing posits that anxiety might emerge based on predictions and anticipations of potential future negative outcomes (Mellings and Alden 2000). Accordingly, the simulation of future events that have not yet occurred influences the perception of these anticipated outcomes (Taylor et al. 1998).

However, our AOL has shown two distinctive anticipated negative outcomes: the feeling of being dominated by the smart object and the feeling of being reduced by the assemblage.

As mentioned by Novak and Hoffman (2019), the feeling of being dominated by the smart object involves part-part interactions where the consumer directly interacts with the smart object. Conversely, feeling reduced by the relationship (the simulated assemblage) involves part-whole interactions, where the consumer feels diminished by the relational outcome (the emerging experience). Accordingly, the mental simulation captured by the image elaboration will influence the feeling of being dominated alone. Indeed, the smart object's agency will influence the anticipated interaction. The more consumers will apprehend smart object's agency, the more they will tend to feel dominated by its agency by simulating situations where the object acts like the master of the relationship. This comes in line with our tendency to simulate others' mental states (Davies and Stone 2001). Hence, we suppose the following hypothesis:

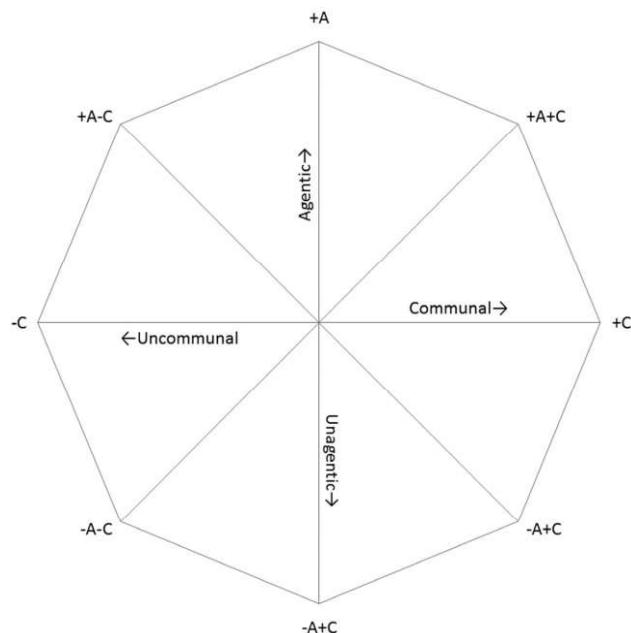
**H5: Image elaboration has a positive influence over the feeling of being dominated.**

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### *Interpersonal relationship variables*

To assess the feelings of being dominated and reduced in terms of relational dynamics. We must rely upon the interpersonal relationship literature. Based on this, it becomes possible to use the interpersonal circumplex model to assess the expected role anticipated by consumers based on agentic and communal expressions (Locke and Adamic 2012)

According to Locke (2015), a high expression of communion indicates the willingness to enhance cooperation and the feeling of closeness, while a low expression of communion shows a feeling of vulnerability. Regarding agency, a high level of agency expressed by an individual indicates the willingness to dominate and gain control over the relationship, while a low level of agency shows the intention to avoid rivalry.



As conceptualized in our literature review, the feeling of being dominated originate from the smart object's agentic expression. The principle of complementarity indicates that a highly agentic expression triggers a highly Unagentic expression. Conversely, the principle of correspondence posits that a highly communal expression elicits the same expression of communality (Horowitz et al. 2006).

Hence, it appears theoretically possible to link the Unagentic vector of the circumplex to the feeling of being dominated by the partner, while the Uncommunal vector can be considered as the feeling of being reduced (vulnerable) by the relationship. Accordingly, both feelings of being dominated and reduced can be measured and integrated into our research model.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Feeling of being dominated in terms of agency

Technology has become widely spread and necessary in our everyday life, especially internet-based products, and services (Hoffman et al. 2014). This dependency can lead consumers to develop negative attitudes toward technology, illustrated by concepts such as technostress (Weil and Rosen 1997, Shu et al. 2011) or technology anxiety (Nomura and Kanda 2004).

The impact of dependence on consumer resistance have only been considered regarding active resistance (Mani and Chouk 2017). Its impact on passive resistance has not been examined due to its nature (Ram and Sheth 1989). Yet, according to Novak and Hoffman (2019), considering consumer-smart objects relationships as interpersonal relationships allow us to study the influence of dependence (in terms of domination) on consumer resistance as a part of a master-servant relationship. From this perspective, we can measure dependence and its influence as the degree to which the consumer feels dominated by the assemblage.

Our literature review and the AOL support the assumptions made earlier. The smart object's expression of agency can potentially trigger the feeling of being dominated in terms of relational outcome. Such anticipated experience had multiple consequences.

First, consumers might anticipate negative relational outcomes emerging from the simulated assemblage. As there is a risk for being dominated in part-part interactions, consumers might apprehend being reduced during part-whole interactions (Novak and Hoffman 2019). Thus, we suppose the following hypothesis:

**H6.0: The feeling of being dominated in terms of agency has a positive influence over the feeling of being reduced in terms of communalit**y.

Secondly, part-part interactions under which the consumer is the servant of the relationship might elicit apprehension and anxiety toward engaging the relationship. The simulated experience of being dominated might directly influence the emergence of negative attitudes and emotions, especially the anxiety felt as exposed in our AOL exploratory study. Consequently, we can posit the following hypothesis:

**H6.1: The feeling of being dominated in terms of agency has a positive influence over the anxiety felt.**

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Last, the experience that is mentally simulated might operate like real-life experience as supposed by the AOL. Experience can be defined as all “the thoughts, emotions, activities and appraisals that occur during or as a consequence of an event” (Pagani and Malacarne 2017, p.135). It refers to all the beliefs associated with the evaluations of an event, situation or even people and objects (Calder and Malthouse 2004). Hence, consumer experience emerges from a continuous flow of stored memory related to past or anticipated interactions. The literature has shown the extent to which past experiences can influence the perception of usefulness, as a determinant of future usage (Taylor and Todd 1995, Ajzen and Fishbein 1980, King and He 2006).

According to Schweitzer and colleagues (2019), the perception of smart objects as servants of the relationship improves the feeling of usefulness and self-extension. Consequently, the more the smart object express high levels of agency, the less it is going to be perceived useful. Accordingly, the negative part-part interaction (feeling of being dominated) might impede the perception of usefulness as a reaction of avoidance (Ardelet et al. 2017). Hence, we posit the following hypothesis:

### **H6.2: The feeling of being dominated in terms of agency has a negative influence over the perceived usefulness.**

#### *Feeling of being reduced in terms of communality*

The feeling of being reduced in terms of communality refers to the perception of being diminished by the simulated assemblage, where the smart object plays the role of master and the consumer, the servant of the relationship. Such anticipated relational configuration might have several consequences.

First, consumers might face the famous struggle for domination. Indeed, they start feeling that the smart object is potentially dominating the relationship and aspires to the role of master. Hence, the object is challenging the natural configuration of consumer-object interaction. As a consequence, consumers might start feeling negative emotions, such as fear and anxiety. Such phenomenon has been observed in our exploratory study (AOL). The more the smart object will express a form of domination through its agentic capacities, the more the consumer will feel dominated. Thus, the negative experience of being reduced by the future relationship triggers negative emotions and attitudes. Based on our literature review regarding

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

the struggle for domination and the Frankenstein complex (Hegel 1977, Asimov 1975), we believe that the feeling of being reduced will influence the emergence of negative emotions. Accordingly, we suppose the following hypothesis:

**H7.0: The feeling of being reduced in terms of communality has a positive influence over the anxiety felt.**

On the other hand, the literature provides strong support for considering prior experience as affecting the perceived ease of use (Igbaria et al. 1996). Such perception can also be translated in terms of perceived complexity or the capacity of consumers to understand the technology being used (Mani and Chouk 2018). For that reason, the negative experience of being reduced might influence the perception of the smart object as an alien artefact, challenging its supposed nature. Accordingly, we posit the following hypothesis:

**H7.1: The feeling of being reduced in terms of communality has a negative influence over the perceived ease of use.**

### Consequences

Theories and models of prediction of human behavior postulate that “performance or non-performance of a behavior is a function of salient information, or beliefs, relevant to the behavior” (Ajzen and Driver 1991, p. 186). These salient beliefs can be relied on and adapted to predict the attitude toward smart objects’ adoption. Indeed, prior beliefs regarding a specific behavior are supposed to shape the attitude toward it (Davis et al. 1989, Venkatesh and Davis 2000). As we are dealing with mental simulated assemblages, we can posit that attitude toward using smart objects is influenced by:

- The perception of benefits (performance expectancy through Perceived Usefulness) and efforts expectancy (with Perceived Ease of Use) as instrumental components of attitude.
- On the other hand, the anxiety elicited by the mental simulation and the expected role within the relationship can be considered as the affective response that contribute to the attitude formation.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Consumers might believe that using smart objects in part-part interaction will have positive consequences in terms of performance (“they are useful”) but at the same time, developing negative feelings towards part-whole interaction (“I feel anxious as regard the interaction”). Thus, it is important to separate instrumental from affective beliefs.

Based on the AOL results and the interpersonal relationship literature, we argue that simulated experiences can elicit emotions (positive or negative). Consequently, the expected role endorsed by consumers (in terms of feeling dominated and reduced) might have a significant influence over the emergence of negative emotions, especially anxiety.

Control beliefs are defined as the requisite resources and opportunities that go alongside with the behavior. They include past experiences, but also any other information that increase or reduce the perceived difficulty of adopting the behavior (Ajzen and Fishbein 1980). As a matter of fact, “the more resources and opportunities individuals believe they possess, and the fewer obstacles or impediments they anticipate, the greater should be their perceived control over the behavior” (Ajzen and Driver 1991, p.188).

Based on the interpersonal relationship literature, we can propose an interesting adaptation of control beliefs. Relationships are supposed to be stable when they meet certain criterion (reciprocity of agency, complementary of communality). Thus, different relationship styles can potentially lead to either stable and positive relationships or unstable and negative outcomes. The expected role (in terms of agency and communality) held by people within a relationship not only fully encompass the definition behavioral control, which reflects anticipated obstacles and impediments associated with a behavior, but also have a direct influence over affective responses (positive vs negative experiences).

Contrary to theory of planned behavior or models of technology acceptance, we posit that the interpersonal relationship framework can help to explain technology acceptance and resistance. Accordingly, the consequences of simulated interaction over the consumer behavioral intention, and more specifically, the formation of attitudes toward future usage can be assessed through the interpersonal relationship dynamic.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Anxiety

According to Harwood and Garry (2017), as there is no central entity to rely on for trust related issues, trust becomes a fundamental component of the perceived value “residing within and across a network of actors and objects” (p.444). The consumer interacts with a network of objects and might have his own understanding of its capacities as well as his role within the interaction. Thus, the degree of trust depends on agentic roles expressed by both consumers and objects (Harwood and Garry 2017).

Most consumers remain unaware of how smart objects work in collecting, analysing, and processing private information. Consequently, consumers interacting with smart objects might feel vulnerable and develop apprehension toward them (Mani and Chouk 2017). Therefore, trust exists due to the interaction between at least two different agents. Agents can be humans, but also objects, organizations, and technologies. Situations that involve humans and technologies are deemed to be frequently associated with uncertainties (Fusaro 2002, Rogers 1995).

Mayer and colleagues (1995) define trust as a process under which one agent (trustee) accepts to lose control over a specific situation, and to become vulnerable regarding actions of the other agent (trustee) based on expectations made. For the authors, trust has three main determinants: ability, benevolence, and integrity.

Ability refers to a set of capacities and traits that agents express for domination and control. Benevolence is defined by the extent to which the trustee expresses kindness toward the trustee. Integrity refers to the degree to which both the trustee and trustee adhere to the same or relatively close set of values and beliefs. The perceived risk depends on agents' abilities (or agency), trustee's degree of benevolence and agents' integrity (or communality) (Mayer et al. 1995).

Regarding smart objects, people tend to feel tension when objects express high levels of agency (Jia et al. 2012). This state of tension can also impede the performance-effort expectancies and negatively influence the attitude toward future usage (Venkatesh 2000, Igbaria and Parasuraman 1989). Accordingly, the expectations made regarding future relational outcomes can elicit negative emotions that will have an impact over the perception of usefulness and ease of use, but also directly upon the attitude toward future usage. Hence, we made the following hypotheses:

**H8.0: The anxiety felt has a negative influence over the perception of usefulness.**

**H8.1: The anxiety felt has a negative influence over the perceived ease of use.**

**H8.2: The anxiety felt has a negative influence over the attitude toward future usage.**

Additionally, studies have shown that affective components of attitude toward a specific behavior are better predictors of intention than instrumental components (French et al. 2005). Consequently, we believe that a direct influence of negative emotions over the intention to use the smart object might exist. We posit the following hypothesis:

**H8.3: The anxiety felt has a negative influence over the intention to use.**

*Perceived usefulness and ease of use*

Perceived usefulness and ease of use are largely known for being key variables of technology acceptance models since the work of Davis (1989). Based on the theory of reasoned action, exposed by Ajzen and Fishbein (1980), these concepts refer to the degree to which a person feels improved by using the technology and the perceived effort required to use it (Amoako-Gyampah 2007). Literature already highlighted the effect of perceived usefulness on consumer adoption of IoT devices (Bruner and Kumar 2005, Kim and Shin 2015, Kang and Kim 2020). Regarding smart objects, perceived usefulness can be defined as the perceived benefits (convenience, saving time, new uses) resulting from future use of smart objects (Mani and Chouk 2017). Thus, it is directly referring as outcomes of extension and expansion experiences (Hoffman and Novak 2018).

According to the literature, “the TAM measures (Perceived Usefulness, Ease of Use, and Intention to use) are highly reliable and may be used in a variety of contexts.” (King and He 2006, p.751). This is corroborated by Sun (2003), which found that perceived usefulness and ease of use were one of the most important determinants of technology acceptance. According to Davis (1989, p.320): “A system high in perceived usefulness, in turn, is one for which a user believes in the existence of a positive use-performance relationship”. Conversely, a system perceived as useless will impede this effect (Mani and Chouk 2018). Hence, we posit the following hypothesis:

**H9: The perception of usefulness positively influences the attitude toward future usage.**

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Additionally, there is strong support for the idea that perceived ease of use also influences attitude toward using the system (Davis et al. 1989, Chau 1996). According to Davis (1989, p.320) “an application perceived to be easier to use than another is more likely to be accepted by users.” Indeed, Davis and his colleagues (1989) have shown the extent to which perceived ease of use affects directly attitudes toward using the system. The concept of perceived ease of use also refers to the perception of complexity and ability to understand the system (Chouk and Mani 2016). Hence, in line with Davis and colleagues (1989), Chau (1996) and Venkatesh and Davis (2000), we posit that:

**H10: The perception of ease of use has a positive influence over the attitude toward future usage.**

### Attitude toward future usage and Intention to use

This variable refers to the evaluation of user’s desirability to use a system (Mathieson 1991). Attitude toward using a system is defined by user’s positive and negative thoughts and feelings about a specific behavior (Brown and Venkatesh 2005) or elicited by the acceptance or resistance toward a system (Davis et al. 1989). It is also defined as “the degree to which a person has a favorable or unfavourable evaluation or appraisal of the behavior in question” (Ajzen 1991, p.188). This definition encompasses the previous one and corresponds to our conceptualization. This construct includes both affective and cognitive components (Ajzen and Fishbein 1980). Thus, it becomes possible to consider anxiety (anticipatory affect) and perceived usefulness / ease of use (instrumental components) as its main antecedents.

Studies have shown the significant relationship between attitude toward using a system and the intention to use it (Mathieson 1991, Chau 1996). Indeed, while most of research of technology acceptance have omitted attitude toward using, researchers must pay attention to its influence over acceptance behavior (Kim et al. 2009). According to Chau and Hu (2001), attitude toward using a system tend to be positive when users believe using the system will benefit them. For Ajzen (1991), the more positive is the attitude toward using the system, the stronger individual’s intention should be.

Unfavourable attitudes are often associated with undesirable consequences, while favorable attitudes are deemed correlated with desirable consequences (Fishbein and Ajzen

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

1975). Attitudes toward usage will indicate how desirable the potential interaction with the smart object is. Consequently, we suppose that attitude toward using the smart object will directly affect the behavioral intention. A positive attitude toward the future usage will increase the intention to use it, while a negative attitude hold regarding future usage will decrease the intention to use the smart object. Hence, we posit the following hypothesis:

**H11: Attitude toward future usage has a positive influence over the intention to use.**

Regarding the intention to use, this variable refers to consumer's intention to perform a specific task or behavior (Davis et al. 1989). Several studies have already brought support for considering behavioral intention as a reliable predictor for technology acceptance and actual usage (Davis et al. 1989, Mathieson 1991, Taylor and Todd 1995, Venkatesh and Davis 2000). According to Davis and his colleagues (1989), user's actual usage of computers can be accurately predicted by their intentions. This is also supported by Turner et al. (2010) which findings suggest a strong correlation between behavioral intention and future usage.

We also posit that measuring intentions will provide insights on whether consumers will adopt or reject smart objects. Moreover, "people's computer use can be predicted reasonably well from their intentions" (Davis et al. 1989, p. 997). In line with previous findings, we posit that behavioral intention represent a good indicator and predictor to assess acceptance and resistance, providing insights on whether consumers are inclined to accept or reject the smart object.

The following figure shows our conceptual model and the relations we identified across the core concepts that originate from both our literature review and the AOL findings.

We believe smart object's agency will trigger the consumer's ability to elaborate mental simulation. The capacities hold by the smart object coupled with the anticipated interaction will influence the feeling of being dominated. In turn, the smart object's agency, and the feeling of being dominated will trigger the emergence of negative experiences of reduction alongside negative emotions (anxiety). These negative anticipated experiences will also negatively influence the perception of usefulness and ease of use. Accordingly, both attitudes and intention to use the smart object will be negatively influenced by the anticipated interpersonal relationship and its anticipated outcomes.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

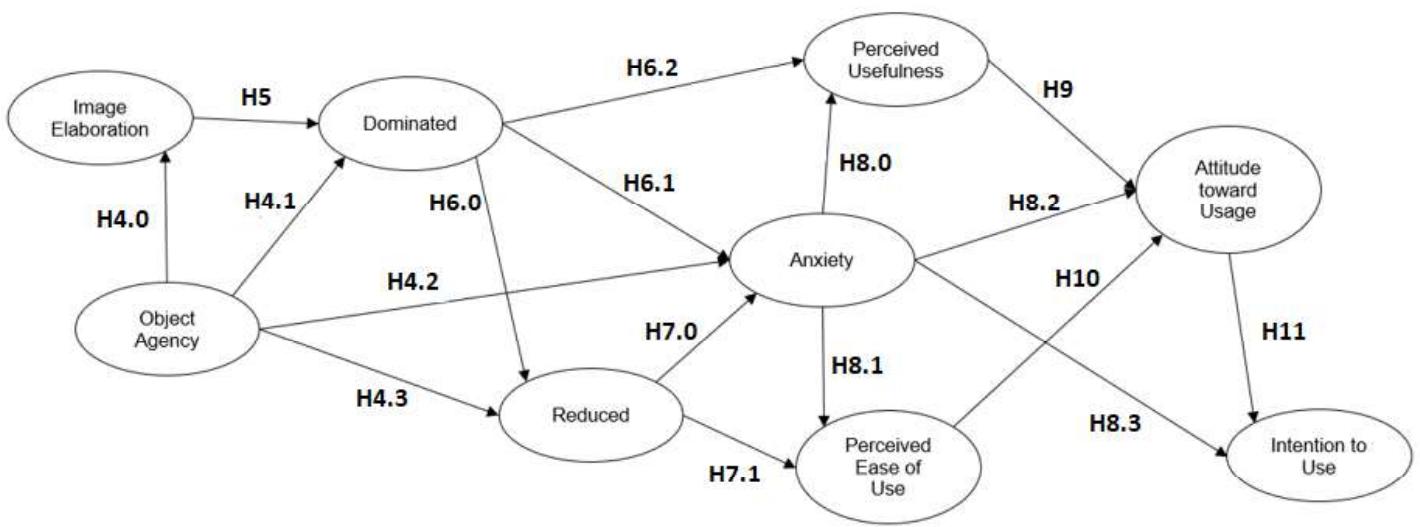


Figure 55 - Conceptual model - The model of interpersonal technology acceptance

The summarized all the hypotheses in a table for clarity:

Group	Hypotheses
Antecedent variables	H4.0: Object's agency has a positive influence over the image elaboration capacity.
	H4.1: Object's agency positively influences the feeling of being dominated in terms of agency.
	H4.2: Object's agency has a positive influence over the anxiety felt.
	H4.3: Object's agency positively influences the feeling of being reduced in terms of communalism.
	H5: Image elaboration has a positive influence over the feeling of being dominated.
Interpersonal relationship variables	H6.0: The feeling of being dominated in terms of agency has a positive influence over the feeling of being reduced in terms of communalism.
	H6.1: The feeling of being dominated in terms of agency has a positive influence over the anxiety felt.
	H6.2: The feeling of being dominated in terms of agency has a negative influence over the perceived usefulness.
	H7.0: The feeling of being reduced in terms of communalism has a positive influence over the anxiety felt.
	H7.1: The feeling of being reduced in terms of communalism has a negative influence over the perceived ease of use.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Consequences	H8.0: The anxiety felt has a negative influence over the perception of usefulness.
	H8.1: The anxiety felt has a negative influence over the perceived ease of use.
	H8.2: The anxiety felt has a negative influence over the attitude toward future usage.
	H8.3: The anxiety felt has a negative influence over the intention to use.
	H9: The perception of usefulness positively influences the attitude toward future usage.
	H10: The perception of ease of use has a positive influence over the attitude toward future usage.
	H11: Attitude toward future usage has a positive influence over the intention to use.

## II - Measurement scales

This section is dedicated to the presentation of our measurement scales. We relied upon reliable and valid measurement tools to assess the different concepts of the conceptual model. The scales were modified when necessary to better fit our research topic. We expose the different scales based on the same structure relied on for sorting our hypotheses.

### Antecedent variables

#### Object Agency (manipulated variable)

We relied on Rijssdijk and colleagues (2007) concept of object's intelligence to measure the concept of object's agency. However, the original scale aims at measuring object's intelligence through six different dimensions: autonomy, reactivity, ability to learn, ability to cooperate, humanlike interaction and personality.

While humanlike interaction and personality can easily fit in a human-oriented ontology, these dimensions suppose an anthropocentric approach, violating the flat ontology principle in the object-oriented ontology. According to Novak and Hoffman (2019), these

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

dimensions induce an anthropocentric ontology, while autonomy, ability to learn, ability to cooperate and reactivity can be seen as variations of agency and communality which fulfil the conditions of a flat ontology (different capacities, same ontological status).

Accordingly, we removed the two last dimensions and relied upon four dimensions and 17 items to measure the concept of object's agency: the perceived autonomy and reactivity, alongside the ability to learn and to cooperate. All dimensions were assessed on a Likert scale from 1 (Not agree at all) to 6 (Totally agree).

Table 35 - Rijssdijk et al. (2007) Measurement Scale - Object's Agency

Object's Agency	Scale	Dimension	Items “Please indicate to what extent the object corresponds to the following statements:”
Object's Agency	Autonomy	Autonomy	This product determines how it performs tasks.
			This product makes decisions on its own
			This product takes initiatives
			This product does things by itself
	Reactivity	Reactivity	This product works based on observations
			This product is aware of its surroundings
			This product reacts to changes
			This product directly adapts its behavior to the environment
	Ability to learn	Ability to learn	This product can learn
			This product performs the tasks better and better
			This product learns with experience
			This product gets better on its own
	Ability to cooperate	Ability to cooperate	This product adapts itself over time
			This product may cooperate with other objects
			This product communicates with other objects
			This product can be connected to other objects
			This product works better when cooperating with other objects

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

A general score of smart object's agency is obtained by averaging the items. The higher the score, the more intelligent and agentic the object is perceived.

### Image elaboration

We relied upon the scale proposed by Babin and Burns (1998) for measuring the image elaboration capacity. Elaboration is defined as the activation of images used in the elaboration of mentally simulated situations beyond what is offered by the stimulus.

A high elaboration score indicates a high ability to integrate information, the participant's interest, and ability to experience the stimulus, all in a process of constructing scenarios and mental images (Ellen and Bone 1991). This indicates if the participant goes further than what is proposed in the stimulus. A low score indicates on the contrary that the participant did not go further than what the stimulus proposes.

Items were assessed on a scale from 1 (Not agree at all) to 6 (Totally agree).

Scale	Dimension	Items
<b>Image Elaboration</b>	/	I fantasized about interacting with the product of the description.
		I imagined what it would be to use the product.
		I imagined the feel of using the product.

### Interpersonal relationship variables

#### The interpersonal circumplex model

The most complicated concepts to measure were the concepts related to the anticipated interpersonal outcome (e.g., feelings of being dominated and reduced). We relied upon the interpersonal circle literature to measure expressions of agency and communal (Wiggins, 1979, Kiesler, 1983).

Interpersonal circumplex measures are designed for assessing specific behaviors based on the measurement of agentic and communal expressions (Locke 2000). It consists of a series

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

of items that aim at measuring specific points of a circumplex that captures all the possibilities in terms of relational expression (Pincus and Ansell 2003). The circumplex is made 8 octants that allow the computation of 4 different vectors: the Agentic Vector, the Unagentic Vector, the Communal Vector, and the Uncommunal Vector.

Haslam (1994) has provided a list of 32 items describing the axes of the interpersonal circle. From this pool of items, 16 items (2 per dimension) were retained regarding their relevance with our research topic. Accordingly, 16 items were relied upon to measure the interpersonal circle. Items were measured on a Likert-scale from 1 (not at all) to 6 (totally agree).

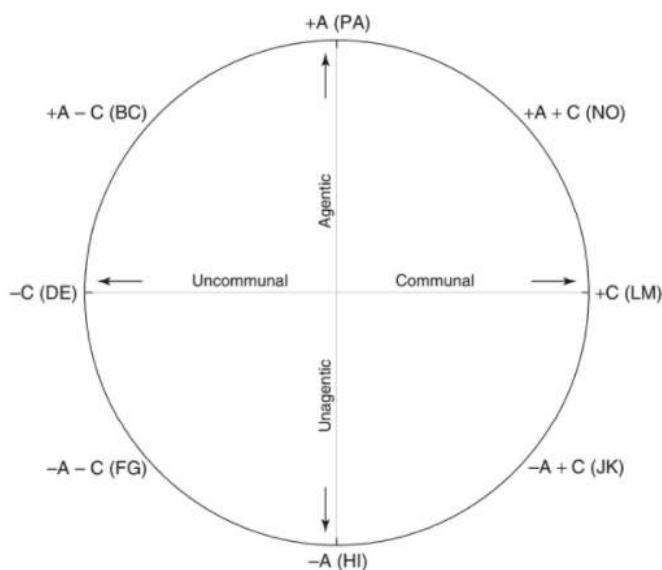


Figure 56 - The interpersonal circumplex model (Locke and Adamic 2012)

We followed the recommendation and guidelines from Locke and Adamic (2012) to compute the four vectors structuring the circumplex. Accordingly, the vectors were computed as follow:

- Agentic Vector (AV) = PA + (0.707\*(BC + NO))
- Unagentic Vector (UAV) = HI + (0.707\*(FG + JK))
- Communal Vector (CV) = LM + (0.707\*(JK + NO))
- Uncommunal Vector (UCV) = DE + (0.707\*(BC + FG))

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The interpersonal circumplex model also allows us to compute agentic and communal vectors, that can help identify the degree of domination and communion expressed by an agent, or its agentic and communal dispositions (Locke and Adamic 2012). With this method, we can map on two dimensions, people's interpersonal positioning in terms of agency and communality. This allows us to provide a graph of this kind (A and B being different agentic entities).

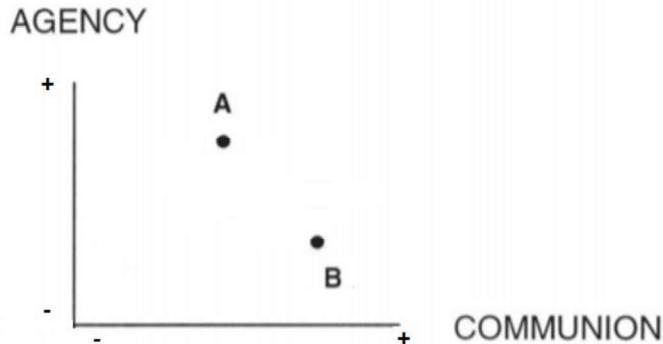


Figure 57 - Mapping interpersonal positions

The method for mapping the consumer interpersonal response is as simple as follow:

- Agency = Agentic Vector – Unagentic Vector
- Communality = Communal Vector – Uncommunal Vector

The Agency gives us the degree of perceived agency of an individual. On the hand, the Communality refers to the perceived degree of communion of an individual.

Based on Novak and Hoffman (2019) conceptualization of consumer-smart object relationships styles, the interpersonal circumplex measures and the direct measures of anxiety, attitude, and intention, it becomes possible to explain the simulated experience lived by the participants regarding the smart object exposed in the description.

Mixing direct measures of behavioral intention with measures of interpersonal motives provide meaningful information regarding how people felt regarding a situation (which is simulated in our case) or a partner (Locke 2015).

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*Table 36 - The interpersonal circumplex model*

Scale	Dimension	Items
<b>The interpersonal circumplex model</b>	+A (PA)	“By mentally simulating interactions with the object, I imagine that...”
		“...I assert myself against him”
	+A+C (NO)	“...I dominate the relationship”
		“...I am open to interaction”
	+C (LM)	“...I am sociable”
		“...I am pleasant”
	-A+C (JK)	“...I am cooperative”
		“...I am courteous”
	-A (HI)	“...I am confident”
		“...I am dependant”
	-A-C (FG)	“...I obey the object”
		“...I am distant”
	-C (DE)	“...I am withdrawn into myself”
		“...I am cold”
	+A-C (BC)	“...I am indifferent”
		“...I am cunning”
		“...I am suspicious”

### Consequences

#### Anxiety

The anxiety induced by the smart object's agency can be seen as a momentary state of tension elicited by the mental simulation of potential relationship outcomes (negative experiences). Accordingly, measuring anxiety through measurement scales like robot or computer anxiety scales might not correspond to our approach. These different scales aim at measuring the anxiety and apprehension elicited by using the technology regardless of the

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

individual's personal traits (Nomura and Kanda 2004). Our approach aims at measuring the anxiety elicited by consumer's reaction to smart object's agency.

Accordingly, the anxiety does not directly stem from the usage experience, but from expected relational outcomes (negative relational experiences). For that purpose, we decided to measure this anxiety as the mood, or momentary state of tension and anxiousness felt by the consumer when simulating future interaction with the smart objects.

We relied upon the Activation Deactivation Adjective Check List (AD-ACL) scale first proposed by Thayer (1986) and the Positive and Negative Affect Schedule (PANAS) from Watson and colleagues (1988), to measure anxiety as the high negative arousal provoked by expected relational outcomes. From that perspective, anxiety regarding the anticipation of relational outcome refers to a momentary state of high tension induced by simulated negative experiences (Gregg and Shepherd 2009). A general score of anxiety is obtained by computing the mean of these five items.

Likert-scale:

- 1 (not at all)
- 2 (a little)
- 3 (moderately)
- 4 (often)
- 5 (totally)

*Table 37 - Anxiety measurement scale*

Scale	Dimension	Items “When imagining the interaction with the object, I felt...”
Anxiety	/	Tense
		Anxious
		Fearful
		Nervous
		Edgy

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Perceived Usefulness and Ease of use

Perceived Usefulness and Perceived Ease of Use were measured based on items used in prior research from the TAM literature (Davis et al. 1989, Agarwal and Prasad 1997, Venkatesh 2000, Venkatesh and Davis 2000, Venkatesh and Brown 2001, Venkatesh et al. 2003, Kim et al. 2009, Lee and Lehto 2013).

Perceived Usefulness was supposed to measure the extent to which the smart object can be relied on to improve the effectiveness, enhancing performance by performing tasks more rapidly. And Perceived Ease of Use aimed at measuring the extent to which using the smart object will be free of effort, measuring its usage complexity, and the extent to which using the smart object will be easy. All items were measured on a scale, from 1 (not at all) to 6 (totally agree).

Table 38 - Perceived usefulness scale

Scale	Dimension	Items
<b>Perceived usefulness</b>	/	Using this object will improve my daily life.
		The object is convenient.
		The object is useful.

Table 39 - Perceived ease of use scale

Scale	Dimension	Items
<b>Perceived Ease of Use</b>	/	Using the object is clear and understandable.
		Using the object does not require a lot of mental effort.
		I find the object to be easy to use.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Attitude toward future usage and Intention to use

Attitude toward usage and Intention to use were also operationalized based on the TAM literature (Davis et al. 1989, Venkatesh 2000, Venkatesh and Davis 2000, Venkatesh et al. 2003).

Attitude toward usage was supposed to measure the evaluation (positive or negative) associated with using the smart object in the future. While intention to use was based on planned utilization and the intent to use the smart object in the future, regardless of its price.

*Table 40 - Attitude toward usage scale*

Scale	Dimension	Items
<b>Attitude toward usage</b>	/	Using the object appears to be a good idea.
		I feel positive about the idea of using the object.

*Table 41 - Intention to use scale*

Scale	Dimension	Items
<b>Intention to use</b>	/	Assuming I can have access to the product, I intend to use it.
		Given that I have access to the product, I would use it.

### III – Concretization design

The aim of this research is to explore the effect of simulated interpersonal relationships over the acceptance and resistance toward smart objects.

Based on our literature review and exploratory study, we believe that different expressive roles endorsed by the smart object (different levels of agency) should elicit different types of interpersonal relationship patterns.

We relied upon Rijssdijk, and colleagues (2007) measurement scale of smart object perceived intelligence to conceptualize smart object's perceived agency as the perception of autonomy, reactivity, capacity to learn and to cooperate as suggested by Novak and Hoffman (2019).

A smart object with a low agency should be perceived as a tool, a servant in the relationship style. Thus, consumers might express higher levels of agency and communalities. Conversely, a smart object with a higher level of agency should elicit lower levels of agentic expression.

To increase the explanatory power of our model, we decide to perform two different quantitative studies. The first quantitative study will explore the potential mechanism exposed above through a structural equation modeling approach, relying on the PLS path modeling method. This method will allow us to explore the influence of smart object agency over the interpersonal dimensions of consumer's feeling of being dominated and reduced.

For that purpose, three different products with different levels of agency are relied upon in study 1:

- A product with a low level of agency: a smart plug
- A product with a mid-level of agency: a smart bulb
- A product with a high level of agency: a smart speaker

These different products with their own expression of agency will help to explore the relationship dynamic they respectively elicit. Accordingly, these different groups will help comparing the effect of object's agency over acceptance and resistance toward the smart object.

Here, two different elements are getting manipulated:

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- The level of agency (in terms of autonomy, reactivity, capacity to learn and react)
- The nature of the smart object

To confirm the findings from study 1, and to exclude any potential influence of the nature of smart objects, the study 2 will investigate the influence of a smart object that expresses three different levels of agency.

Study 2 will rely upon the same experimental design than study 1, assessing the influence of smart object' agency over the acceptance or resistance toward it.

Hence, study 2 will focus on one object (a smart coffee maker) with three different levels of agency, to provide empirical support for our explanations.

One smart object (smart coffee maker), three different levels of agency:

- Low
- Moderate
- High

Measuring specific behaviors across different situations tend to reduce the effect of external factors. By aggregating these different situations, we get a more valid measure of the specific behavior under study (Ajzen 1991). The combined results of study 1 and 2 will provide support for considering if there is indeed an effect of object's agency over the variables identified in the model, and more particularly on the intention to use it (acceptance/resistance).

In summary, the proposed model encompasses the influence of mental representations of goals (ideal situation) through expected relational outcomes, and the influence of instrumental (perceived usefulness, ease of use) and affective beliefs (anxiety) as determinants of attitudes and usage intentions. We hypothesized a negative influence of smart object's agency over the intention to use it, as a part of a simulated assemblage mentally imagined by consumers.

**Chapter 4 – Experimental design, results, and discussion**

**Introduction to Chapter 4 - Experimental design, results, and discussion**

This chapter will provide an assessment of the manipulation made, a validation of the different measurement scales relied upon, and the overall quality of our model. Finally, all hypotheses exposed in chapter 3 will be assessed here, and their various implications (theoretical and managerial) will be discussed.

We have decided to use the structural equation modeling approach which as gained a certain interest in management sciences (Natchigall et al. 2002). This approach provides a set of different methods for assessing complex relationships between latent variables (Tenenhaus et al. 2005). The structural equation modeling approach aims at testing hypotheses and assumptions based on variance or covariance of observed data, through a structural model (structural parameters) (Kaplan 2000). Additionally, structural equation modeling approaches provide many advantages compared to traditional assessment methods, such as the possibility to estimate error terms, the overall quality of the conceptual model in terms of adjustment, and complex relations between latent constructs (Roussel et al. 2002).

There are two main structural equation modeling approaches: variance-based (PLS) and covariance-based (LISREL) approaches. While the co-variance-based approach is designed for confirmatory research, the variance-based approach is more indicated for predictive models (Chin 2010). A comparison of the approaches is provided by Juhel (2015):

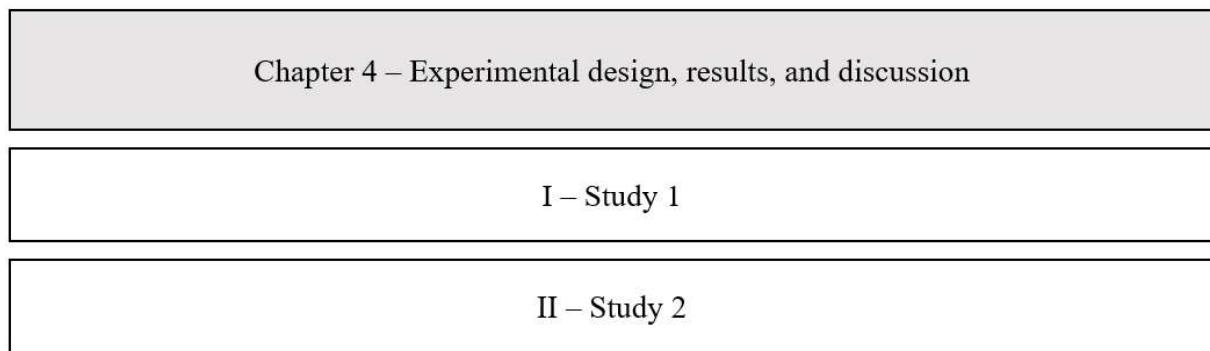
*Table 42 - Comparison of variance-based and covariance-based approaches in SEM (Juhel 2015)*

	<b>Variance-based (PLS)</b>	<b>Covariance-based (LISREL)</b>
<b>Approach</b>	Predictive/exploratory	Confirmatory
<b>Measurement model</b>	Principal component analyses	Common factor analysis
<b>Principle</b>	To maximize the explained variance of endogenous variables, (the accuracy of the predictions) captured by the R <sup>2</sup> .	To estimate the values of the population parameters for which the variance-covariance matrix implied by the specified model is as close as possible to the observed variance-covariance matrix.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Adjustment procedure</b>	<u>For latent variables:</u> External estimates (linear combination of latent variables' indicators) and internal estimates (correlations between latent variables). <u>For the structural model:</u> Linear regression between latent variables' estimates.	To minimize the difference between the observed values of the parameters and the values get from loss functions (maximum likelihood, least squares, etc.).
<b>Software</b>	SmartPLS, XLSTAT, PLS-Graph, etc.	AMOS, LISREL, OpenMx, cSEM

Considering our approach, we decided to rely on a PLS path modeling method (XLSTAT) to assess our conceptual model. Accordingly, this chapter will expose the two quantitative studies supposed to provide more information regarding our assumptions. This chapter is organised as follow:



*Figure 58 - Chapter 4 organization - Experimental design, results, and discussion*

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### I – Study 1 - PLS approach

#### Experimental design

Our AOL results indicate the existence of a relation between the smart object's agentic capacities and the emergence of anxiety and negative attitudes toward it. It seems that object's agency gives rise to several reactions and feelings that originate from the anticipated interpersonal relationship. Accordingly, we must investigate the extent to which different levels of agency influence the emergence of different anticipated experiences and relational outcomes.

#### Experimental conditions

The AOL exploratory research has highlighted the potential existence of anticipated interpersonal relationship between consumers and smart objects. The capacities to affect and to be affected expressed by the smart object have provoked different reactions and feelings, from positive simulated experiences of comfort and utility, to negative simulated experiences of anxiety and dependence.

It appears that negative experiences originate from the smart object's perceived capacities or, the expressive role endorsed by the object within the relationship. These findings provide support for Novak and Hoffman (2019) conceptualization of consumer-smart object relationships.

Indeed, consumers and smart objects seem to get involved in social relationships under which they both express agentic and communal roles (Novak and Hoffman 2019). Consumers and smart objects can be seen as equal entities (from a flat ontology) that both hold capacities for domination (agency) and cooperativeness (communality). From that point, their relationship follows the principle of complementarity (Horowitz et al. 2006). Hence, a smart object perceived as dominating the relationship will give rise to a consumer that must endorse the role of servant (low level of agency) to engage into a stable and long-term relationship (Monsurro et al. 2020).

This is also supported by Schweitzer and colleagues (2019) study of smart speakers and virtual assistants, which advocate for the existence of interpersonal relationships between consumers and smart objects. More precisely, smart objects can be seen as either master or

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

servant of the relationship depending on their capacities and the role they endorse during the relationship (Schweitzer et al. 2019).

According to Novak and Hoffman (2019), consumer response in terms of interpersonal behavior depends on the smart object expression of agency and communality. Relying on the complementarity principle, the capacities expressed by the smart object have a different impact over consumer's behavior regarding its level of agency.

As seen in our literature review, smart object's capacities to affect and to be affected exist on continua and can be categorized into three main levels (Hoffman and Novak 2018):

*Table 43 - Levels of agentic capacities*

<b>Agency</b>	<b>Autonomy</b>	<b>Authority</b>
The basic capacity to interact with other components, but still requiring human intervention.	The level at which smart objects operate independently, without human interventions, according to their own agenda.	Smart objects are operating autonomously and have the control over the way they interact with other components and how other components must respond to them.

These levels of agency refer to variations in terms of perceived object's intelligence (Novak and Hoffman 2019). Conceptualized by Rijssdijk and colleagues (2007), object's intelligence is a multidimensional concept that aims at structuring the perception of agentic features through six main dimensions: autonomy, reactivity, ability to learn, ability to cooperate, humanlike interaction and personality. While the four main dimensions can be relied upon in an object-oriented ontology, humanlike interaction and personality dimensions violate the flat ontology principle and are designed for human-oriented ontology (which considers humans as the main entity) (Hoffman and Novak 2018). Thus, variations in terms of level of agency (basic agency, autonomy, authority) can be translated in variations in terms of autonomy, reactivity, ability to learn and to cooperate (Novak and Hoffman 2019).

The autonomy dimension refers to the object's capacity to operate without consumer's intervention. This dimension can be seen as the degree to which the object can act on its own

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

(Rijssdijk and Hultink 2009). The reactivity dimension is defined by the object's ability to react actively to different situations. It is basically the “ability of a product to react to changes in its environment in a stimulus/response manner” (Rijssdijk et al. 2007, p. 342). Regarding the ability to learn, it refers to the object's capacity to improve through time and experience. Finally, ability to cooperate refers to its capacity to achieve shared objectives with other entities (Rijssdijk and Hultink 2009).

From that perspective, it becomes possible to design different objects that share different capacities (in terms of autonomy, reactivity, capacity to learn and to cooperate) making them different in terms of levels of agency.

Consistent with our literature review and the AOL results, it appears reasonable to think that smart object's level of agency can influence consumer's behavioral response based on the anticipation of future interpersonal interactions. Hence, comparing the impact of different levels of smart object's agency over the anticipated experiences will help to measure the effect of smart object's capacities over consumer's behavioral intention.

Accordingly, the methodology relied upon in this study will consider three different conditions:

- A smart object with a low level of agency (Agency)
- A smart object with a moderate level of agency (Autonomy)
- A smart object with a high level of agency (Authority)

These objects will express different degrees of autonomy, reactivity, ability to learn and to cooperate. This design will allow us to explore the impact of different levels of smart object's agency over consumer's acceptance and resistance, as already proposed by Rijssdijk and colleagues (2007).

### Stimuli

This research aims at exploring the impact of smart object's agency over the anticipated interpersonal relationship, mentally simulated by consumers. The same stimuli's structure used during the AOL study will be relied on for eliciting evocations and mental simulations of future interactions. Accordingly, the stimuli will be made of two different parts:

- A visual (image) of the smart object
- A description of different scenarios where the smart object expresses its agency

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Our experimental conditions (agency, autonomy, authority) require three different stimuli: an agentic smart object, an autonomous smart object, and an authoritarian smart object. These conditions originate from the literature review and correspond to the perception of the expressive role endorsed by the smart object (Hoffman and Novak 2018).

To elaborate effective stimuli, three main elements were considered:

- The environment where the smart object expresses its agency must be similar across the stimuli.
- The chosen smart objects must be consistent with their respective level of agency.
- The visuals must depict a smart object that does not hold any physical resemblance with human to avoid the effect of anthropomorphism.

We have decided to anchor the stimuli' descriptions within the smart home market as it represents one of the IoT market segments that is potentially facing the Chasm regarding its global penetration rates barely above 18% (Kemp 2021). All images (visuals) were chosen from Google Image and were used under the Creative Common Licences.

Regarding the smart objects that will be relied upon for illustrating the different levels of agency, we had to select objects that express different degrees of autonomy, reactivity, ability to learn and to cooperate.

The smart plug was chosen for the low-level agency condition (Agency). Indeed, smart plugs are designed mainly for situations where they operate based on users' intervention (Hoffman and Novak 2015). They are connected and can react, yet they do not hold capacities to act with autonomy (e.g., without consumers' intervention and consent). Most of the time, smart plugs are controlled through the smartphone (with applications) and would perfectly fit the role of being a servant during the relationship.



*Figure 59 - The Smart Plug (Low agency condition)*

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

On the other hand, the smart bulb was attributed to the moderate-level agency condition (Autonomy). Smart bulbs are also designed for situations where they get triggered by consumers' actions, yet they can also autonomously interact with users. Indeed, a smart bulb can autonomously manage the light system based on its environment (luminosity according to the music played for instance). More importantly, users can interact with smart bulbs without the necessity to rely upon the smartphone, sometimes only with gestures (turning on / off with a handclap) or through voice interaction, making them the perfect fit for the role of partner during the relationship.



*Figure 60 - Smart bulb (Moderate agency condition)*

Last, the smart speaker was chosen for representing the high-level agency condition (Authority). Smart speakers possess the capacity to interact autonomously with consumers and their environment using voice-based functionalities (Smith 2020). With this capacity, consumers tend to feel like interacting with living entities (Lopatovska and William 2018). These smart speakers often integrate virtual assistants such as Amazon Alexa, Google Assistant or Apple's Siri that provide meaningful interactions and services to consumers such as: voice interactions, tasks management, weather, traffic, music, and video streaming.

They also offer the opportunity to set up networks of smart objects, allowing the smart speakers to control other objects within their surroundings (Hoffman and Novak 2018). These smart speakers integrate capacities based on voice interactions, which translates into social interactions (Lopatovska and William 2018). According to Purington (2017), smart speakers and virtual assistants are highly agentic objects due to four aspects:

- They are conversational agents, integrating speech functionalities, and require a social interaction with consumers to operate. This allows for humanlike interactions and improve the consumer's perception of social interaction with them.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- They are personified and integrated into consumer's daily life, which can modify the conversational agent's characteristics (voice gender, name...), thus socializing the object even more.
- They are designed to incorporate humour and personality traits making them perceived more interactive and intelligent.
- They share the same space as the consumer and can modify the environment by interacting and controlling dynamically other objects.

From that perspective, smart speakers make the ideal fit for being potentially perceived as dominating the relationship (controlling the environment and how objects and users interact with it).



*Figure 61 - Smart speaker (High agency condition)*

The three stimuli were describing the smart objects' capacities regarding difference scenarios depicting the level of agency expressed by the object. Accordingly, the smart plug description was designed with lower levels of autonomy/reactivity/ability to learn/ability to cooperate (agentic capacities), the smart bulb was designed with moderate levels of agentic capacities and the smart speakers was designed based on high levels of agentic capacities.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Levels of Agency



Figure 62 - Levels of Agency conditions

The descriptions were made identical in terms of structure (number of words, characters) and similar in terms of environment (were the described interactions take place). All the descriptions were elaborated based on the AOL results, mixing cognitive and affective evocations as described by the participants. These descriptions are available in appendices.

Table 44 - Study 1 descriptions

Descriptions		
1 (low agency)	2 (moderate agency)	3 (high agency)
Group 1	Group 2	Group 3
<p><b>Votre maison, simplement connectée</b></p>  <p>Plus besoin de paramétrer votre maison pour vous assurer que tout soit bien éteint avant de sortir... Avec la nouvelle prise connectée « K-Smart Plug », toutes vos prises et appareils à piles peuvent être sous votre application directement ! Avec l'application pour smartphone, allumer ou éteindre vos appareils électriques, où que vous soyez.</p> <p>Branchez, profitez... Transformez l'ensemble de vos appareils en objets simplement connectés à votre smartphone et profitez du contrôle à distance, le tout sans installation de votre part.</p> <p>Utilisez le K-Smart Plug pour suivre votre consommation instantanément avec sa fonction Monitoring et gérez au mieux votre facture d'électricité.</p> <p>Choisissez les heures de mise en marche de la cafetière par exemple, afin de la trouver allumée au réveil le matin. Le K-Smart Plug vous permet d'accéder à vos objets et ne fera rien sans que vous ne l'ayez décidé.</p> <p>Pas besoin d'être déconnecté pour utiliser le K-Smart Plug. Connectez vos appareils en toute simplicité, de manière pratique, sans vous soucier d'un quelconque entretien.</p> <p>Une installation simple et une prise en main intuitive, profitez du meilleur du connecté en conservant le contrôle sur vos appareils même à distance.</p>	<p><b>L'éclairage, connecté à vos envies</b></p>  <p>Faites de votre maison un lieu de vie encore plus chaleureux et connecté grâce à l'ampoule connectée « K-Smart Bulb ». Cliquez sur un clic, l'ambiance idéale pour toutes vos occasions.</p> <p>K-Smart Bulb n'est pas seulement une ampoule connectée, mais un véritable outil d'assistance accessible depuis votre smartphone. Découvrez la lumière autrement, il vous proposera un large éventail de couleur et vous aidera à choisir ce qui ira le mieux chez vous.</p> <p>Prenez le contrôle de la lumière tout en gardant les mains libres à l'aide de la commande vocale et entrez dans l'ère de l'échange intelligent.</p> <p>Le K-Smart Bulb est connecté sur l'environnement de sorte à vous proposer le meilleur changement possible. Une lumière douce pour un réveil en douceur le matin, vous stimuler pour bien débuter votre journée ou encore vous accueillir chaleureusement de retour à la maison. Laissez-le faire !</p> <p>Le K-Smart Bulb s'adapte à vos envies même sans intervention de votre part. Programmez l'éclairage de vos volets par exemple, il s'adaptera à la luminosité pour une meilleure gestion de l'éclairage.</p> <p>Cette ampoule connectée et interactive transformera votre quotidien en toute simplicité.</p>	<p><b>Une maison connectée, et plus encore</b></p>  <p>Transformer votre lieu de vie en véritable maison du futur. Donnez votre maison intelligente et autonome à l'aide de l'assistant connecté « K-Smart Assistant ». Interagissez avec une maison intelligente !</p> <p>A la maison laissez le commander, il vous assistera partout. Éteindre les lampes, voir qui est à la porte, régler la température en fonction de la météo et bien plus encore. Observez de l'aide sans même avoir à bouger le petit doigt en l'activant avec la voix et laissez-le prendre ses propres décisions.</p> <p>Commander l'ensemble des équipements connectés de la maison depuis le K-Smart Assistant. Ou bien faire le choix de le laisser gérer vos objets connectés, votre journée, vos déplacements et bien d'autres choses encore, tel un réel assistant domestique.</p> <p>Votre maison se débrouillera très bien toute seule et accomplira automatiquement même les tâches les plus complexes.</p> <p>Le K-Smart Assistant est totalement indépendant et intelligent. Il connaît parfaitement son environnement. Il apprend et s'adapte aux changements grâce à ses capteurs haute précision tout en améliorant les prises de décision au fil du temps, jour après jour.</p> <p>C'est si simple de se lancer, il vous suffit de lui parler !</p>

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Pre-test

The objects' capacities were designed regarding the four dimensions retained from Rijssdijk and colleagues (2007) measurement scale of object's intelligence. Descriptions of the three smart objects were elaborated to be divergent in terms of autonomy, reactivity, ability to learn and to cooperate. From that perspective, these four different variables are supposed to shape object's agency.

To make sure our descriptions were effective, we performed a pre-test to check for a significant difference in terms of perceived object's agency.

We relied upon a convenience sample to assess the descriptions. 157 questionnaires were administrated online from March 2021 to April 2021, and 150 valid questionnaires (50 per group) were analysed using IBM SPSS software. Participants were randomly assigned to one of the three descriptions (group 1 = low agency, group 2 = moderate agency, group 3 = high agency). Participants were mainly undergraduate and postgraduate students recruited through social medias ( $M_{age} = 23.64$ ,  $SD = 3.12$ ).

Regarding the results, we first checked for the reliability and internal consistency of the four dimensions (Autonomy, Reactivity, Ability to Learn and Ability to Cooperate) and our construct Object Agency.

Table 45 - Study 1 Pre-test

Scale	KMO	Bartlett's Test	% Of variance explained	Cronbach Alpha
<b>Autonomy</b>	0.811	0	70.812	0.862
<b>Reactivity</b>	0.793	0	73.962	0.882
<b>Ability to Learn</b>	0.875	0	76.981	0.924
<b>Ability to Cooperate</b>	0.710	0	55.910	0.734
<b>Object's Agency</b> (Autonomy; Reactivity; Ability to learn; Ability to cooperate)	0.628	0	59.563	0.766

We had a reserve regarding the dimension ability to cooperate, so we decided to perform a principal component analysis and found that Ability to Cooperate was below 0.5 in the component matrix (0.465). So, we decided to remove this dimension and to check again for the object's agency reliability.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 46 - Study 1 Pre-test 2

Scale	KMO	Bartlett's Test	% Of variance explained	Cronbach's Alpha
<b>Object's Agency</b> (Autonomy; Reactivity; Ability to learn)	0.688	0	74.877	0.830

By removing the ability to cooperate dimension we noticed an improvement regarding the KMO indicator, the percentage of variance explained and the Cronbach's alpha. Accordingly, we took the decision to remove the ability to cooperate dimension from the analysis. One explanation might originate from our decision to remove the humanlike interaction and the personality dimensions from the scale proposed by Rijsdijk and colleagues (2007). The dimension ability to cooperate might be correlated with those items, measuring object's intelligence (from a human-oriented perspective) instead of object's agentic features.

Regarding the manipulation (levels of agency), the first step was to evaluate the effectiveness of our descriptions. Accordingly, we relied on an ANOVA to compare the results of each dimension between each group. The manipulation worked as the level of object's agency differs significantly between the descriptions:

Table 47 - Study 1 - Anova Pre-test

	Group 1	Group 2	Group 3	F	Sig.
<b>Autonomy</b>	2.765	4.64	4.74	25.770	0.000
<b>Reactivity</b>	3.50	5.1	5.3	22.974	0.000
<b>Ability to Learn</b>	3.07	3.78	4.70	11.665	0.000
<b>Object Agency</b>	3.11	4.52	4.94	26.155	0.000

The descriptions appeared to be effective for eliciting the perception of different levels of object's agency. Thus, we relied upon these descriptions to conduct the first study.

Data collection

The aim of this study is to assess the model that integrates the main concepts identified within the literature review, potentially involved in the emergence of resistance toward smart objects. To fulfil that objective and to test our hypotheses, a questionnaire was elaborated on Lime Survey and diffused online, through the platform Prolific.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

We have decided to perform this data collection online for three main reasons: the cost per participant were relatively low, the data was collected ensuring respondent's anonymity, and because of the Covid-19 situation (the data collection took place during the 2021 lockdown).

The experiment was settled based on different steps:

- First, a website was created to randomly assign the participants to one of the three descriptions. Accordingly, the domain name <https://consumerbehavior.fr/> was bought and the website hosted using the IONOS webhosting service. This link was put on Prolific to reach our participants.
- To randomly assign participants, a Java script was incorporated inside the source code of the webpage, allowing us to randomly assign participants to one of the three URL of the Lime Survey questionnaires.

```
<html>
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
    <title>Etude sur l'évaluation d'objets connectés</title>
    <script type="text/javascript" src="./Pretest_Redirection/jquery.min.js.téléchargement"></script>
    <script type="text/javascript">

      //on genere un lien au chargement de la page
      $(document).ready(function() {

        //quand on click sur le lien, le lien change
        $("#lienaleatoire").live("click", function(){

          generationLienAlea();

        });

        function generationLienAlea(){

          var listliens = [ ];
          listliens[0] = "https://enquetes-screen.msh-alpes.fr/index.php/973969?lang=fr";
          listliens[1] = "https://enquetes-screen.msh-alpes.fr/index.php/293287?lang=fr";
          listliens[2] = "https://enquetes-screen.msh-alpes.fr/index.php/644825?lang=fr";

        }

        nb = rand(0, listliens.length - 1);
        $("#lienaleatoire").attr('href', listliens[nb]);
      }

      //rand pour les parfums qui ont horeur des fn.maths ??
      function rand (min, max) {
    </script>
```

Figure 63 - Random assignment procedure

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- After being randomly assigned to one of the three descriptions, they were exposed to the following informative message, indicating the research objective, the research modalities and how the data will be used:

Bonjour et merci de participer à cette étude intitulée : Étude des représentations mentales de l'interaction avec les objets connectés. Cette recherche est réalisée au sein du laboratoire Centre d'Etudes et de Recherches Appliquées à la Gestion de Grenoble (CERAG - Isère), sous la direction de M. Pierre Valette-Florence, Professeur des Universités. L'objectif de cette étude est de mettre en évidence les mécanismes à l'origine des attitudes négatives à l'égard des objets connectés. À cette fin, l'étude comprend une série de questions. Cela vous prendra environ 10 minutes.

Il est essentiel, avant de commencer, de vous assurer que vous êtes dans de bonnes conditions pour répondre (vous êtes dans un lieu calme, vous avez du temps etc.). Ces recherches que nous menons ont pour but d'étudier les représentations mentales que suscitent les objets connectés.

Vos données seront strictement anonymes. Conformément à l'article 11 alinéa 1 au RGPD, les données recueillies étant strictement anonymes, vous ne pourrez pas demander leur rectification ni leur suppression. Cette recherche sera diffusée dans des colloques et pourra faire l'objet de publications dans des articles de revue académique.

En continuant ce questionnaire je reconnais avoir lu et compris les renseignements ci-dessus et j'accepte de participer à cette étude scientifique. Merci pour votre précieuse collaboration.

*Figure 64 - Study 1 introductory message*

- Then, participants were asked to carefully read the description, and to take the time to think about interacting with the smart object depicted on it.
- Finally, participants had to go through the questionnaire. Questions were randomly ordered for each participant, using the Lime Survey option, to avoid any methodological bias.

The data collection took place from May 2021 to June 2021. The link <https://consumerbehavior.fr/> was shared on Prolific, where participants were randomly assigned to one of the three conditions. Each participation was paid about 2.00€ with an average duration of 8min per participant. At the end of the data collection, we obtained 482 questionnaires. From these, 32 participants were removed because of partial completion (below 50%). Finally, we reached 450 valid questionnaires with 150 participants for each condition.

*Table 48 - Study 1 - total questionnaires*

<b>Condition</b>	<b>Total questionnaires</b>	<b>Total valid</b>
<b>Group 1 – Low agency</b>	155	150
<b>Group 2 – Moderate agency</b>	161	150
<b>Group 3 – High agency</b>	166	150

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The table below indicates the main sample characteristics (gender, age, socio-professional category).

*Table 49 - Study 1 - sample characteristics*

Gender	Male	50.4%
	Female	49.3%
<b>Age</b> <b>(M<sub>age</sub> = 29.16, SD = 9.763)</b>	18-25	45.1%
	25-30	24.2%
	30-40	17.6%
	40-50	8.2%
	50+	4.9%
<b>SPC</b>	Student	36.2%
	Executive	29.1%
	Employed	21.1%
	Artisan	3.8%
	Others	9.8%

*Manipulation Check*

This part is dedicated to the assessment of our manipulation (modifying the level of agency). The aim is to evaluate the extent to which each description was respectively perceived as low agentic (group 1), moderately agentic (group 2) and highly agentic (group 3).

But before, we wanted to make sure that the dimension “ability to cooperate” was indeed, not suitable for measuring object’s agency. We followed the same methodology exposed in the pre-test and found out that the dimension ability to cooperate had to be removed.

*Table 50 - Study 1 - Object's agency internal consistency*

	KMO	Bartlett's Test	% Of variance explained	Cronbach Alpha
<b>Autonomy</b>	0.857	0	82.469	0.929
<b>Reactivity</b>	0.841	0	81.245	0.923
<b>Ability to Learn</b>	0.908	0	88.334	0.967
<b>Ability to Cooperate</b>	0.805	0	67.743	0.839
<b>Object's Agency (With Ability to cooperate)</b>	0.730	0	58.964	0.752
<b>Object's Agency (Without Ability to cooperate)</b>	0.728	0	77.147	0.851

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

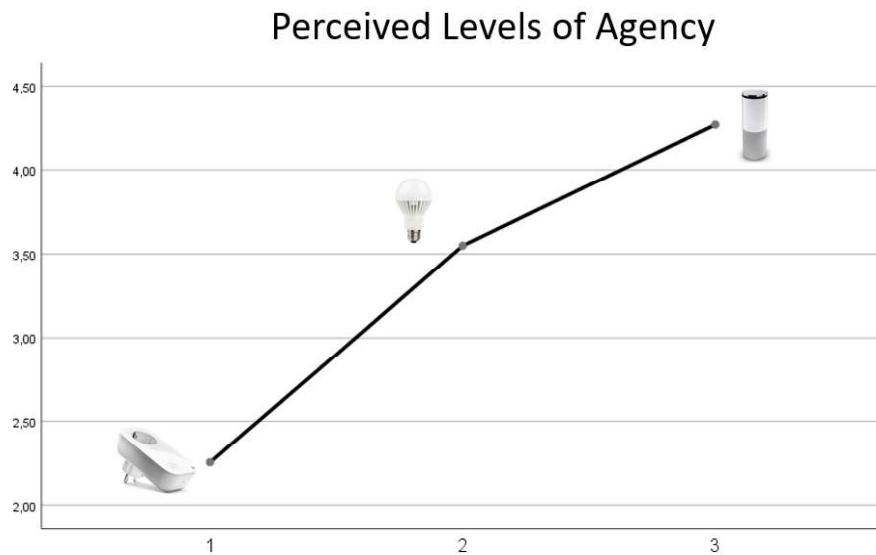
The result confirms the observation made during the pre-test. The construct Object's Agency was better captured by removing the dimension ability to cooperate. Accordingly, the ability to cooperate was removed from the analysis and Object's Agency appeared to be well-measured by three dimensions: autonomy, reactivity, and ability to learn.

Then, we assessed the effectiveness of our manipulation by performing an ANOVA. The results confirm the difference between each description and the effectiveness of our manipulation. The smart plug was perceived less agentic than the smart bulb, which was also perceived less agentic than the smart speaker.

*Table 51 - Study 1 - Manipulation Check*

	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>F</b>	<b>Sig.</b>
<b>Autonomy</b>	2.01	3.33	4.02	116.136	0.000
<b>Reactivity</b>	2.65	4.23	4.62	132.509	0.000
<b>Ability to Learn</b>	2.09	3.07	4.16	108.891	0.000
<b>Object Agency</b>	2.25	3.54	4.26	175.156	0.000

Accordingly, the perception of agency expressed by the different smart objects (smart plug, smart bulb, smart speaker) differed. The agentic capacities hold by each object were indeed perceived significantly different.



*Figure 65 - Study 1 - Perceived levels of agency*

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

A series of different T-test have revealed that each description was significantly different from the two others, indicating that the manipulation was successfully eliciting different perception of agency for each object. This allows us to go further in the analysis.

*Table 52 - Study 1 - Differences in terms of agency*

	<b>t</b>	<b>Sig.</b>
<b>Group 1 vs Group 2</b>	-11.450	0.000
<b>Group 1 vs Group 3</b>	-19.046	0.000
<b>Group 2 vs Group 3</b>	-6.645	0.000

## Model Fit, validation, and reliability of measurement scales

### Overall model fit

All latent variables were measured at the first-order level. The research model was structured using a reflective measurement mode. We relied upon the PLS consistent procedure to generate consistent path coefficients and to reduce inflated loadings (Dijkstra and Henseler 2015).

The PLS PM is a variance-based structural equation modeling approach that better fits with our research. It offers the possibility to assess complex models with multi-group analysis, without a need for variables independence (Chin 2010). While this approach does not offer the same possibilities to assess the model fit compared to the LISREL approach (covariance-based), it also possesses its own indicator of fit.

The overall model fit can be assessed based on the Goodness-of-Fit (GoF). The GoF, proposed by Tenenhaus and colleagues (2005) refers to the square root of the geometric mean of communalities (mean AVE) and the mean regression coefficient (mean R<sup>2</sup>). The value comprised between 0 and 1, indicates the overall fit in terms of model and its structural model's quality (Duarte et Raposo 2010).

Yet, the literature does not provide any cut-off value for assessing the GoF (Dijkstra and Henseler 2015). However, we can rely on Wetzels and colleagues (2009) guidelines to assess the overall fit. According to these authors, a GoF below 0.25 can be seen as small, below 0.36 is medium, and above 0.36 can be considered as high (Wetzels et al. 2009).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Regarding our model, the GoF indicates respectively a value of 0.453 (group 1), 0.401 (group 2) and 0.438 (group 3), which is high according to the guidelines proposed by Wetzels and colleagues (2009). The model was assessed relying on a bootstrapping procedure of 1000 replications showing that an important part of variance was well captured by the model. The values for the GoF and the GoF after Bootstrap are very close. The proximity between groups also indicates a good quality and a stable model.

*Table 53 - Study 1 - Overall model fit*

Overall Model Fit				
	GoF	GoF (Bootstrap)	Standard Error	Critical Ratio (CR)
<b>Group 1</b>	0.453	0.462	0.034	13.294
<b>Group 2</b>	0.401	0.406	0.032	12.489
<b>Group 3</b>	0.438	0.437	0.022	19.633

Now that we have assessed the overall quality of the model, we can evaluate the reliability and validity (convergent and discriminant) of the latent variables.

### Validity and reliability

The measurement scales for each construct were presented with the conceptual model and hypotheses. Each scale was carefully selected based on our literature review and their proven reliability across different publications. These scales are also relied upon in different marketing contexts. However, it is essential to ensure the validity and reliability of the latent variables, especially as regard our exploratory approach.

We have decided to assess our research model through the partial least square (PLS) path modeling (PM) approach. The analysis was performed on the software XLSTAT, with a bootstrapping procedure of 1000 iterations. All the latent variables were treated as first order structures. Accordingly, two main indicators are relied upon for the reliability and validity: the Joreskog Rhô and the Average Variance Extracted (AVE) which are provided by the PLS PM analysis.

The Joreskog Rhô aims at providing a measure of reliability. According to Dijkstra and Henseler (2015) the value of this indicator must be above 0.7. Regarding the convergent and discriminant validity of the measurement scales, the PLS PM approach provides two main indicators. According to the literature, the average variance extracted (AVE) must be above 0.5

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

to ensure convergent validity, while the shared variance with other construct must be lower than the AVE to ensure discriminant validity (Lam 2012).

From our results, it appears that all variables have met the different thresholds for both the Joreskog Rhô and the AVE, except for Object's Agency in Group 3 with an AVE of 0.476. However, this AVE can be accepted. According to Fornell and Larcker (1981) an AVE above 0.4 can be accepted only if its composite reliability is higher than 0.6. For Lam (2012), the AVE below 0.5 can only be accepted if the composite reliability is above 0.8. In our case, the composite reliability is 0.924. Accordingly, we consider that the AVE of Object's Agency for Group 3 is still adequate.

The variables dominated and reduced were computed regarding the methodology provided by Locke and Adamic (2012). Accordingly, they represent a single vector. That is the reason why both the Joreskog Rhô and the AVE cannot be computed regarding these two variables, as the latent variables Dominated and Reduced are made of only 1 factor each.

*Table 54 - Study 1 - Reliability and Convergent Validity*

Variables	Reliability (Joreskog Rhô)			Convergent validity (AVE)		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
<b>Object's Agency</b>	0.950	0.929	0.924	0.594	0.502	<b>0.476</b>
<b>Image Elaboration</b>	0.885	0.902	0.895	0.686	0.726	0.728
<b>Dominated</b>	/	/	/	/	/	/
<b>Reduced</b>	/	/	/	/	/	/
<b>Anxiety</b>	0.911	0.926	0.930	0.669	0.715	0.727
<b>Perceived Usefulness</b>	0.933	0.922	0.924	0.822	0.798	0.802
<b>Perceived Ease of Use</b>	0.904	0.940	0.928	0.754	0.837	0.808
<b>Attitude toward usage</b>	0.969	0.964	0.963	0.940	0.930	0.928
<b>Intention to use</b>	0.981	0.985	0.988	0.964	0.970	0.976

We also assessed discriminant validity of the variables. This is to ensure that the different variables don't share much variance with other constructs. The AVE for all variables appears to be higher than the squared correlation with other constructs. The complete tables for the discriminant validity are provided in appendices.

Regarding the interpersonal circumplex model, we assessed its validity with an individual multidimensional scaling (INDSCAL) approach to analyse whether our measures follow the circumplex. This method allows us to detect any underlying dimensions based on

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

the observed similarities between the items. Accordingly, we computed the main vectors: Agentic Vector (AV), Unagentic Vector (UAV), Communal Vector (CV), Uncommunal Vector (UCV) as described by the method provided by Locke and Adamic (2012). We also mapped the main items that structure the main dimensions: PA1-PA2 for Agency; HI1-HI2 for Unagency; LM1-LM2 for Communality and DE1-DE2 for Uncommunality.

The result, with a RSQ of 90%, indicates a good quality of our measures and a reliable circumplex as both items and vectors are shaping the dimensions they were supposed to measure.

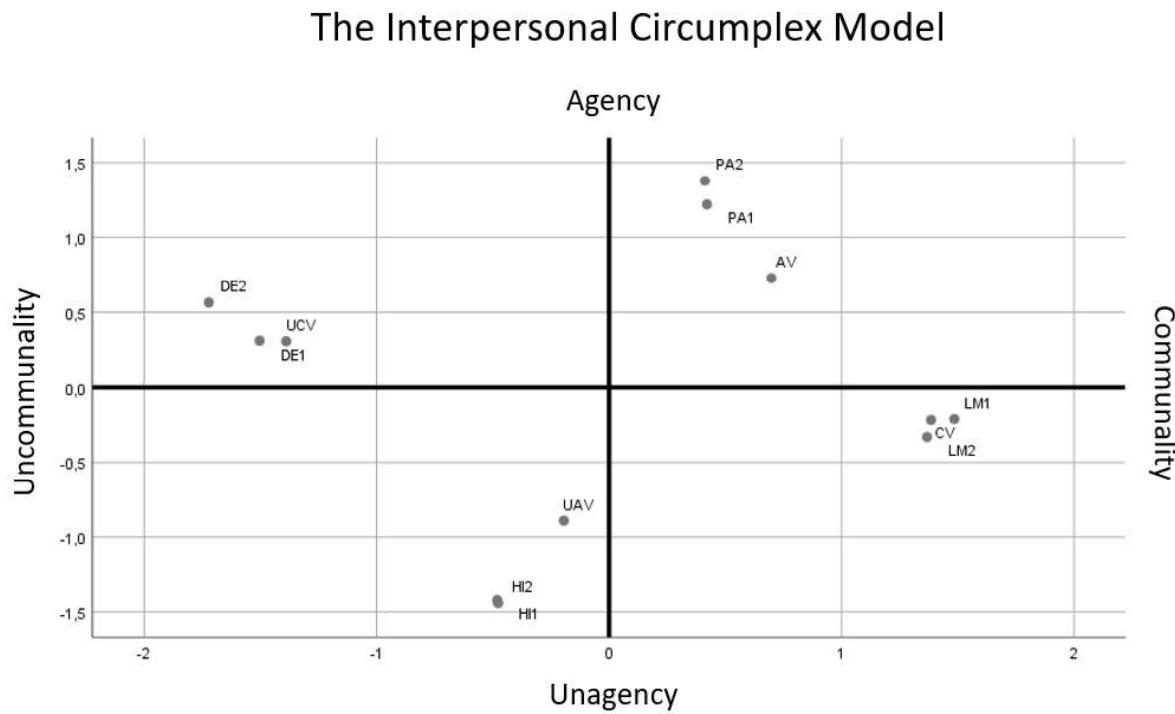


Figure 66 - Study 1 - Assessing the Interpersonal circumplex model

The different latent variables seem to satisfy conditions of both convergent and discriminant validity, indicating valid and reliable measures. Additionally, the measure of the interpersonal circumplex model has shown that it has effectively worked. We can thus, go further with the analysis.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Results

After the verification of the overall model fit, the validity and reliability of the measures, this section will focus on the hypotheses' tests. Implications will be discussed after this section.

#### Main hypotheses results

Based on our literature review and the assumptions we made regarding the potential mechanism that triggers resistance toward smart objects, we performed an ANOVA and several t-tests to assess our general hypotheses.

We made the supposition that a highly agentic smart object would elicit more anxiety, negative attitudes, and lower intention to use it than the other smart objects (low and moderate agency). Accordingly, the ANOVA revealed a significant difference in terms of anxiety felt, attitude toward usage and intention to use based on the smart object's description.

*Table 55 - Study 1 - Anova for the main hypotheses*

	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>F</b>	<b>Sig.</b>
<b>Anxiety</b>	1.32	1.38	1.74	15.395	0.000
<b>Attitude toward Usage</b>	4.54	4.35	3.6	24.587	0.000
<b>Intention to use</b>	4.397	4.353	3.560	14.976	0.000

The smart speaker (high agency) was perceived more agentic than the others, but it had provoked slightly more anxiety, a lower attitude toward future usage and a lower intention to use it.

A series of t-test have also revealed that the differences were only between the highly agentic object and the two others. The smart plug and smart bulb had similar levels of perceived anxiety, attitude, intention to use, and don't share significant differences.

The group 3 (high agency) significantly differs from the others in terms of anxiety felt. Participants that have faced the highly agentic description felt more anxiety. Accordingly, the hypothesis H1: "The object with the highest level of agency will elicit more anxiety than the others" is supported.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*Table 56 - Study 1 - T-tests anxiety*

<b>Variable = Anxiety</b>	<b>t</b>	<b>Sig.</b>
<b>Group 1 vs Group 3</b>	-4.936	0.000
<b>Group 1 vs Group 2</b>	-0.869	0.385
<b>Group 2 vs Group 3</b>	-4.013	0.000

Similarly, the group 3 significantly differs from the others in terms of attitude toward future usage. Participants that have faced the highly agentic description felt lower levels of attitude toward usage. Accordingly, the hypothesis H2: “The object with the highest level of agency will be perceived more negatively in terms of attitude toward future usage compared to the others” is supported.

*Table 57 - Study 1 - T-tests attitude*

<b>Variable = Attitude</b>	<b>t</b>	<b>Sig.</b>
<b>Group 1 vs Group 3</b>	6.399	0.000
<b>Group 1 vs Group 2</b>	1.522	0.129
<b>Group 2 vs Group 3</b>	5.020	0.000

Finally, the group 3 had also a significant lower intention to use the smart object. Hence, the hypothesis H3: “The object with the highest level of agency will elicit lower intention to use it” is also supported.

*Table 58 - Study 1 - T-tests intention*

<b>Variable = Intention</b>	<b>t</b>	<b>Sig.</b>
<b>Group 1 vs Group 3</b>	4.827	0.000
<b>Group 1 vs Group 2</b>	0.267	0.790
<b>Group 2 vs Group 3</b>	4.401	0.000

The first assumptions regarding the influence of a highly agentic object over the consumer's response appeared to be correct. We then proceed to the structural equation modeling.

PLS PM results

Once we have validated the research model and shown its overall fit and quality, we can proceed to the hypotheses' tests exposed earlier. We rely on path coefficients that were obtained

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

following the PLS consistent estimates with a bootstrapping procedure of 1000 resampling. The path coefficients statistically significant (with 95% confidence intervals that do not include 0) will be relied upon to assess the hypotheses (supported or rejected) as they describe significant relationship between two latent variables.

The  $R^2$  for all groups (group 1 = 0.293; group 2 = 0.237; group 3 = 0.288) indicate a medium-high effect size according to Cohen (1992) and a good restitution of variance explained by the structural model.

This part will follow the same structure used to sort our hypotheses. First, we will assess the antecedents, then the interpersonal relationship variables, and finally, the consequences.

### Antecedent variables

In this part, we assess the relationship between object's agency and the identified variables that are supposed to be directly influenced by this construct. We will also evaluate the extent to which the image elaboration (the mental simulation) impacts the anticipated interpersonal relationship. The entire PLS PM outputs are available in appendices.

First, we focused on the first hypothesis (H4) that posits a positive influence of object's agency over the image elaboration variable. Indeed, we believed that the more capacities the object possesses, the more additional simulated situations would emerge from consumers.

#### **H4.0: Object's agency has a positive influence over the image elaboration capacity.**

Table 59 - Study 1 - hypothesis H4

Object's Agency - > Image elaboration	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	$R^2$ (Image Elaboration)	Hypothesis
<b>Group 1</b>	-0.297	-0.296	<b>0.000</b>	0.095	<b>Rejected</b>
<b>Group 2</b>	0.099	0.109	<b>0.230</b>	0.020	<b>Rejected</b>
<b>Group 3</b>	0.197	0.212	<b>0.016</b>	0.050	<b>Supported</b>

The test indicates a significant influence of object's agency over image elaboration, only in group 1 and 3. Surprisingly, the path coefficient appears to be negative for group 1 and positive for group 3. The hypothesis H4.0 is supported for group 3 but rejected regarding group 1 and 2.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

One explanation might correspond to the consumer's perception of the smart object. In group 1, we designed the smart plug as a tool, while in group 3, the smart speaker was designed as an active entity. We think that the perception of the smart plug as a mere tool had negatively influenced the emergence of additional simulation of future interactions. Conversely, the perception of the smart object as an agentic entity in group 3 has positively influenced the mental simulation of future interaction.

A multi-group analysis (multi-groups t-test) provided by XLSTAT advocates for this explanation and shows a statistically significant difference between group 1 and the others (2 and 3).

*Table 60 - Study 1 - Multi-group t-test H4*

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.396	3.213	0.001	Yes
<b>3 vs 1</b>	0.495	4.604	0.000	Yes
<b>3 vs 2</b>	0.099	0.877	0.381	No

These tests allow us to assess the potential differences between groups. Accordingly, we can conclude that the smart plug had negatively influenced the image elaboration, while the smart speaker had positively influenced the image elaboration variable. The hypothesis H4.0 is supported (for group 3) but rejected for group 1 and 2. Yet, the multigroup analysis have highlighted an interesting phenomenon. The perception of object's agency had a completely different impact over the capacity to elaborate additional simulations based on its level.

Then, we focused on the influence of object's agency over the feeling of being dominated in terms of agency (H4.1) and the influence of image elaboration on this feeling (H5). We have supposed a positive influence of object's agency and image elaboration over the consumer's feeling of being dominated. The more the object will show agentic capacities, the more the consumer would potentially feel dominated. And, the more consumers will mentally simulate additional interactions, the more they might face negative experiences of domination.

**H4.1: Object's agency positively influences the feeling of being dominated in terms of agency.**

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 61 - Study 1 - hypothesis H4.1

Object's Agency -> Dominated	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Dominated)	R <sup>2</sup> contribution	Hypothesis
<b>Group 1</b>	0.500	0.493	0.000	0.266	98.118%	Supported
<b>Group 2</b>	0.378	0.378	0.000	0.164	96.712%	Supported
<b>Group 3</b>	0.117	0.102	0.152	0.081	27.327%	Rejected

Surprisingly, H4.1 was supported excepted for group 3. Looking carefully to the R<sup>2</sup> contribution, we can notice that object's agency significantly explains the variance of the latent variable Dominated in group 1 (98% of R<sup>2</sup> contribution) and group 2 (96%). Yet, the contribution falls at 27% in group 3. To better understand this phenomenon, we assessed the hypothesis H5 and found out an explanation.

**H5: Image elaboration has a positive influence over the feeling of being dominated.**

Table 62 - Study 1 - hypothesis H5

Image Elaboration -> Dominated	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Dominated)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.028	-0.028	0.711	0.266	1.882%	Rejected
<b>Group 2</b>	0.054	0.055	0.481	0.164	3.228%	Rejected
<b>Group 3</b>	0.211	0.218	0.010	0.081	72.673%	Supported

The influence of image elaboration over the feeling of being dominated is only significant with group 3. Interestingly, the R<sup>2</sup> contribution is also important only in this group. Accordingly, it appears that object's agency positively influences the feeling of being dominated (group 1 and 2), and the effect of object's agency over the image elaboration (H4.0) has provoked a significant influence of image elaboration over the feeling of being dominated.

Consequently, the feeling of being dominated in group 3 didn't increase because of a direct effect object's agency, but instead, due to the simulation (image elaboration) elicited by object's agency. This is supported by the multi-group analysis as well.

Regarding object's agency over the feeling of being dominated:

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 63 - Study 1 - Multi-group t-test H4.1

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.122	1.106	0.270	No
<b>3 vs 1</b>	0.383	3.392	0.001	Yes
<b>3 vs 2</b>	0.261	2.212	0.028	Yes

The difference in terms of influence between object's agency and the feeling of being dominated only occurs with group 3 involved.

Regarding the effect of image elaboration over the feeling of being dominated:

Table 64 - Study 1 - Multi-group t-test H5

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.082	0.621	0.535	No
<b>3 vs 1</b>	0.239	1.969	0.050	Yes
<b>3 vs 2</b>	0.157	1.326	0.186	No

The effect of image elaboration over the feeling of being dominated was significantly different between group 3 and group 1. Accordingly, the simulation elicited by the smart object's perceived highly agentic had a different impact over the feeling of being dominated.

Then, we evaluated the influence of object's agency over the perception of anxiety (H4.2). We made the supposition that the level of object's agency might directly influence the emergence of anxiety. Hence, we have supposed that **H4.2: Object's agency has a positive influence over the anxiety felt.**

Table 65 - Study 1 - hypothesis H4.2

Object Agency -> Anxiety	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Anxiety)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	0.178	0.173	0.052	0.124	40.264%	Rejected
<b>Group 2</b>	-0.023	-0.022	0.786	0.101	<1%	Rejected
<b>Group 3</b>	0.045	0.053	0.515	0.322	1.138%	Rejected

It appears that object's agency had no significant influence over the perceived anxiety. Group 1 path coefficient is rejected, yet the p value would have permit to support H4.2 if we

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

have decided to take a higher risk. Nonetheless, the R<sup>2</sup> contribution in group 2 and 3 shows no direct influence of object's agency over anxiety, indicating that anxiety might be influenced indirectly through another latent variable (see hypothesis H7.0). The multigroup analysis doesn't show any difference between groups.

Table 66 - Study 1 - Multi-group t-tests H4.2

Groups	Difference	Observed value	Sig.	Is there any difference?
2 vs 1	0.201	1.343	0.180	No
3 vs 1	0.133	0.937	0.350	No
3 vs 2	0.069	0.592	0.554	No

Then, we focused on the influence of object's agency over the feeling of being reduced. Accordingly, we assessed the relationship between these two constructs based on the path coefficients.

### **H4.3: Object's agency positively influences the feeling of being reduced in terms of communality.**

Table 67 - Study 1 - hypothesis H4.3

Object Agency -> Reduced	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Reduced)	R <sup>2</sup> Contribution	Hypothesis
Group 1	-0.054	-0.057	0.493	0.337	12.28%	Rejected
Group 2	-0.084	-0.091	0.289	0.233	9.08%	Rejected
Group 3	-0.035	-0.051	0.661	0.107	1.35%	Rejected

We observed no direct influence of object's agency over the feeling of being reduced, H4.3 is not supported. The multigroup analysis also shows no difference between groups. Accordingly, the feeling of being reduced is not influenced directly by the object's agency. Interestingly, the R<sup>2</sup> contribution also decreases the same way as with anxiety.

It appears that most of the significant relations between the latent variables identified as antecedents occurred with group 3 (high agency). The first observation we make is that differences between groups always involve the highly agentic smart object. The highly agentic smart object seems to influence more mental simulations and feelings of being dominated.

Then, we continue the analysis with interpersonal relationship variables.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Interpersonal relationship variables

This part will assess the different relations of the feelings of being dominated and reduced as posit by our model. We will evaluate the path coefficients that links the feeling of being dominated with other latent variables, then the links between the feeling of being reduced and other variables.

We made the supposition that the feeling of being dominated positively influence the feeling of being reduced. Accordingly, we assessed the path coefficients that link these two latent variables.

#### **H6.0: The feeling of being dominated in terms of agency has a positive influence over the feeling of being reduced in terms of communality.**

Table 68 - Study 1 - hypothesis H6.0

Dominated -> Reduced	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Reduced)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	0.590	0.600	0.000	0.337	87.72%	Supported
<b>Group 2</b>	0.497	0.496	0.000	0.233	90.92%	Supported
<b>Group 3</b>	0.301	0.300	0.000	0.107	98.65%	Supported

The results support the hypothesis H6.0. Accordingly, the feeling of being dominated positively influence the feeling of being reduced. Thus, a participant that will feel dominated by the smart object will feel also reduced by the future interaction. We saw earlier that the effect of smart object's agency over the feeling of being dominated was different between group 3 and the two others. Here, the relationship between the two latent variables also seems different.

Table 69 - Study 1 - Multi-group t-tests H6.0

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.092	0.864	0.388	No
<b>3 vs 1</b>	0.289	2.782	0.006	Yes
<b>3 vs 2</b>	0.196	1.755	0.080	No

The multigroup analysis indicates a significant difference between group 3 and 1, in terms of influence between the feeling of being dominated over the feeling of being reduced. Additionally, the p value regarding the difference between group 3 and 2 ( $p\_value = 0.080$ )

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

would have permit to conclude also for a different impact between these groups, if we have accepted to take a higher risk. Nonetheless, the impact of being dominated over the feeling of being reduced seems to be different between groups 1 and 3, when the object's is perceived either low agentic (group 1) or highly agentic (group 3).

Regarding the influence of the variables dominated and reduced over anxiety, we made the suppositions that they might have a positive influence over the anxiety felt by participants. Accordingly, we assessed the path coefficients of these latent variables.

### **H6.1: The feeling of being dominated in terms of agency has a positive influence over the anxiety felt.**

*Table 70 - Study 1 - hypothesis H6.1*

Dominated -> Anxiety	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Anxiety)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	0.024	0.016	<b>0.820</b>	0.124	5.32%	Rejected
<b>Group 2</b>	0.045	0.049	<b>0.639</b>	0.101	6.31%	Rejected
<b>Group 3</b>	0.181	0.169	<b>0.014</b>	0.322	18.70%	Supported

Regarding the result, the hypothesis H6.1 was rejected for group 1 and 2. Yet, the hypothesis is supported for group 3. Thus, the direct influence of the feeling of being dominated is partially supported. However, the R<sup>2</sup> contribution remains relatively low, accordingly no difference between groups was found.

*Table 71 - Study 1 - Multi-group t-test H6.1*

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.021	0.139	<b>0.889</b>	No
<b>3 vs 1</b>	0.156	1.220	<b>0.223</b>	No
<b>3 vs 2</b>	0.136	1.071	<b>0.285</b>	No

The influence of being reduced by the simulated interaction over the anxiety felt was also assessed. The path coefficients provided by the analysis highlight an interesting phenomenon.

### **H7.0: The feeling of being reduced in terms of communality has a positive influence over the anxiety felt.**

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 72 - Study 1 - hypothesis H7.0

Reduced -> Anxiety	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Anxiety)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	0.215	0.206	<b>0.025</b>	0.124	54.51%	Supported
<b>Group 2</b>	0.273	0.263	<b>0.003</b>	0.101	72.15%	Supported
<b>Group 3</b>	0.478	0.479	<b>0.000</b>	0.322	80.16%	Supported

Here, the results indicate a significant influence of the feeling of being reduced by the simulated interaction over the anxiety felt. Accordingly, H7.0 is supported in all groups. Yet, the R<sup>2</sup> contribution differs. Regarding the multigroup analysis, the t-tests indicate significant differences between group 3 and the others.

Table 73 - Study 1 - Multi-group t-tests H7.0

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.058	0.448	<b>0.654</b>	No
<b>3 vs 1</b>	0.264	2.206	<b>0.028</b>	Yes
<b>3 vs 2</b>	0.205	2.025	<b>0.044</b>	Yes

It appears that participants from group 3 felt more anxiety due to the feeling of being reduced by the potential interaction with their respective smart object. A highly smart object seems to elicit more feelings of being dominated which positively influence the feeling of being reduced. The more people believe they might be reduced by the interaction, the more anxiety they tend to develop.

We also posit a potential influence of the feeling of being dominated over the perceived usefulness. Accordingly, we assessed the path coefficients between these two latent variables.

**H6.2: The feeling of being dominated in terms of agency has a negative influence over the perceived usefulness.**

Table 74 - Study 1 - hypothesis H6.2

Dominated -> Perceived Usefulness	Path coefficient	Path coefficient (Bootstra p)	Pr >  t	R <sup>2</sup> (P.U)	R <sup>2</sup> Contributi on	Hypothesis
<b>Group 1</b>	0.011	0.015	<b>0.893</b>	0.121	<1%	Rejected
<b>Group 2</b>	0.182	0.166	<b>0.025</b>	0.085	37.22%	Rejected
<b>Group 3</b>	0.333	0.328	<b>0.000</b>	0.230	26.47%	Rejected

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Surprisingly, the influence of the feeling of being dominated had a positive influence over the perceived usefulness. Hence, the hypothesis H6.2 is rejected in all groups. The positive influence is even significant for group 2 and 3. This is perhaps one evidence for the ambivalence face consumers.

One explanation can potentially be the need for assistance. An agentic object that challenges our agency might also elicit the feeling for usefulness and necessity. An agentic object might give the impression of being able to perform tasks that users are not able to perform on their own, making it useful in a way. Accordingly, the positive effect of feeling dominated over the perceived usefulness can be explained, yet it remains surprising.

This explanation is also supported by the multigroup analysis, where the main difference remains between group 1 (low agentic object) and group 3 (high agentic object).

Table 75 - Study 1 - Multi-group t-tests H6.2

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.171	1.288	0.199	No
<b>3 vs 1</b>	0.322	2.718	0.007	Yes
<b>3 vs 2</b>	0.151	1.432	0.153	No

Despite the fact H6.2 is rejected, these results brought valuable information to better understand the complex phenomenon under study.

The last relationship to test within this category is the link between the feeling of being reduced and the perceived ease of use as conceptualized previously. We assumed that this feeling negatively influences the perception of ease of use. Accordingly, we assessed our hypothesis based on the path coefficients between these two variables.

**H7.1: The feeling of being reduced in terms of communality has a negative influence over the perceived ease of use.**

Table 76 - Study 1- hypothesis H7.1

Reduced -> Perceived Ease of Use	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (P.E.U)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.014	-0.030	0.861	0.126	1.31%	Rejected

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Group 2</b>	0.032	0.017	<b>0.700</b>	0.112	4.62%	<b>Rejected</b>
<b>Group 3</b>	-0.182	-0.178	<b>0.052</b>	0.102	54.89%	<b>Rejected</b>

The results indicate no significant influence regarding the feeling of being reduced over the perception of ease of use. However, regarding group 3 both the p value (0.052) and the R<sup>2</sup> contribution indicate a potential negative influence, yet not significant. The multigroup analysis also shows no difference between groups. Accordingly, H7.1 is rejected.

*Table 77 - Study 1 - Multi-group t-tests H7.1*

<b>Groups</b>	<b>Difference</b>	<b>Observed value</b>	<b>Sig.</b>	<b>Is there any difference?</b>
<b>2 vs 1</b>	0.046	0.400	<b>0.689</b>	<b>No</b>
<b>3 vs 1</b>	0.168	1.403	<b>0.162</b>	<b>No</b>
<b>3 vs 2</b>	0.214	1.727	<b>0.085</b>	<b>No</b>

The interpersonal relationship variables had no significant impact over the perceived usefulness and ease of use. Yet, they play a significant role in the emergence of anxiety. Indeed, the feeling of dominated had significant influenced the feeling of being reduced in all groups. Just like the significant influence of the feeling of being reduced over the anxiety felt. However, the multi-group analysis provides insights about the difference between groups.

Like antecedent variables, group 3 was most of the time involved when a difference occurred between groups. The different multi-group analyses indicate that the relations between interpersonal relationship variables and anxiety were stronger with the highly agentic object (group 3). This confronts the principle of complementarity that is involved in interpersonal interactions.

We proceed the analysis with the consequences.

Consequences

Regarding the consequences, we first assess the impact of anxiety over the perception of usefulness and ease of use.

**H8.0: The anxiety felt has a negative influence over the perception of usefulness.**

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 78 - Study 1 - hypothesis H8.0

Anxiety -> Perceived Usefulness	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (P.U)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.313	-0.325	0.000	0.121	>99%	Supported
<b>Group 2</b>	-0.226	-0.230	0.006	0.085	62.77%	Supported
<b>Group 3</b>	-0.466	-0.461	0.000	0.230	73.52%	Supported

The results indicate that, in all group, the anxiety felt had a significant negative influence over the perception of usefulness. Accordingly, the hypothesis H8.0 is supported for all groups. The multigroup analysis has highlighted that this influence was significantly different between group 2 and 3. Participants in group 3 had a stronger effect of anxiety over the perceived usefulness, negatively impacting the perception of utility.

Table 79 - Study 1 - Multi-group t-tests H8.0

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.086	0.607	0.544	No
<b>3 vs 1</b>	0.154	1.313	0.190	No
<b>3 vs 2</b>	0.240	2.130	0.034	Yes

The same negative relationship was assumed between anxiety and perceived ease of use. We supposed that a high level of anxiety felt negatively influence the perceived ease of use. We assessed the path coefficients to test this hypothesis.

**H8.1: The anxiety felt has a negative influence over the perceived ease of use.**

Table 80 - Study 1 - hypothesis H8.1

Anxiety -> Perceived Ease of Use	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (P.E.U)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.330	-0.324	0.000	0.126	98.68%	Supported
<b>Group 2</b>	-0.312	-0.306	0.000	0.112	94.23%	Supported
<b>Group 3</b>	-0.157	-0.167	0.095	0.102	45.10%	Rejected

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The results show a significant negative influence of anxiety over perceived ease of use, except for group 3 ( $p\_value = 0.095$ ). The hypothesis H8.1 is partially supported. One explanation might stem from the  $R^2$  Contribution (45.10%). This drop is due to the important influence of the feeling of being reduced over the perceived ease of use in group 3. Yet, there was no difference between groups regarding the influence of anxiety over perceived ease of use.

Table 81 - Study 1 - Multi-group t-tests H8.1

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.018	0.111	<b>0.912</b>	No
<b>3 vs 1</b>	0.174	1.212	<b>0.227</b>	No
<b>3 vs 2</b>	0.155	0.968	<b>0.334</b>	No

We then assessed the influence of anxiety, perceived usefulness, and ease of use over the attitude toward usage. Path coefficients and results from multigroup analysis were relied upon to assess the hypotheses.

### **H8.2: The anxiety felt has a negative influence over the attitude toward future usage.**

Table 82 - Study 1 - hypothesis H8.2

Anxiety - > Attitude toward usage	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Attitude)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.078	-0.095	<b>0.128</b>	0.684	3.80%	Rejected
<b>Group 2</b>	-0.094	-0.089	<b>0.088</b>	0.615	4.02%	Rejected
<b>Group 3</b>	-0.206	-0.202	<b>0.000</b>	0.724	13.67%	Supported

The influence of anxiety felt by participants over attitude toward usage in groups 1 and 2 was not significant. Conversely, anxiety felt in group 3 had a significant negative influence over attitude toward usage. The hypothesis H8.2 is partially supported. It seems that the anxiety felt in group 3 had a stronger influence over the attitude compared to the other groups. The multigroup analysis shows a difference between group 3 and the others, but that is only statistically significant between group 3 and 1.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 83 - Study 1 - Multi-group t-tests H8.2

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.014	0.153	<b>0.878</b>	No
<b>3 vs 1</b>	0.123	1.971	<b>0.050</b>	Yes
<b>3 vs 2</b>	0.109	1.194	<b>0.234</b>	No

The anxiety felt regarding the smart speaker (group 3) had a stronger and significant negative influence over attitude toward usage compared to the others.

Regarding the perception of usefulness, we relied upon the existing literature to suppose that it positively influences attitude toward usage, regardless of the smart object.

**H9: The perception of usefulness positively influences the attitude toward future usage.**

Table 84 - Study 1 - hypothesis H9

Perceived Usefulness -> Attitude toward usage	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Attitude)	R <sup>2</sup> Contribution	Hypotheses
<b>Group 1</b>	0.786	0.783	<b>0.000</b>	0.684	95.17%	Supported
<b>Group 2</b>	0.770	0.765	<b>0.000</b>	0.615	91.21%	Supported
<b>Group 3</b>	0.715	0.719	<b>0.000</b>	0.724	81.83%	Supported

The results show that the perception of usefulness has a significant and positive influence over the attitude toward usage. Accordingly, the hypothesis H9 is supported. The multigroup analysis shows no difference between groups.

Table 85 - Study 1 - Multi-group t-tests H9

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.015	0.218	<b>0.828</b>	No
<b>3 vs 1</b>	0.070	1.117	<b>0.265</b>	No
<b>3 vs 2</b>	0.055	0.889	<b>0.375</b>	No

Regarding the influence of perceived ease of use over the attitude toward future usage, we also relied upon the literature to assume a positive influence.

**H10: The perception of ease of use has a positive influence over the attitude toward future usage.**

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 86 - Study 1 - hypothesis H10

Perceived Ease of use - > Attitude toward usage	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Attitude)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	0.019	0.013	<b>0.722</b>	0.684	1.02%	Rejected
<b>Group 2</b>	-0.035	-0.023	<b>0.555</b>	0.615	2.62%	Rejected
<b>Group 3</b>	0.066	0.064	<b>0.205</b>	0.724	4.49%	Rejected

Surprisingly, perceived ease of use had no significant influence over the attitude toward future usage. Regarding the R<sup>2</sup> contribution, attitude toward usage seems to be almost entirely explained by the perceived usefulness and the anxiety felt. Additionally, there was no difference between groups. This provides support for Venkatesh and colleagues (2003) observation of a low importance of perceived ease of use compared to perceived usefulness for explaining attitudes.

Table 87 - Study 1 - Multi-group t-tests H10

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.054	0.573	<b>0.567</b>	No
<b>3 vs 1</b>	0.047	0.562	<b>0.575</b>	No
<b>3 vs 2</b>	0.101	1.189	<b>0.235</b>	No

Regarding anxiety and the intention to use, we previously supposed that they were negatively correlated. We have assumed that **H8.3: The anxiety felt has a negative influence over the intention to use.**

Table 88 - Study 1 - hypothesis H8.3

Anxiety - > Intention to use	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Intention)	R <sup>2</sup> Contribution	Hypothesis
<b>Group 1</b>	-0.068	-0.070	<b>0.162</b>	0.697	3.27%	Rejected
<b>Group 2</b>	-0.078	-0.078	<b>0.118</b>	0.651	3.12%	Rejected
<b>Group 3</b>	0.078	0.074	<b>0.094</b>	0.759	<1%	Rejected

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

We have supposed a direct influence of anxiety over the intention to use. However, the results indicate that they were no significant influence. Accordingly, the hypothesis H8.3 is rejected. Even the R<sup>2</sup> contribution shows very little effect. However, the multigroup analysis indicate differences between group 3 and the two others.

Table 89 - Study 1 - Multi-group t-tests H8.3

Groups	Difference	Observed value	Sig.	Is there any difference?
2 vs 1	0.010	0.161	0.872	No
3 vs 1	0.146	2.033	0.043	Yes
3 vs 2	0.156	2.032	0.043	Yes

One possible explanation is that the influence of anxiety over the intention to use might be fully mediated by the attitude toward usage. Indeed, based on the literature, we also supposed a direct influence of attitude over the intention to use. Hence, we assessed this relationship as well.

### **H11: Attitude toward future usage has a positive influence over the intention to use.**

Table 90 - Study 1 - hypothesis H11

Attitude toward usage -> Intention to use	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Intention)	R <sup>2</sup> Contribution	Hypothesis
Group 1	0.807	0.807	0.000	0.697	96.72%	Supported
Group 2	0.790	0.783	0.000	0.651	96.88%	Supported
Group 3	0.905	0.074	0.000	0.759	>99%	Supported

The results indicate a significant positive influence of attitude toward usage over the intention to use in all groups. The path coefficient and the R<sup>2</sup> contribution support the explanation above regarding anxiety. Hence, the hypothesis H11 is supported. Regarding difference between groups, we can observe a stronger influence of attitude in group 3. The multigroup analysis confirms that the influence of attitude over intention is significantly stronger in group 3 compared to the two others.

Table 91 - Study 1 - Multi-group t-tests H11

Groups	Difference	Observed value	Sig.	Is there any difference?
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Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>2 vs 1</b>	0.017	0.297	<b>0.767</b>	No
<b>3 vs 1</b>	0.098	2.055	<b>0.041</b>	Yes
<b>3 vs 2</b>	0.115	2.061	<b>0.040</b>	Yes

The attitude toward future usage had a stronger influence over the intention to use with the highly agentic object. This can be explained regarding the significant impact of anxiety over the attitude in group 3.

The following table summarizes all supported and rejected hypothesis. A complete description and explanation of the results are provided in the discussion section.

*Table 92 - Hypotheses status*

Category	Research hypotheses	Status
<b>Main hypotheses</b>	H1: The object with the highest level of agency will elicit more anxiety than the others.	Accepted
	H2: The object with the highest level of agency will be perceived more negatively in terms of attitude toward future usage compared to the others.	Accepted
	H3: The object with the highest level of agency will elicit lower intention to use it.	Accepted
<b>Antecedent variables</b>	H4.0: Object's agency has a positive influence over the image elaboration capacity.	Partially supported
	H4.1: Object's agency positively influences the feeling of being dominated in terms of agency.	Partially supported
	H4.2: Object's agency has a positive influence over the anxiety felt.	Rejected
	H4.3: Object's agency positively influences the feeling of being reduced in terms of communalitY.	Rejected
	H5: Image elaboration has a positive influence over the feeling of being dominated.	Partially supported
<b>Interpersonal relationship variables</b>	H6.0: The feeling of being dominated in terms of agency has a positive influence over the feeling of being reduced in terms of communalitY.	Accepted

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Consequences</b>	H6.1: The feeling of being dominated in terms of agency has a positive influence over the anxiety felt.	Partially supported
	H6.2: The feeling of being dominated in terms of agency has a negative influence over the perceived usefulness.	Rejected
	H7.0: The feeling of being reduced in terms of communalism has a positive influence over the anxiety felt.	Accepted
	H7.1: The feeling of being reduced in terms of communalism has a negative influence over the perceived ease of use.	Rejected
	H8.0: The anxiety felt has a negative influence over the perception of usefulness.	Accepted
	H8.1: The anxiety felt has a negative influence over the perceived ease of use.	Partially supported
	H8.2: The anxiety felt has a negative influence over the attitude toward future usage.	Partially supported
	H8.3: The anxiety felt has a negative influence over the intention to use.	Rejected
	H9: The perception of usefulness positively influences the attitude toward future usage.	Accepted
	H10: The perception of ease of use has a positive influence over the attitude toward future usage.	Rejected
	H11: Attitude toward future usage has a positive influence over the intention to use.	Accepted

Discussion

The study 1 aimed at exploring the impact of smart object's agency over the anticipated interpersonal relationship, and the implication of object's agency in the emergence of resistance toward smart objects.

Relying on 3 different smart objects, study 1 highlights differences between groups in terms of anxiety felt, attitudes and intention to use the smart object. Participants from group 3 had higher levels of anxiety, and experienced lower attitudes and intention to use the highly agentic

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

object. Conversely, the two other groups had experienced similar anxiety, attitudes, and intention to use the smart object (either the smart plug, or smart bulb).

To better understand this phenomenon and to provide an explanation, we relied on a structural equation modeling approach to assess the potential relations between the concepts identified across the literature and the AOL findings.

Results indicate that the relationship between smart object's agency and the intention to adopt the object is not linear, leading to partially supported hypotheses. Yet, participants' reaction toward the smart object, from group 1 and 2, were both more positive (lower anxiety felt, higher attitudes and intention to use the object) compared to participants' reaction from group 3.

Accordingly, we decided to mix the result from the PLS path modeling with the interpersonal mapping exposed below.

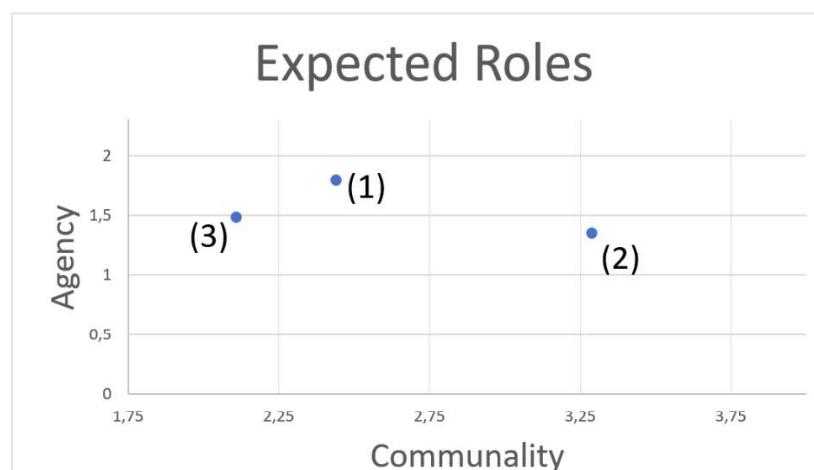


Figure 67 - Study 1 - Expected Roles mapping

### The potential mechanism explained

Based on the interpersonal circumplex model and the methodology provided by Locke and Adamic (2012), we were able to compute the agentic and communal vectors to provide a mapping of participants' expected role regarding the smart object's agency. This mapping highlights an amazing mechanism.

Participants from group 1 were exposed to a smart object that possesses a low agency. We designed the smart plug description for making it the servant of the relationship. What we

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

can observe in the expected role is that participants from group 1 had a high expression of agency, and moderate expression of communalism (1). This refers basically to the master-servant relationship style n°1 as described by Novak and Hoffman (2019). Participants from group 1 have expected to endorse the role of master in their anticipated interaction with the smart plug, which was perceived as the servant (low agency). Accordingly, the anticipated experience was positive (extension) and resulted in lower levels of anxiety and higher levels of attitudes and intention to use the object.

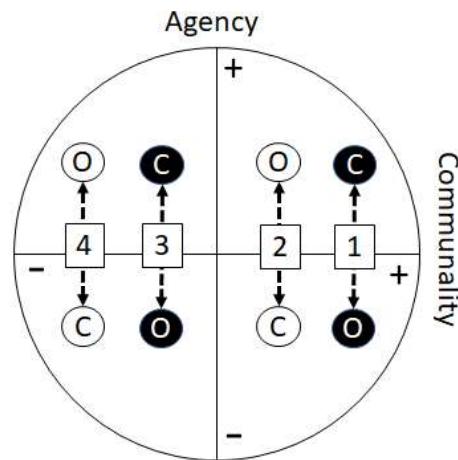


Figure 68 - Master-Servant relationship styles (Novak and Hoffman 2019)

On the other hand, participants from group 2 were exposed to a smart object that possesses a moderate agency. We designed the smart bulb description for making it a partner in the relationship. What we can observe in the expected role that participants from group 2 had a moderate expression of agency, and a high expression of communalism (2). This refers basically to the partner relationship style n°1 as described by Novak and Hoffman (2019). Participants from group 2 have expected to endorse the role of partner, in their anticipated interaction with the smart bulb, which was also perceived as a partner (moderate agency). Accordingly, the anticipated experience was also positive (expansion) and resulted in lower levels of anxiety and higher levels of attitudes and intention to use the object, just like group 1.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

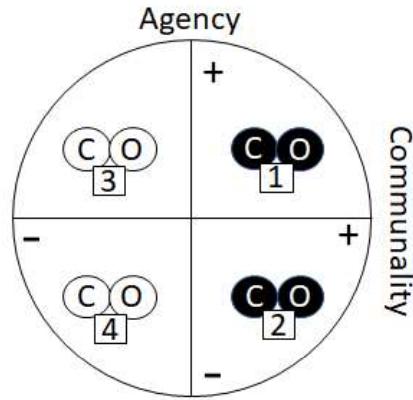


Figure 69 - Partner relationship styles (Novak and Hoffman 2019)

Finally, participants from group 3 were exposed to a smart object that possesses a high agency. We designed the smart speaker description for making it a master of the relationship. What we can observe in the expected role is that participants from group 3 had a high expression of agency, and a low expression of communality (3). This refers basically to the unstable pattern and conflicting position n°2 as described by Novak and Hoffman (2019). Participants from group 3 have expected to endorse the role of servant, in their anticipated interaction with the smart speaker, which was perceived as the master (high agency). Yet, consumers have not accepted the relationship and decided to enter an unstable state, for impeding and restricting the interaction. Accordingly, the anticipated experience was negative (restriction) and resulted in higher levels of anxiety and lower levels of attitudes and intention to use the object compared to the others.

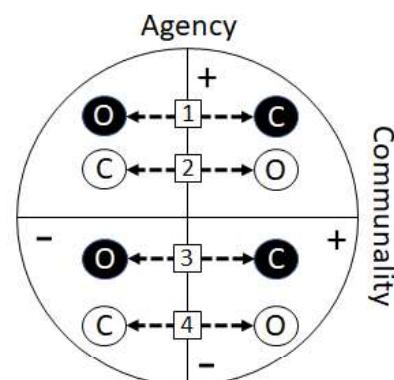


Figure 70 - Unstable relationship styles (Novak and Hoffman 2019)

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

This supports our inferences made regarding the potential implications of interpersonal relationship dynamics in anticipated interactions prior to any real-life experience.

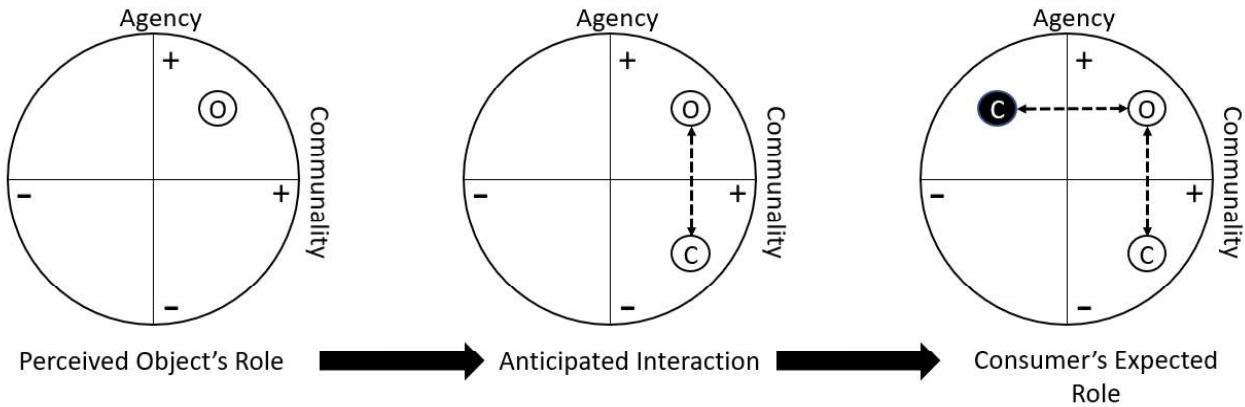


Figure 71 - Explanation of the phenomenon

Participants from group 3 have perceived the smart speaker as the master of the relationship due to its highly agentic capacities. Consequently, they knew that they had to endorse the role of servant during the anticipated interaction. In this anticipated interaction, negative experiences of reduction were simulated as a potential relational outcome. This feeling of reduction was perceived as a potential risk if engaging the relationship. Accordingly, the negative anticipated experience has elicited anxiety and negative attitudes toward the interaction, resulting in the unstable expected role to impede and restrict a potential future interaction.

Participants from group 1 and 2 faced different positive experiences. Group 1 was experiencing anticipated self-extension as they expressed a high agency and a moderate communality (they have simulated using the smart object as a tool). While group 2 was experiencing anticipated self-expansion, as they had a moderate agency, but a high communality (they have simulated cooperating with the smart object as a partner). Conversely, group 3 was experiencing anticipated self-restriction experiences, as they had a high agency and a low communality (they have simulated being reduced by the smart object, as a master, and decided to restrict the future interaction).

Study 1 confirms our inferences and assumptions regarding the emergence of a relational barrier, preventing consumers to adopt smart objects based on their perception of object's agency and the potential negative relational outcomes mentally simulated.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The framework proposed by Novak and Hoffman (2019) represents a powerful tool to assess the extent to which smart object's capacities potentially elicit apprehension and resistance. Such mechanisms involving interpersonal relationship dynamics explain the resistance toward smart objects from a relational perspective, supporting the existence of a relational barrier to adoption as mentioned by Monsurro and colleagues (2020).

Yet, one aspect of study 1 represents a major limit for confirming our findings. Indeed, we relied upon three different smart objects to assess the mental simulation of anticipated interaction. As they are different in terms agency, they are also different in terms of nature.

A smart plug is not a smart bulb, which are not smart speakers either. Regardless of their level of agency, these objects differ in terms of product's category. Accordingly, we must provide support for study 1 results by performing a similar study with one same smart object holding three different levels of agency. By doing so, we will isolate the effect of smart object's agency over the consumer behavioral intention.

By performing study 2, we will be able to provide support for study 1 and confirm our inferences made regarding the impact of smart object's agency over the anticipated interpersonal relationship between consumers and smart objects.

## II – Study 2 – Empirical support

### *Experimental design*

#### *Experimental conditions*

The study 2 aims at providing an empirical support for study 1. We wanted to isolate even more the potential influence of smart object's agency over the intention to use the object. Thus, we relied upon similar experimental conditions except that we kept the same smart objects in all descriptions, that holds different levels of agency.

Study 1 has highlighted the influence of different levels of agency over the anticipated experiences. The capacities to affect and to be affected expressed by the smart object have

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

provoked different reactions and feelings. In study 2, we try to observe if the same phenomenon can occur with one smart object that holds different levels of agency.

As seen in study 1, object's agency can be sorted in three categories: agency, autonomy, and authority (Hoffman and Novak 2018). These different levels of agency were supposed to be shaped by different expressions of autonomy, reactivity, ability to learn and to cooperate (Rijsdijk et al. 2007). Yet, both the pre-tests and study 1 have revealed that the ability to cooperate might not measure object's agency as conceptualized by Hoffman and Novak (2018). To confirm that finding, we decided to elaborate study 2 descriptions the same way as in study 1, and to keep the ability to cooperate items.

Hence, we designed three descriptions of the same smart object with different levels of agency. Consistent with our literature review, the AOL results, and study 1 findings, it is very likely that smart object's level of agency can influence consumer's behavioral intention based on the anticipation of future interpersonal interactions.

Consequently, comparing the impact of one smart object with different levels of agency over the anticipated experiences will provide strong support to consider a real impact of object's agency over consumer's acceptance / resistance toward smart objects.

Accordingly, the methodology relied upon in this study will consider three different conditions with the same smart object depicted:

- A low level of agency expressed by the object (Agency)
- A moderate level of agency expressed by the object (Autonomy)
- A high level of agency expressed by the object (Authority)

The object will hold different degrees of autonomy, reactivity, ability to learn and to cooperate. This design will allow us to better understand the findings from study 1, providing support for our explanation.

### Stimuli

This study aims at supporting study 1 in exploring the impact of smart object's agency over the anticipated interpersonal relationship. The same stimuli's structure used during study 1 was relied on for eliciting mental simulations of future interactions. Accordingly, the stimuli were also made of two different parts:

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- A visual (image) of the smart object that remained the same across the descriptions.
- A description of similar scenarios where the smart object expresses its agency.

Our experimental conditions (agency, autonomy, authority) require one smart object depicted in three different stimuli with either agentic, autonomous, and authoritarian capacities. These categories originate from the literature and have shown their effectiveness during study 1. Hence, two main elements were considered in elaborating the descriptions in study 2:

- The capacities depicted in the descriptions must be real and not fantasized, to be consistent with the smart object technical specifications.
- Just like study 1, the visual must depict a smart object that does not hold any physical resemblance with human to avoid the effect of anthropomorphism.

To provide more support to study 1, we have decided to anchor the stimuli' descriptions within the smart home market as well. The image was also chosen from Google Image and was used under the Creative Common Licences.

Regarding the smart object that will serve in all descriptions, we have decided to rely on the smart coffee maker. Indeed, a lot of different smart coffee makers are already available in the market. Yet, they do not share the same capacities. Some smart coffee makers are barely agentic, while others have highly agentic functionalities. Accordingly, we found it possible to design different descriptions of the same object that expresses different levels of agency.



*Figure 72 - The smart coffee maker*

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Like study 1, the low agentic description was designed to present the smart coffee maker as a mere connected tool. The object in the low agentic description is connected and can be controlled using the smartphone. The moderate agentic description was designed to depict the smart coffee maker as more autonomous. The aim was to present the object as an interactive partner with voice interaction enabled. Last, the highly agentic description was supposed to present the smart coffee maker as an independent entity, that can express control without consumer's intervention, and can improve by learning through time. The object is for instance, capable of ordering coffee bean autonomously when the level is low, directly from the store. It can also work as a hub, controlling other smart devices to improve the consumer experience. This description depicted the smart coffee maker as more aware and agentic.



*Figure 73 - Study 2 - Levels of Agency*

The descriptions were also made identical in terms of structure (number of words, characters) and similar in terms of environment (where the described interactions take place). Like study 1, all descriptions were elaborated based on the AOL results, mixing cognitive and affective evocations as described by the participants. The descriptions are available in appendices.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 93 - Study 2 descriptions

Descriptions		
1 (low agency)	2 (moderate agency)	3 (high agency)
Group 1	Group 2	Group 3
<p><b>Votre café, simplement connecté</b></p> <p>Profitez d'un café d'exception avec la machine à café connectée « K-Smart CoffeeMaker » et offrez-vous dès à présent un moment d'évasion vers le futur.</p> <p>Toutes vos envies d'un simple clic ! Prenez le contrôle de votre K-Smart CoffeeMaker à distance depuis votre smartphone et son application mobile dédiée. Personnalisez vos boissons ou choisissez parmi une liste de 18 boissons proposées.</p> <p>Rajoutez l'intensité de votre café, la pré-infusion, la température ou encore la quantité de mousse, depuis votre smartphone et gardez le contrôle sur votre café du début à la fin.</p> <p>L'application vous permet non seulement de personnaliser vos boissons, mais aussi d'accéder aux réglages de votre machine. Gérez l'alimentage, la mise en place de scénarios et de routines : telle que la préparation de votre café au réveil ou en rentrant du travail.</p> <p>Grâce au K-Smart CoffeeMaker, bénéficiez du café de demain, dès aujourd'hui !</p> 	<p><b>Le café, connecté à vos envies</b></p> <p>Faites de votre cuisine un espace encore plus chaleureux grâce à la machine à café connectée « K-Smart CoffeeMaker ». Dégustez en un clic un café unique pour toutes vos occasions.</p> <p>Le K-Smart CoffeeMaker n'est pas seulement une machine à café connectée, mais un véritable outils de création accessible depuis votre smartphone. L'intelligence embarquée vous fera découvrir le café autrement.</p> <p>Prenez le contrôle de votre machine tout en gardant les mains libres à l'aide de la commande vocale, et entrez dans l'ère du café intelligent.</p> <p>A la pointe de la technologie, le K-Smart CoffeeMaker est connecté à son environnement de sorte à vous proposer la meilleure expérience possible. Il mémorise et s'adapte à vos goûts pour vous proposer le meilleur du café, que ce soit au réveil ou bien pour vous accueillir de retour à la maison. Laissez-le gérer !</p> <p>Le K-Smart CoffeeMaker apprend et s'adapte à vos envies, même sans intervention de votre part. Programmez votre réveil sur votre smartphone il s'adaptera à celui-ci et vous proposera une boisson au réveil.</p> <p>Cette machine à café connectée et interactive transformera votre quotidien, sans que vous n'ayez à vous en soucier.</p> 	<p><b>Un café connecté, et plus encore</b></p> <p>Transformez votre lieu de vie en véritable maison du futur. Rendre votre maison intelligente en utilisant votre voix en toute simplicité à l'aide de la machine à café connectée « K-Smart CoffeeMaker ». Interagissez avec une machine à café intelligente !</p> <p>A la maison laissez-le faire. S'il manque du café à mouler, le K-Smart CoffeeMaker se chargera de passer commande de façon autonome. Vous pouvez également le charge de faire le resto de vos courses, gérer vos rendez-vous et bien d'autres choses encore, tel un vrai assistant domestique.</p> <p>Utilisez le K-Smart CoffeeMaker comme une véritable passerelle pour vous connecter et tirer-le commander vos humains, volets roulants et autres appareils connectés. Il adaptera l'éclairage par exemple, en fonction des boissons pour une véritable expérience immersive.</p> <p>Obtenez le meilleur du café sans même avoir à prendre votre smartphone en l'activant par la voix.</p> <p>Le K-Smart CoffeeMaker est indépendant et intelligent, il perçoit son environnement. Il vous proposera des boissons en fonction des informations à sa disposition collectées autour de lui.</p> <p>C'est si simple de se lancer, il vous suffit de lui parler !</p> 

### Pre-test

The smart coffee maker's capacities were designed regarding the four dimensions retained from Rijsdijk and colleagues (2007) measurement scale of object's intelligence. Descriptions were elaborated to be perceived different in terms of autonomy, reactivity, ability to learn and to cooperate. To make sure our descriptions were effective, we performed a pre-test to check for a significant difference in terms of perceived object's agency.

Like study 1, we relied on a convenience sample to assess the different descriptions. About 162 questionnaires were administrated online alongside study 1 pre-test, from March 2021 to April 2021. Participants that didn't fully complete the questionnaire were removed from the sample. At the end, 150 valid questionnaires (50 per group) were analysed using IBM SPSS software.

Participants were randomly assigned to one of the three descriptions (group 1 = low agency, group 2 = moderate agency, group 3 = high agency). The sample was made of undergraduate and postgraduate students that were recruited through social medias ( $M_{age} = 21.26$ ,  $SD = 2.33$ ).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Regarding the results, we first checked for the reliability of the four dimensions (Autonomy, Reactivity, Ability to Learn and Ability to Cooperate) and our construct Object Agency.

Table 94 - Study 2 - Object's agency reliability

Scale	KMO	Bartlett's Test	% Of variance explained	Cronbach's Alpha
<b>Autonomy</b>	0.749	0	64.048	0.810
<b>Reactivity</b>	0.804	0	69.106	0.850
<b>Ability to Learn</b>	0.856	0	75.405	0.918
<b>Ability to Cooperate</b>	0.785	0	62.821	0.794
<b>Object's Agency</b> (Autonomy; Reactivity; Ability to learn; Ability to cooperate)	0.872	0	53.466	0.668

The observation regarding the dimension “Ability to cooperate” made during study 1 (pre-test and data collection) seems to be confirmed once again. The Cronbach’s alpha of Object’s Agency falls below 0.7 when Ability to cooperate is included. Accordingly, we decided to perform a principal component analysis and found that Ability to Cooperate was below 0.2 in the component matrix (0.146). So, we decided to remove this dimension and to check again for the object’s agency reliability.

Table 95 - Object's agency reliability 2

Scale	KMO	Bartlett's Test	% Of variance explained	Cronbach's Alpha
<b>Object's Agency</b> (Autonomy; Reactivity; Ability to learn)	0.897	0	70.904	0.793

By removing the “ability to cooperate” dimension from the analysis, we noticed an improvement regarding the KMO indicator, the percentage of variance explained and the Cronbach’s alpha. Like study 1, we took the decision to remove the ability to cooperate dimension from the analysis.

This observation confirms the possibility that ability to cooperate might be correlated with the other dimensions that were previously not retained (humanlike interaction and personality). The dimension ability to cooperate might be correlated with items made to

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

measure object's intelligence from the human-oriented perspective and not exactly object's agentic features as conceptualized in the object-oriented ontology (Hoffman and Novak 2018).

Regarding the manipulation (levels of agency), we have evaluated the effectiveness of our descriptions based on the result of an ANOVA. Accordingly, we have compared the results of each dimension between each group. The manipulation worked as the level of object's agency differs significantly between the descriptions:

*Table 96 - Study 2 - ANOVA object's agency*

	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>F</b>	<b>Sig.</b>
<b>Autonomy</b>	2.75	4.25	5.43	62.705	0.000
<b>Reactivity</b>	3.07	4.42	4.77	16.816	0.000
<b>Ability to Learn</b>	3.29	3.73	4.15	3.197	0.044
<b>Object Agency</b>	3.03	4.13	4.78	25.936	0.000

Results indicate that the descriptions were perceived significantly different in terms of autonomy, reactivity, ability to learn and so in terms of object's agency. The descriptions seem to be effective for eliciting the perception of different levels of agency for the same object. Thus, we relied upon these descriptions to conduct the second study.

### Hypotheses

Based on our literature review, the AOL and study 1 results, we made different hypotheses prior to the data analysis for study 2. The data collection for study 2 was performed right after study 1, with a similar experimental design. Accordingly, we designed study 2 as an empirical support for the investigation and research model assessed in study 1.

Study 1 provided support for the inferences made as regard the anticipated relational outcomes and the potential influence of smart object's agency over the anticipated interaction. Main findings suggest that negative experiences occurred when the object was perceived highly agentic. When the smart object is perceived highly agentic, it triggers the feeling of being reduced by the relationship. The smart object is seen as potentially mastering and dominating the relationship. Accordingly, negative experiences emerge from the anticipated relationship.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

As a result, participants had adopted an unstable relationship pattern to restrict the future interaction. This form of resistance comparable to passive resistance, represents a relational barrier to adoption.

For that purpose, study 2 aims at identifying the same patterns as observed in study 1. If the same phenomenon occurs with the same object that holds three different levels of agency, then the inferences will be strongly supported empirically.

We have observed from study 1 that the influence of smart object's agency had different implications and consequences. One of the main implications was the differences in terms of negative emotions elicited by the highly agentic object (group 3). The smart speaker had elicited more anxiety and negative attitudes, which in turn had provoked stronger influences over the perception of usefulness, ease of use, and intention to use the object. Based on the findings from study 1, we have articulated the following hypotheses:

**H1: The description with the highest perceived agency will elicit more anxiety than the others.**

**H2: The description with the highest perceived agency will be perceived less useful than the others.**

**H3: The description with the highest perceived agency will be perceived less easy to use than the others.**

**H4: The description with the highest perceived agency will elicit a lower attitude toward future usage than the others.**

**H5: The description with the highest perceived agency will elicit a lower intention to use than the others.**

### Data collection

The aim of this study was to provide support for study 1 results. To fulfil that objective and to test our hypotheses, the same design used for study 1 was relied upon. A questionnaire was elaborated on Lime Survey and diffused online, through the platform Prolific.

The experiment was settled based on the same steps:

- The same website (<https://consumerbehavior.fr/>) was used to randomly assign the participants to one of the three questionnaires on Lime Survey.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

- Participants were randomly assigned to one description based on the Java script incorporated inside the source code of the webpage. We only had to modify the URL links to assign them randomly to the different Lime Survey questionnaires.

```
<html>
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
    <title>Etude sur l'évaluation d'objets connectés</title>
    <script type="text/javascript" src="./Pretest_Redirection/jquery.min.js.téléchargement"></script>
    <script type="text/javascript">

      //on génère un lien au chargement de la page
      $(document).ready(function() {

        //quand on click sur le lien, le lien change
        $("#lienaleatoire").live("click", function() {
          generationLienAlea();
        });

        function generationLienAlea(){

          var listliens = [ ];
          listliens[0] = "https://enquetes-screen.msh-alpes.fr/index.php/826398?lang=fr";
          listliens[1] = "https://enquetes-screen.msh-alpes.fr/index.php/835386?lang=fr";
          listliens[2] = "https://enquetes-screen.msh-alpes.fr/index.php/267537?lang=fr";

          nb = rand(0, listliens.length - 1);
          $("#lienaleatoire").attr('href', listliens[nb]);
        }

        //rand pour les parâmes qui ont horeur des fn.maths ??
        function rand (min, max) {
      </script>
```

Figure 74 - Random assignment procedure 2

- After being randomly assigned to one of the three descriptions, they were exposed to the exact same informative message used in study 1, indicating the research objective, the research modalities and how the data will be used.
- Then, participants were asked to carefully read the description, and to take the time to think about interacting with the smart object depicted on it.
- Finally, participants had to go through the questionnaire. Questions were also randomly ordered for each participant, using the Lime Survey option, to avoid any methodological bias.

The data collection took place from June 2021 to July 2021. The link <https://consumerbehavior.fr/> was shared on Prolific, where participants were randomly assigned to one of the three conditions. Each participation was paid around 2.00€ with an average duration of 7min30 per participant. We make sure that no participant from study 1 took part in study 2 (participants have a Prolific ID).

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

At the end of the data collection, we obtained 480 questionnaires. From these, 30 participants were removed because of partial completion. We finally reached 450 valid questionnaires with 150 participants for each condition.

Table 97 - Study 2 total questionnaires

Condition	Total questionnaires	Total valid
<b>Group 1 – Low agency</b>	163	150
<b>Group 2 – Moderate agency</b>	161	150
<b>Group 3 – High agency</b>	156	150

The table below indicates the main sample characteristics (gender, age, socio-professional category). We can notice that the samples from study 1 and 2 are almost similar in terms of distribution and characteristics.

Table 98 - Study 2 sample characteristics

Gender	Male	53.3%
	Female	46.2%
Age ( $M_{age} = 28.35$ , $SD = 9.240$ )	18-25	49%
	25-30	20.9%
	30-40	19.6%
	40-50	7.2%
	50+	3.3%
SPC	Student	38.7%
	Executive	26.2%
	Employed	22%
	Artisan	1.8%
	Others	11.3%

### Manipulation Check

This part is dedicated to the evaluation of our manipulation. The aim is to assess the extent to which each description was respectively perceived as low agentic (group 1), moderately agentic (group 2) and highly agentic (group 3).

Like study 1, we wanted to check if the dimension “ability to cooperate” was indeed, not exactly measuring object’s agency. We followed the same methodology exposed in study 1 and found out that the dimension ability to cooperate had to be removed.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Table 99 - Study 2 - Object's agency reliability

Scale	KMO	Bartlett's Test	% Of variance explained	Cronbach Alpha
<b>Autonomy</b>	0.821	0	77.938	0.906
<b>Reactivity</b>	0.828	0	78.769	0.910
<b>Ability to Learn</b>	0.884	0	80.628	0.940
<b>Ability to Cooperate</b>	0.812	0	70.618	0.856
<b>Object's Agency (With Ability to cooperate)</b>	0.701	0	55.833	0.724
<b>Object's Agency (Without Ability to cooperate)</b>	0.690	0	71.634	0.802

The result confirms the observation made regarding the dimension ability to cooperate. Despite a lower KMO indicator, the construct object's agency was better captured by removing the dimension ability to cooperate. Accordingly, the ability to cooperate was removed from the analysis. It seems that autonomy, reactivity, and ability to learn are sufficient to capture the perception of object's agency.

We then assessed the effectiveness of our manipulation by performing an ANOVA. Results confirm the difference between each description and the effectiveness of our manipulation. The description 1 (low agency) was perceived less agentic than the description 2 (moderate agency), which was also perceived less agentic than the description 3 (high agency).

Table 100 - Study 2 - ANOVA pre-test

	Group 1	Group 2	Group 3	F	Sig.
<b>Autonomy</b>	2.27	3.25	4.42	154.039	0.000
<b>Reactivity</b>	2.53	3.48	4.53	118.625	0.000
<b>Ability to Learn</b>	2.61	3.27	3.92	44.454	0.000
<b>Object Agency</b>	2.47	3.33	4.29	160.511	0.000

Accordingly, the perception of agency in each description (low, moderate, high) differed as expected. The agentic capacities held by the smart coffee maker in each description were indeed perceived significantly different.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Perceived Levels of Agency

Smart coffee maker

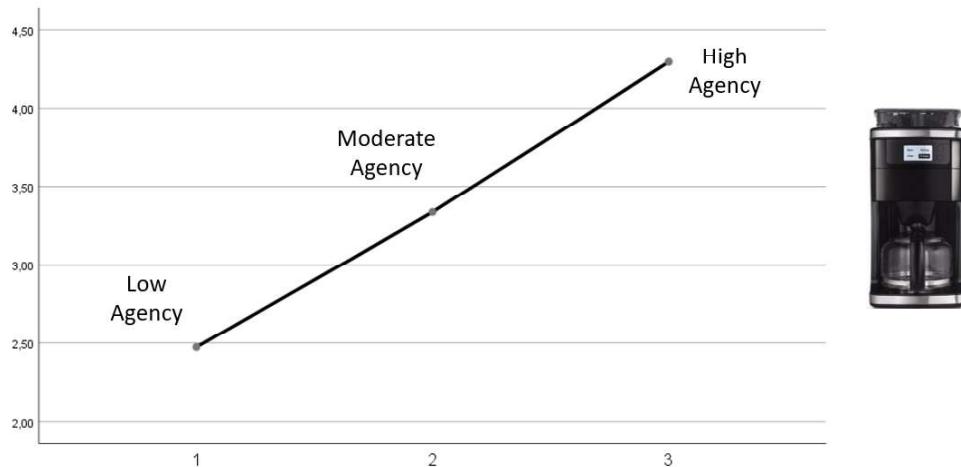


Figure 75 - Study 2 - Perceived levels of agency

A series of different T-test have revealed that each description was significantly different (in terms of autonomy, reactivity, ability to learn and perceived agency) from the two others, indicating that the manipulation was successfully eliciting different perception of agency for each description. This allows us to go further in the analysis.

Table 101 - Study 2 - Manipulation check between groups

	t	Sig.
<b>Group 1 vs Group 2</b>	-8.214	0.000
<b>Group 1 vs Group 3</b>	-18.289	0.000
<b>Group 2 vs Group 3</b>	-9.550	0.000

### Model fit, validation, and reliability of measurement scales

#### Overall model fit

We relied upon the PLS path modeling method to assess the validity and reliability for all the measurement scales. All latent variables were measured at the first-order level. The research model was structured using a reflective measurement mode.

Regarding our model, the GoF indicates respectively a value of 0.422 (group 1), 0.421 (group 2) and 0.412 (group 3), which is high according to Wetzels and colleagues (2009). The model was assessed relying on a bootstrapping procedure of 1000 replications showing that an

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

important part of variance was well captured by the model. The values for the GoF and the GoF after Bootstrap are very close. The proximity between groups also indicates a good quality and a stable model.

*Table 102 - Study 2 - Overall model fit*

Overall Model Fit				
	GoF	GoF (Bootstrap)	Standard Error	Critical Ratio (CR)
<b>Group 1</b>	0.422	0.432	0.030	13.949
<b>Group 2</b>	0.421	0.434	0.027	15.719
<b>Group 3</b>	0.412	0.417	0.030	13.746

Now that we have assessed the overall quality of the model, we can evaluate the reliability and validity (convergent and discriminant) of the latent variables.

### Validity and reliability

The same method used in study 1 was relied upon to assess the validity and reliability of our variables. From our results, it appears that all variables have met the different thresholds for both the Joreskog Rhô and the AVE, except for Object's Agency in all groups with an AVE between 0.4 and 0.5. Yet, its composite reliability remains above 0.8 and the AVE is superior to any squared correlation. Accordingly, this value can be accepted (Fornell and Larcker 1981, Lam 2012).

The variables dominated and reduced were computed regarding the methodology provided by Locke and Adamic (2012) like study 1. Accordingly, they represent a single vector. That is the reason why both the Joreskog Rhô and the AVE cannot be computed regarding these two variables.

*Table 103 - Study 2 - Reliability and validity*

Variables	Reliability (Joreskog Rhô)			Convergent validity (AVE)		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
<b>Object's Agency</b>	0.919	0.920	0.902	<b>0.460</b>	<b>0.465</b>	<b>0.410</b>
<b>Image Elaboration</b>	0.908	0.914	0.903	0.764	0.776	0.755
<b>Dominated</b>	/	/	/	/	/	/
<b>Reduced</b>	/	/	/	/	/	/
<b>Anxiety</b>	0.930	0.921	0.954	0.723	0.699	0.805
<b>Perceived Usefulness</b>	0.935	0.948	0.930	0.826	0.859	0.816
<b>Perceived Ease of Use</b>	0.929	0.930	0.920	0.814	0.816	0.793
<b>Attitude toward usage</b>	0.974	0.975	0.972	0.949	0.950	0.946

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

<b>Intention to use</b>	0.979	0.984	0.986	0.959	0.968	0.972
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We also assessed discriminant validity of the different measurement scales. The AVE for all variables appears to be higher than the squared correlation with other constructs. The complete tables for the discriminant validity are provided in appendices.

Regarding the interpersonal circumplex model, we also assessed its validity with an individual multidimensional scaling (INDSCAL) to evaluate if it follows a circumplex. We computed the main vectors: Agentic Vector (AV), Unagentic Vector (UAV), Communal Vector (CV), Uncommunal Vector (UCV) as described by the method provided by Locke and Adamic (2012). The INDSCAL was also performed with main items that structure the main dimensions: PA1-PA2 for Agency; HI1-HI2 for Unagency; LM1-LM2 for Communality and DE1-DE2 / for Uncommunality.

The circumplex is a bit less circular compared to study 1. Yet, it also offers the 4 dimensions and structure as suggested by the literature. The result, with a RSQ of 91.5%, indicates a good quality of our measures and a reliable circumplex as both items and vectors are shaping the dimensions they were supposed to measure.

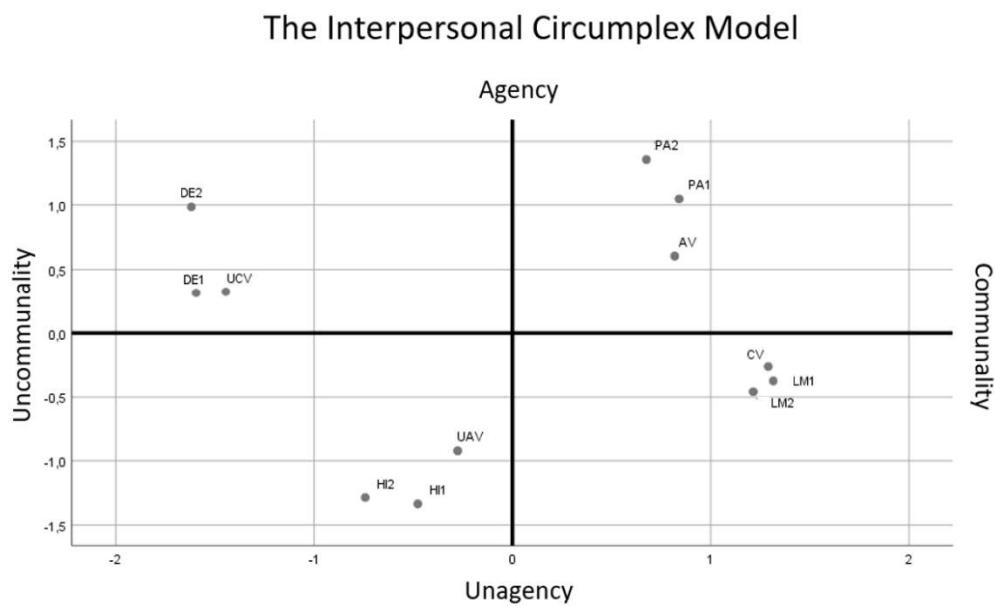


Figure 76 - Study 2 - Interpersonal circumplex model

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

The different variables seem to satisfy conditions of both convergent and discriminant validity, indicating valid and reliable measures. Additionally, the measure of the interpersonal circumplex model has shown that it has effectively worked. We can thus, go further with the analysis.

### Results

After the verification of the overall model fit, the validity and reliability of the measures, this section will focus on the hypotheses' tests. Implications will be discussed after this section.

Based on our literature review, the AOL and study 1 results, we made five different hypotheses regarding the potential mechanism that triggers resistance toward smart objects. To assess our assumptions, we have decided to rely upon the results of an ANOVA and different t-tests to assess our hypotheses. Results from those tests will be supported by the path coefficients provided by the PLS path modeling for more clarification when needed.

We have supposed that a smart object described as highly agentic would elicit more anxiety, a lower perception of usefulness and ease of use, alongside negative attitudes, and a lower intention to use it compared to the same smart object described as low or moderately agentic.

Accordingly, an ANOVA revealed a significant difference in terms of anxiety felt, perceived usefulness, ease of use, attitude toward usage and intention to use based on the description.

Table 104 - Study 2 - ANOVA results

	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>F</b>	<b>Sig.</b>
<b>Anxiety</b>	1.26	1.39	1.71	14.151	0.000
<b>Perceived Usefulness</b>	3.90	3.77	3.50	3.974	0.019
<b>Perceived Ease of Use</b>	4.50	4.25	4.14	5.128	0.006
<b>Attitude toward Usage</b>	4.08	3.91	3.53	12.397	0.000
<b>Intention to use</b>	3.927	3.943	3.270	8.653	0.000

The smart coffee maker described as highly agentic (group 3) was perceived more agentic than the others, but it had provoked slightly more anxiety, and a lower perceived

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

usefulness and ease of use. The group 3 also expressed a lower attitude toward future usage and a lower intention to use the smart coffee maker.

We performed different t-tests to explore the differences between the descriptions. It appears that group 3 (high agency) significantly diverge from the two others in terms of participants' reactions.

Regarding the anxiety felt for instance, the difference between group 3 and the others is significant.

Table 105 - Study 2 - T-test H1

Variable = Anxiety	t	Sig.
<b>Group 1 vs Group 3</b>	-4.848	0.000
<b>Group 1 vs Group 2</b>	-1.857	0.064
<b>Group 2 vs Group 3</b>	-3.327	0.001

Accordingly, the hypothesis **H1: “The description with the highest perceived agency will elicit more anxiety than the others”** is supported.

An analysis of the path coefficients between the groups indicate that anxiety was mainly influenced by the feeling of being reduced, just like in study 1.

Table 106 - Study 2 - Path coefficients Reduced -> Anxiety

Reduced -> Anxiety	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Anxiety)
<b>Group 1</b>	0.201	0.209	0.029	0.156
<b>Group 2</b>	0.290	0.281	0.001	0.136
<b>Group 3</b>	0.259	0.283	0.003	0.118

This feeling of being reduced was also positively influenced by the feeling of being dominated, providing support for our assumptions and study 1 results as well.

Table 107 - Study 2 - Path coefficients Dominated -> Reduced

Dominated -> Reduced	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (Reduced)
<b>Group 1</b>	0.524	0.528	0.000	0.301
<b>Group 2</b>	0.453	0.462	0.000	0.216
<b>Group 3</b>	0.370	0.377	0.000	0.160

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Then, we performed different t-tests to assess the hypotheses H2 and H3 regarding the perceived usefulness and ease of use.

**H2: The description with the highest perceived agency will be perceived less useful than the others.**

**H3: The description with the highest perceived agency will be perceived less easy to use than the others.**

Table 108 - Study 2 - T-test H2

Variable = Perceived Usefulness	t	Sig.
Group 1 vs Group 3	2.788	0.006
Group 1 vs Group 2	0.897	0.370
Group 2 vs Group 3	1.870	0.062

Table 109 - Study 2 - T-test H3

Variable = Perceived Ease of Use	t	Sig.
Group 1 vs Group 3	3.052	0.002
Group 1 vs Group 2	2.206	0.028
Group 2 vs Group 3	0.944	0.346

Results suggest that the smart coffee maker from group 3 was indeed perceived less useful compared to group 1. The p\_value regarding the comparison between group 2 and group 3 remains above the cut off value of 5% but could have been accepted if we have decided to take a higher risk. Hence, H2 is partially supported.

As regard H3, the difference between group 1 and 3, and group 1 and 2 are significant. Yet, the smart coffee maker is not significantly perceived different in terms of ease of use between group 2 and 3. Here also, the hypothesis is only partially supported. However, the path coefficients indicate that anxiety had a significant negative influence over the perception of usefulness and ease of use as supposed by the findings from study 1.

The negative influence of anxiety over these variables also appears to be stronger in group 3, suggesting that the level of agency might have influenced more negative reactions.

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*Table 110 - Study 2 - Path coefficients Anxiety -> Perceived usefulness*

Anxiety -> Perceived Usefulness	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (PU)
<b>Group 1</b>	-0.242	-0.248	0.004	0.074
<b>Group 2</b>	-0.356	-0.360	0.000	0.139
<b>Group 3</b>	-0.431	-0.437	0.000	0.224

*Table 111 - Study 2 - Path coefficients Anxiety -> Perceived ease of use*

Anxiety -> Perceived Ease of Use	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (PEU)
<b>Group 1</b>	-0.320	-0.327	0.000	0.202
<b>Group 2</b>	-0.259	-0.265	0.002	0.172
<b>Group 3</b>	-0.337	-0.350	0.000	0.140

This is also supported by the hypothesis **H4**, which posits that the description with the highest perceived agency will elicit a lower attitude toward future usage than the others.

*Table 112 - Study 2 - T-test H4*

Variable = Attitude toward usage	t	Sig.
<b>Group 1 vs Group 3</b>	4.687	0.000
<b>Group 1 vs Group 2</b>	0.421	0.268
<b>Group 2 vs Group 3</b>	3.717	0.000

Based on this result, we can observe a significant difference in terms of attitude toward usage between group 3 and the others. We analysed the path coefficient regarding the latent variable attitude and found a significant influence of anxiety only with group 3, providing supports for our assumptions.

*Table 113 - Study 2 - Path coefficients Anxiety -> Attitude toward usage*

Anxiety -> Attitude toward usage	Path coefficient	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup> (AU)
<b>Group 1</b>	-0.040	-0.035	0.404	0.720
<b>Group 2</b>	0.018	0.020	0.692	0.765
<b>Group 3</b>	-0.167	-0.172	0.001	0.690

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Indeed, the multigroup analysis shows a significant difference in terms of influence of anxiety over the attitude toward usage between group 3 and the others. Accordingly, H4 is supported.

Table 114 - Study 2 - Multi-group t-tests anxiety -> attitude

Groups	Difference	Observed value	Sig.	Is there any difference?
<b>2 vs 1</b>	0.058	0.943	<b>0.346</b>	No
<b>3 vs 1</b>	0.127	2.301	<b>0.022</b>	Yes
<b>3 vs 2</b>	0.185	2.867	<b>0.004</b>	Yes

Regarding the influence of object's agency over the intention to use, we also performed different t-tests and found out that group 3 significantly differs from the two other groups in terms of intention to use the smart object, supporting the hypothesis **H5: The description with the highest perceived agency will elicit a lower intention to use than the others.**

Table 115 - Study 2 - t-test H5

Variable = Intention to Use	t	Sig.
<b>Group 1 vs Group 3</b>	3.566	<b>0.000</b>
<b>Group 1 vs Group 2</b>	-0.092	<b>0.927</b>
<b>Group 2 vs Group 3</b>	3.576	<b>0.000</b>

The following table summarizes all supported and rejected hypothesis. A complete description and explanation of the results are provided in the discussion section.

Table 116 - Study 2 - Hypotheses status

Hypotheses	Status
<b>H1: The description with the highest perceived agency will elicit more anxiety than the others.</b>	Accepted
<b>H2: The description with the highest perceived agency will be perceived less useful than the others.</b>	Partially supported
<b>H3: The description with the highest perceived agency will be perceived less easy to use than the others.</b>	Partially supported
<b>H4: The description with the highest perceived agency will elicit a lower attitude toward future usage than the others.</b>	Accepted
<b>H5: The description with the highest perceived agency will elicit a lower intention to use than the others.</b>	Accepted

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Discussion

The study 2 aimed at providing empirical support for study 1 findings. In the first study, we compared three different objects with their own agentic capacities. We found out that they have elicited different reactions. Based on the circumplex model of interpersonal interaction and the patterns provided by Novak and Hoffman (2019) we managed to propose a potential explanation regarding the mechanism that trigger the resistance toward smart objects.

Hence, we tried to further investigate the impact of smart object's agency over the anticipated interpersonal relationship, and the implication of object's agency in the emergence of resistance toward smart objects.

Relying on one smart object (the smart coffee maker) with three different levels of agency (low, moderate, high), study 2 was aiming at isolating the potential influence of smart object's agency over the consumer behavioral intention. As supposed by our hypotheses, the results highlight significant differences between the group 3 (high agency) and the two others in terms of anxiety felt (H1), perceived usefulness (H2), ease of use (H3), attitudes (H4) and intention to use (H5) the smart objects. Like study 1, participants from group 3 experienced higher levels of anxiety, and lower attitudes and intention to use the highly agentic object. Conversely, identical reactions were observed between the two other groups in terms of anxiety, attitudes, and intention to use the smart object.

The path coefficients provided confirms the relations identified between the core concepts, providing support for the AOL exploratory phase and study 1 results.

Results from study 2 confirm the non-linear relationship between smart object's agency and the interpersonal simulated interaction, as observed in study 1. Participants' reaction toward the smart object, from group 1 and 2, were more positive compared to participants' reaction from group 3.

Consequently, we used the same method to understand what happened, by mixing the hypotheses results with the interpersonal mapping exposed below:

Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

*Table 117 - Study 2 - Expected Roles*



We computed the agentic and communal vectors as described by Locke and Adamic (2012) to provide a mapping of participants' expected role regarding the smart object's agency. This mapping fully supports the explanations provided in study 1 results.

Indeed, participants from group 1 were exposed to a smart coffee maker that was described with a low agency. The group 1 description was designed to depict the smart coffee maker as a tool, a servant in the relationship.

What we observe in the group 1 expected role, is that participants expressed a high agency and a moderate expression of communalitY (1). This refers to the same expressive role endorsed by group 1 from study 1. In study 2, participants from group 1 also positioned themselves as master of the relationship, which corresponds to the position n°1 as described by Novak and Hoffman (2019). Participants from this group have expected to endorse the role of master in the anticipated interaction with the smart coffee maker. The smart object was perceived with low agentic features; accordingly, the anticipated experience was positive (extension) and resulted in lower levels of anxiety and higher levels of attitudes and intention to use the object.

The object described as a tool was also perceived more useful and easier to use. This gives support for considering that participants from group 1 have simulated a master-servant interpersonal relationship from which positive self-extension experiences emerged as an anticipated relational outcome.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Regarding participants from group 2, they were exposed to the description of a moderate agency, which tried to represent the smart coffee maker as a partner of the relationship. The expected role endorsed by participants is made of a lower agency, and a higher communality (2).

Just like study 1, participants from group 2 had expressed the same role of partner in the interpersonal relationship. The smart coffee maker depicted as moderately agentic has elicited a similar reaction from participants as observed in study 1. Accordingly, the anticipated experience was also positive (expansion) and resulted in lower levels of anxiety and higher levels of attitudes and intention to use the object, just like group 1. This supports the explanation regarding the experience lived by participants from study 1. People that were confronted to the description 2 have simulated a partner interpersonal relationship from which positive self-expansion experiences emerged as an anticipated relational outcome.

Finally, participants exposed to the highly agentic smart coffee maker expressed a high agency and a low communality (3). Like study 1, participants from group 3 had adopted an unstable relationship pattern under which they intend to restrict the future interaction with the smart object. Participants knew that they had to endorse the role of servant of the relationship. Accordingly, they experienced negative anticipated interaction resulting in a higher level of anxiety felt, and lower levels of attitudes and intention to use the smart coffee maker.

The findings from study 2 provide empirical support and sufficient evidence for considering the effective negative influence of high levels of objects' agency over the consumer's intention to adopt smart objects. Hence, the explanation provided regarding the mechanism that potentially triggers negative attitudes and intention to use the smart objects is supported.

The AOL explorative research combined with the quantitative studies confirm the inferences and assumptions made regarding the relational barrier as first mentioned by Monsurro and colleagues (2020). We relied upon the framework provided by Novak and Hoffman (2018-2019) to investigate the perception of object's agency and the potential negative relational outcomes mentally simulated by consumers as proposed by Rijsdijk and colleagues (2007). Accordingly, we are now able to address our research objectives.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Research objective n°1: “Explore the structure of the consumer-smart object anticipated relationship”

We have investigated the consumer-smart object anticipated relationship by adopting an explorative approach. First, we have explored the mental simulation and evocations elicited by the description of a smart object (the smart fridge). Based on the Album-Online (AOL) projective technique (Vernette 2007, Kessous and Valette-Florence 2019), we were able to identify the main dimensions structuring the mental simulation of future interaction between consumers and smart objects. This qualitative approach has allowed us to explore hidden thoughts and motives structuring the anticipated relationship with a smart object.

Findings have shown the relevance of relying upon the interpersonal and social perspective for assessing consumer-smart object interaction. The anticipated relationship was indeed structured by dimensions that were possible to understand and explain through the assemblage theory (Hoffman and Novak 2018). Consumers were able to simulate complex interaction with different relational outcomes. From positive experiences to negative experiences, participants have shown the extent to which human-object relationship has become complex regarding smart objects' capacities. Indeed, evocations of future interaction with the smart object were structured by anticipated enabling and constraining experiences, illustrating the existence of ambivalent reactions toward smart objects (Ardelet et al. 2017).

Consumers can mentally initiate complex interaction based on the smart object's capacities and simulate the relational outcomes. Based on our qualitative and quantitative studies, we explored and found that consumer-smart object anticipated relationship follow the same dynamic as described by interpersonal relationship styles proposed by Novak and Hoffman (2019) with potentially expected negative or positive relational outcomes. Following their guidelines and the master-servant dialectic as described by Hegel (1977), we were able to identify the relational mechanism that might have negatively influenced the behavioral intention.

Consequently, we also relied on Novak and Hoffman (2019) conceptualization to assess our research objective n°2.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Research objective n°2 “Study the influence of smart-object’s capacities over the consumer behavior from a relational and interpersonal perspective”:

As exposed in our introduction, the research objective n°2 can be subdivided into three distinct subj-objectives. Indeed, exploring the influence of smart object’s agency over the consumer behavioral intention have many implications.

#### Sub-objective 1: “Study the influence of perceived object’s capacities over consumer expected role”.

First, we investigate the impact of object’s agency over the consumer expected role. We have adopted a relational perspective to assess the implication of object’s agency as regard the potential emergence of a relational barrier to adoption (Monsurro et al. 2020). Based on the interpersonal circumplex model, and our quantitative studies we were able to explain the effect of smart object’s agency over the consumer’s expected role.

In line with the principle of complementarity (Horowitz et al. 2006), consumers’ agency appears to change based on the smart object agentic expression. When the smart object’ agency is perceived as low, consumers tend to feel like mastering the relationship. Accordingly, our studies show that participants that faced the low agentic object tend to adopt a master position (high agency, moderate communal). Such feeling has elicited the emergence of self-extension experiences.

On the other hand, when participants were facing the moderate agentic object, they appear to adopt lower levels of agency, alongside higher communal expressions. This indicates that they are engaging in partner relationship styles with the smart object. Accordingly, they are likely going to live self-expansion experiences with the smart object.

Conversely, participants exposed to the highly agentic object seem to adopt an unstable relationship style. They expressed high levels of agency and lower levels of communal, indicating that they were willing to restrict the relationship. Such reaction emerges because they have apprehended the role of being the servant of the relationship. In line with the struggle for domination (Hegel 1977) and the Frankenstein complex (Asimov 1975), consumers might have feared to engage in a relationship with a master smart object. Thus, they have likely faced self-restrictive experiences trying to restrict and impede the future interaction.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

Hence, our results suggest that the influence of smart object's agency is non-linear, with negative relational outcomes originating from the expression of a high level of smart object's agency. This provides support for considering that anticipated interactions are structured by the same relational mechanism as real-life interpersonal interaction.

### Sub-objective 2: "Study the emergence of anxiety based on mental simulation of potential relational outcomes".

Our studies also show the mechanism under which anxiety seems to emerge. We made the assumptions that anticipated interpersonal relationship between consumers and smart objects might elicit negative emotions based on the nature of the relational outcome.

This statement was supported by both studies. Participants that have faced the highly agentic smart object have felt more tension and anxiety compared to the other participants (low and moderate agency). Indeed, participants that have simulated positive relational outcomes (such as extension and expansion) were likely willing to engage in the future interaction with the smart objects. They have shown higher levels of attitude toward future usage alongside higher levels of intention to use the smart object.

On the contrary, participants that were exposed to the highly agentic object have simulated negative relational outcomes. Accordingly, they have developed more tension and anxiety regarding the future interaction with the smart object. Such emotions have negatively influenced the attitude toward usage and the intention to use the smart object.

Hence, the anxiety emerged because of the mental simulation of negative relational outcome, which originate from the perceived smart object's capacities to dominate the consumer, resulting in negative experiences of reduction. A highly agentic smart object with the capacities to impose a form of control over consumers represents a strong source of resistance regarding technology adoption.

That is because such capacities are processed by consumers as part of interpersonal relationship mechanisms which trigger specific patterns. Consequently, smart object master-consumer servant anticipated relationship style, elicited by a high level of object's agency, is likely going to raise anticipatory anxiety toward future consumer-smart object interaction.

## Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology

### Sub-objective 3: “Study the impact of potential relational outcomes over smart objects’ adoption”.

Finally, our empirical studies have explored the influence of anticipated relational outcomes, over smart object’s acceptance. In both studies, consumers that have faced the highly agentic object have expressed lower intention to use it alongside higher levels of anxiety.

Based on our conceptual model, we were able to identify the mechanism through which mental simulation of potential relational outcomes impede the consumer’s intention to engage in future interaction with the smart object. Consumers were able to anticipate the relational outcome of engaging an interaction with the smart object. The perception of a highly agentic object has negatively influenced the intention to use it in the future.

The reason explaining such phenomenon lies with the passive resistance exposed in the literature review. Indeed, consumers are trying to avoid future interaction where they will potentially face negative experiences of self-reduction, being dominated by the smart object. Accordingly, negative relational outcomes that are expected by consumers will likely trigger a passive form of resistance, such as behaviors of avoidance, impeding smart object’s diffusion.

Both quantitative studies have shown the negative impact of a high level of agentic features over the intention to use the smart object. Based on the circumplex models, we were able to explain why the intention was negatively impacted by the smart object’s agency. Implications regarding this aspect are exposed in the general discussion below.

## **General discussion**

This doctoral research aimed at providing insights regarding the impact of smart objects' agentic expression over the consumer behavior, prior to purchase (Rijssdijk et al. 2007). Despite the ever-going evolution of technology, traditional approaches of acceptance and resistance toward smart objects have neglected the social and interpersonal nature of consumer-smart object relationship (Monsurrò et al. 2020, Novak and Hoffman 2019). Accordingly, little is known about the potential influence of smart objects' agency over the consumer behavior.

This work aims at addressing current literature gap as regard the implications of interpersonal relationship dynamics prior to any real-life interaction. By considering the social and interpersonal perspective of human-machine interaction, we tried to contribute to the understanding of consumer resistance toward smart objects and more broadly, toward technology adoption. This appears to us as fundamental considering the actual situation of most IoT markets. Indeed, "the slow pace of consumer adoption of new technologies is a major disappointment for the IoT industry" (Mani and Chouk 2017, p.77).

Thus, this doctoral research has been articulated based on different research objectives, aiming at contributing to actual theories of consumer-object interaction and providing insights for managerial practices. This work aims at helping managers to better understand consumers' reluctance and fear toward smart objects, thus, helping them to better design their products and their communication to enhance smart objects adoption. Based on this context, we formulated the following research question: to what extent smart objects' agency and anticipated interactions influence the emergence of resistance toward IoT products?

We first explored the consumer-smart object relationship and the evocations associated with anticipated interactions. Then we have investigated the influence of smart objects' agency over the interpersonal relationship dynamics that occurred in simulated interactions. This has allowed us to believe that consumer-smart object interaction was, indeed, profoundly social, and interpersonal (Hoffman and Novak 2018, Novak and Hoffman 2019, Schweitzer et al. 2019, Kang and Kim 2020).

## General discussion

Our research has allowed to better understand the process under which resistance toward smart objects emerge prior to a real-life interaction. The following figure summarizes the mechanism through which negative experiences are likely going to emerge from anticipated interaction:



Figure 77 - Mechanism through which passive resistance regarding object's agency emerges

Our literature review has permitted to identify different theories, concepts and paradigms that allowed us to better understand and apprehend our research topic. Yet, our research also shows different limits, in terms of methodology, theoretical grounding and data collection. Accordingly, this general conclusion will expose first our research contributions, then the limits of this research, and finally the research avenues that our work might have initiated.

## Research contributions

While most studies focused on consumer adoption (Hsu and Lin 2016) or resistance (Mani and Chouk 2017) our research deepen the understanding of both by examining the emergence of resistance and its influence on consumer adoption, relying on the interpersonal circumplex model (Novak and Hoffman 2019). Accordingly, the present research has different contributions. That is the reason why we decided to sort them by themes: theoretical, methodological, and managerial contributions.

### Theoretical contributions:

This thesis has first proposed an extensive literature review of the main concepts involved in the technology acceptance/resistance literature. More specifically, we provided a comparison of the main perspectives to assess human-technology interaction: the human-oriented perspective and the object-oriented ontology. The literature considers smart objects' adoption and resistance like they assess any other innovation (Heidenreich et al. 2016, Laukkanen 2016, Heidenreich and Spieth 2013). They don't consider the nature of smart objects. Accordingly, we designed this research by relying over a flat ontology to overcome this theoretical gap.

Indeed, traditional approaches insist on investigating functional barriers and psychological barriers to adoption (Mani and Chouk 2017) without considering the meanings attributed by consumers to smart objects (Hoffman and Novak 2018). Accordingly, we explored different concepts and relied upon the assemblage theory, coupled with theories from the interpersonal relationship literature to overcome the theoretical limits of traditional approaches for assessing the resistance toward technology and smart objects. The main theoretical contribution lies with our consideration for anticipated interpersonal relationship to explain smart objects' acceptance and resistance. By doing so, we enriched our understanding and invite researchers to consider these aspects for assessing innovation diffusion.

The second theoretical contribution lies with our consideration for the concept of smart object's agency. We confronted the limits for considering smart objects as mere possessions and highlighted the need for adopting an object-oriented perspective to better apprehend the new meanings attributed to smart objects' capacities. We tried to explain the implications for considering smart objects as active entities involved in complex and intermingled interaction

### General discussion

with their surroundings, and the necessity for considering the relationship with consumers as intrinsically social and active. The implications of smart objects' agency over the consumers' willingness to engage in future interaction have been highlighted in two quantitative studies, providing a basis for additional investigations.

Another contribution concerns the consideration for abstract and metaphorical concepts that aimed at better exploring the consumer-smart object interaction and its implications. Theories and concepts such as the struggle for domination or the Frankenstein complex have allowed us to explore different perspectives and concepts that were linked, in a way, to our research topic. Our results show that it is conceivable to rely on an object-oriented perspective to understand the implications for considering inanimate objects as potential conscious entities. It is also possible to identify similar patterns across the science-fiction culture and to explain them regarding the potential mechanism identified in this research. In science-fiction stories, books and movies, technology and artificial intelligence often challenge humans in terms of domination and control. When machines are getting granted with agentic capacities, they naturally stress the emergence of struggles for domination. Both humans and machines are trying to achieve certainty of the self, trying to impose their own vision of reality over the other. Hence, such mechanism already depicted in 1818 by Mary Shelley with Frankenstein, provides support for considering that anticipating relational outcomes with non-human entities is natural for humans, preventing us to become potential servants of future relationships.

Last theoretical contribution lies with the research avenue proposed by Rijsdijk and colleagues (2007) regarding the influence of smart object's perceived intelligence over the consumer behavior prior to purchase. We highlight the existence of relational structures mentally simulated by people, that operates like real-life interactions, with different consequences on attitude and behavioral intention. Our research contributes to the recent findings of Monsurrò and colleagues (2020) regarding the existence of a relational barrier to technology adoption.

## General discussion

### Methodological contributions:

The different methods relied upon during this research have allowed us to identify several methodological contributions. The main contribution lies with our operationalization of interpersonal motives. We used the interpersonal circumplex model as proposed by Novak and Hoffman (2019) to assess the consumer response in terms of agentic and communal expressions. Hence, we draw on the methodology provided by Locke and Adamic (2012) a way to map consumers' expressive roles in terms of agentic and communal response. This has allowed us to understand the mechanism through which anticipated relational outcomes emerged and their influence over consumers' attitudes and behavioral intention. This contribution invites for additional operationalization as well. Indeed, considering that the circumplex model of interpersonal relationship can be relied upon to map individuals' agentic and communal motives, researchers might seek for mixing measures from the circumplex model with other empirical measures (not only attitudes and behavioral intention). This aspect is discussed in managerial contributions.

A second contribution refers to the exploratory qualitative approach relied upon in this research. We have implemented an innovative and emerging exploratory method called Album-Online (AOL). The AOL is a qualitative projective technique based on the collection and interpretation of images performed by the respondents. This technique aims at exploring the mental representations that are associated with specific situations (Vernette 2007). Such method allows the researcher to access evocations that are hardly accessible (Christensen and Olson 2002). We applied the recommendations and guidelines from the enhanced version proposed by Kessous and Valette-Florence (2019) to avoid methodological biases induced by the researcher's interpretation. Accordingly, we relied on an individual multidimensional scaling approach (INDSCAL) to map the evocations, allowing us to identify the underlying dimensions of consumer-smart object anticipated interaction.

We also proposed to measure the object's agency based on Rijssdijk and colleagues (2007) measurement scale for object's intelligence. Our findings suppose a difference between the concepts of intelligence and agency. In line with Hoffman and Novak (2018), we believe that humanlike interaction and personality are two dimensions that induce a human-oriented

## General discussion

perspective for assessing objects' capacities. Additionally, our findings suggest that the dimension ability to cooperate does not sufficiently contribute to measure object's agency. Instead, it seems that the ability to cooperate was more suitable for assessing object's intelligence, from a human-oriented perspective.

Finally, our conceptual model is the first to our knowledge that incorporate interpersonal relationship variables as antecedents for explaining technology acceptance and the behavioral intentions. Relying on structural equation modeling and the PLS PM approach, we believe that our conceptualization for the relational mechanism of consumers smart object's acceptance represents a valuable contribution. The negative anticipated relational outcomes (dominated, reduced) have negatively influenced the behavioral intention and consumers' response. Accordingly, we enriched the TAM literature and invite researchers from this field to consider irrational motives as potential antecedents of performance-effort expectancies.

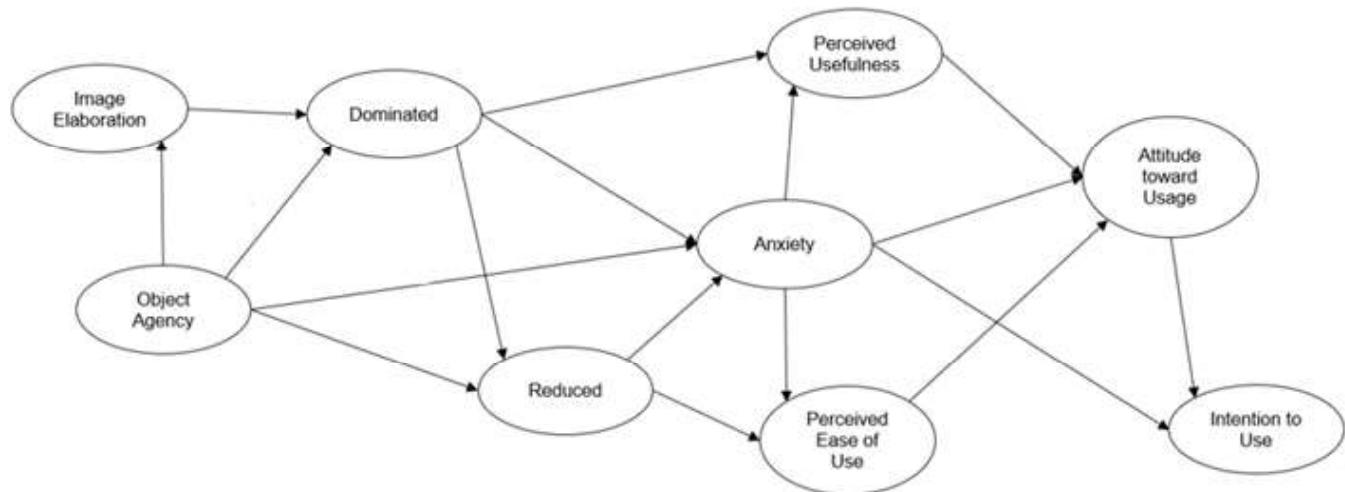


Figure 78 - Conceptual Model

## General discussion

### Managerial contributions:

The aim of this research is also to provide insights for managers of the IoT sectors to maximize the acceptance of these objects while reducing the formation of negative and ambivalent attitudes towards them. Consumer resistance must be considered to avoid risk for innovation failure (Wiedmann et al. 2011). Thus, the main contribution of this research is to help managers for reducing the risk of innovation failure (Ram 1989). This translates in two main recommendations focusing on smart object's capacities and the way managers should communicate about them.

The first managerial contribution refers to the need for maximizing the anticipation of positive relational outcomes. Managers should focus on providing smart objects' capacities that will trigger the perception of interacting either with a tool (for simulating self-extension experiences) or with a partner (for simulating self-expansion experiences). Using the theoretical framework offered by the assembly theory (Hoffman and Novak, 2018), it can be argued that when the smart object is described as a low or moderately agentic object, consumers tend to evaluate the smart object as a tool or partner, simulating positive experiences of extension and expansion. This suggests presenting the smart object from a performance angle, emphasizing about the utility, the advantages and benefits associated with using the smart object.

This, to maximize the simulation of enabling experiences. The consumer will then tend to simulate interactions where the object is limited to the consumer's needs and wants, giving rise to positive mental simulations. Managers must therefore insist on communicating about the smart object as a useful tool, that serves the consumer above all.

Conversely, when the smart object is described with highly agentic capacities, consumers tend to evaluate the smart object rather as a social entity pretending mastering the relationship. Accordingly, simulated negative experiences of restriction and reduction are likely going to emerge. Managers should avoid referring to the smart object as an independent and autonomous entity to reduce the emergence of object master-consumer servant anticipated relationship styles. It is therefore appropriate to avoid manufacturing objects with smart features that don't bring much value, but instead will negatively impact its adoption.

## General discussion

One possible operationalization of interpersonal measures consists of providing different versions of the same product, with different capacities. By measuring consumers' behavioral intention alongside interpersonal expressive roles (agency, communal) managers would be able to design objects in terms of anticipated relational outcomes. Hence, companies like Amazon and their Astro Robot might explore the anticipated relational outcomes induced by different versions of their smart object.

The main advantage offered by the circumplex is that it also works for assessing anticipated interactions. Accordingly, companies operating in the IoT field might be interested in assessing their smart objects prior to market the product. Companies will not only design the right product for consumers' needs, but the right product for consumers' ideational relationship with it. Consequently, the main objectives for companies would be to design products for maximizing positive anticipated relational outcomes (extension, expansion), reducing the risk for innovation failure.

## Operationalization of Interpersonal Circumplex Measures

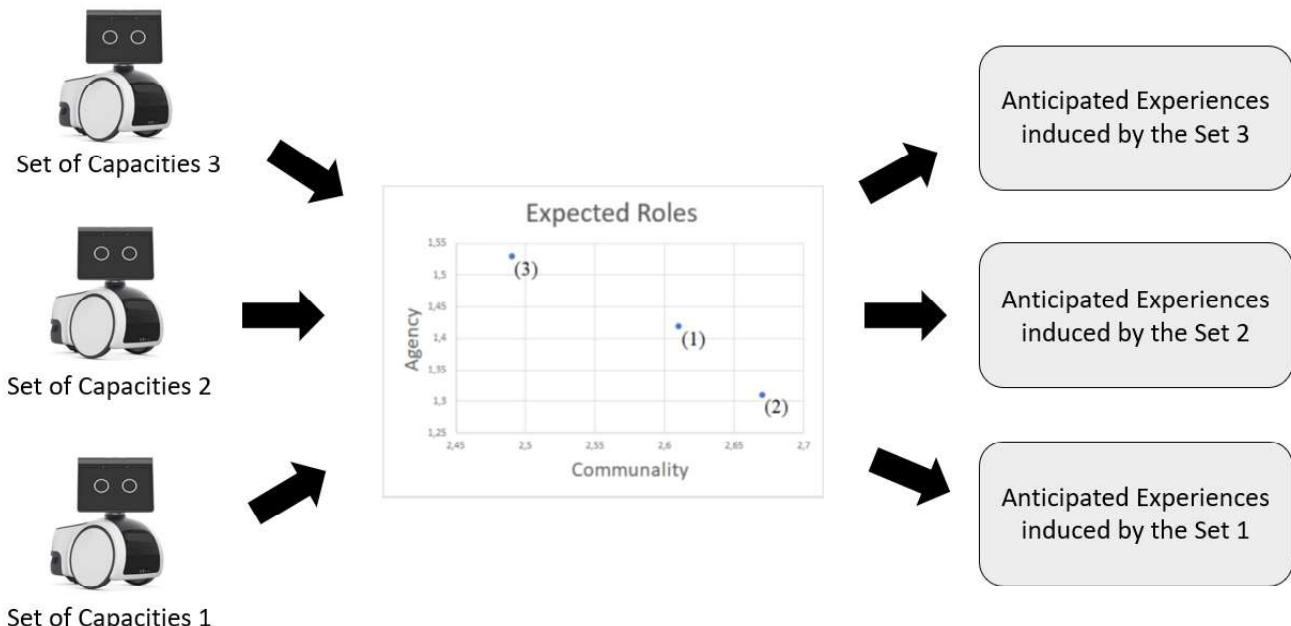


Figure 79- Operationalization of Interpersonal Circumplex Measures

## General discussion

Managers must reflect about the capacities that will serve the consumer's vision of reality instead of promoting objects based on their agentic and intelligent capacities. Our results suggest that anxiety is elicited by the fear of what the product "could" do, based on what the product "can" do (Agency). Undeniably, the use of certain terms has an influence over the nature of mental simulations experienced by consumers as exposed by the AOL and the quantitative studies. By claiming that the object is intelligent and autonomous, managers might indirectly harm its adoption.

The perceived capacities of the smart object therefore play a role in the emergence of positive attitudes and anticipatory anxiety, and de facto, can be considered as either a vector of positive simulated experiences (when described as a tool, or partner) or negative simulated experiences (when described as mastering its environment). Companies should focus on measuring the anticipated interaction induced by their smart object, based on its capacities, prior to any real-life interaction.

The more the object is intelligent and agentic, the more it challenges the meanings usually attributed to inanimate objects. We therefore advise not to abuse a form of communication that can provoke the emergence of anxiety and negative attitudes, and instead promote a form of communication that will restrict the smart object to be either a tool or a partner interacting with consumers. We also invite companies to implement measures of expressive roles to better understand consumers' needs and wants, and to reduce the risk for market failure.

## Research limits

Our research also suffers from different limits. Despite its relative contributions, this doctoral work comes with limitations regarding the concepts relied upon (theoretical) and the different methods used (methodological). Accordingly, this section will attempt to identify the main limitations and shortcomings regarding the choices made during this research journey.

## General discussion

### Theoretical limitations:

This research has several theoretical limitations which can mitigate our findings. The main one refers to the conceptualization and measurement of object's agency. We relied upon the measurement scale provided by Rijsdijk and colleagues (2007) that was first developed to measure and capture object's intelligence, from a human-oriented perspective. We first used this scale and applied modifications based on Novak and Hoffman (2019) recommendations. Accordingly, we removed two dimensions from the scale: the human-like interaction and the personality dimensions. Four dimensions were retained: autonomy, reactivity, ability to learn and ability to cooperate. Hence, our empirical studies were built considering object's capacities instead of perceived human-like intelligence. Yet, nothing indicates if object's perceived intelligence would have fulfilled the same function as object's agency.

A second theoretical limitation lies with our conceptualization of consumer's feeling of being dominated and reduced. As we are dealing with anticipated interpersonal relationship, we tried to adapt concepts from the interpersonal relationship literature to the marketing context. Additionally, despite our literature review, the choices made regarding this adaption can be questioned. Indeed, adapting concepts that involve human-human interaction to human-object interaction can be reasonably discussed.

### Methodological limitations

The first methodological limitation lies with our choices of investigating the smart home market in our studies. We decided to anchor our empirical studies within the smart home market (AOL with smart, Study 1 and 2 with different smart home devices) as we identified this specific market as potentially facing the Chasm conceptualized by Moore (2014). Hence, our results can be limited to this specific segment, challenging the external validity of this research.

A second methodological limitation refers to the choices made regarding the operationalization of smart object's agency. Indeed, we adapted object's intelligence as conceptualized by Rijsdijk and colleagues (2007), by removing two dimensions from the scale proposed. Such intervention has different implications and consequences. One of them is the

### General discussion

non-adequation of the ability to cooperate dimension to measure object's agency. Our results indicate that ability to cooperate was not meant to measure object's agency from the object-oriented perspective. Accordingly, we might have missed other dimensions structuring object's agency, and should have perhaps developed our own measurement scale for object's agency. This can also be observed regarding the discriminant validity of object's agency from the structural equation modeling, always below the other latent variables.

Another methodological limitation is the use of interpersonal circumplex measures in our conceptual model. As we relied on specific methods to compute the different vectors, the latent variables Dominated and Reduced had single factors. Accordingly, we had no reliable information regarding the structural validity and reliability of these two latent variables. We checked for the circumplex model with a multidimensional scaling method, yet this does not provide sufficient information for objectively assessing their validity and reliability. Additionally, the choice made regarding the data analysis with the PLS path modeling approach can also be discussed. Indeed, this method provides less indicators of quality compared to the LISREL approach (Juhel 2015). We relied on the Goodness of Fit indicator - GoF (Tenenhaus et al., 2005) for assessing our model. Yet, there is no cut off value regarding this indicator, instead of covariance-based methods.

Finally, methodological limitations were observed regarding the different data collection. Our choice to perform the data collection online were justified regarding the cost related to this method, the possibility to reduce biases, and the Covid-19 situation. However, such methods to collect data also have shortcomings. First, collecting through the Prolific platform represents a potential bias. Indeed, participants from those platforms are used to internet-based technologies and might share a certain interest for the research topic. More importantly, participants were paid for completion introducing a potential bias regarding their responses. Additionally, collecting data online can also increase the psychological distance, eliciting higher order construal and more abstract mental simulations (Taylor et al. 1998).

## Research avenues

This section provides the research avenues that stem from our findings, contributions, and limits. Accordingly, we identify five main research avenues that we intend to explore in further research.

### Exploring the interpersonal anticipated relationship

This research avenue is a continuation of my doctoral work aimed at understanding and exploring the antecedents of acceptance and resistance to smart objects. The present research was able to highlight the presence of a resistance resulting from anticipated interactions with the smart object based on its agentic capacities. Indeed, we have shown the extent to which the consumer is able to mentally imagine future interactions with the smart object, which involves interpersonal and social mechanisms.

Yet, the complementarity principle that structures the social response also depends on the consumer's degree of dependence (Locke 2015). Accordingly, the main objective of this research avenue is to identify the potential effect of consumers' need for dependence (or assistance) over smart objects' acceptance. Based on our previous quantitative studies, we believe that the degree of dependence expressed by individuals might moderate the phenomenon. In the literature on interpersonal relationship, individuals with reduced capacities for autonomy tend to accept interaction more naturally with dominant individuals (Horowitz et al. 2006).

Given the interpersonal nature of the interaction simulated by the consumer, we believe that the reduced capacity for autonomy experienced by some consumers might enhance smart objects' acceptance, by reducing the emergence of negative anticipated interactions.

The future research could investigate the implication of individuals' characteristics, involved in the interpersonal interaction's mechanism with a smart object. Therefore, consumers might have different perceptions of their role in the future interaction depending on the agentic capacities of the object but also their own capacities for pretending mastering the relationship. These studies will aim at exploring how consumers' degree of independence (or dependence) mitigate smart objects' acceptance.

## General discussion

### Exploring the implication for the origin of smart objects' agency

Our findings also call for a better understanding of the antecedents that structure the emergence of anticipated interaction. Additional research might aim at understanding and exploring the antecedents of acceptance and resistance to smart objects by considering different “origins” of smart object’s agency.

This work has highlighted the presence of a resistance resulting from anticipated interactions with the smart object based on its agentic expression. Accordingly, future research can explore this phenomenon by focusing on the origin, or the source of smart objects’ agency.

Indeed, it is considered as smart, any object “that interact and communicate with themselves and each other - and with humans - on an ongoing basis by sending and receiving data through the Internet that is stored and organized in a database” (Hoffman and Novak 2015, p.14). Accordingly, two main kinds of “smart” objects can be identified:

- Native smart objects: an object that intrinsically possess agentic capacities.
- Augmented objects: a traditional object (non-smart) made connected using an external device that provides it with the same agentic capacities as native smart objects.

Such research might focus on the extent to which the essence of the perceived agency (native vs external device), without any other difference between the objects in terms of capacities, could influence the acceptance or resistance to the object.

The aim of this research is to explore the potential effect of the origin of smart objects’ agency over mental simulations of anticipated interactions. The present work has shown the extent to which people were able to anticipate interpersonal relationships with a smart object based on its agency. However, we believe that an object with an external device making it connected might not be evaluated the same way as a native smart object. Indeed, while we have shown the influence of smart object’s agency over consumer’s capacity to anticipate social interaction, the impact of the origin of smart object’s agency over such anticipation remains to be explored.

## General discussion

### Collecting data directly on stores

One of the main research avenues is related to the empirical confirmation of the potential mechanism identified in this research. Our work remains limited by the data collection methodology. We have collected online and for that reason, relying on our findings to assess the potential mechanism in real-life situations is questionable. Accordingly, we propose to researchers to investigate the extent to which anticipated relationship can impede the purchase decision, directly on stores.

Our present research has shown that consumers were living simulated experiences with smart objects before any real-life interaction. Intuitively, we might posit that consumers might also experience the same anticipated relationship with smart objects directly on stores. The descriptions provided to sell smart objects on stores might also influence the type of experience that will enhance, or potentially impede, the purchase decision. Accordingly, we invite researchers to put our identified mechanism into test, directly on real-life situations, where consumers and the description of smart objects' capacities are being confronted prior to interaction.

### Exploring the Uncanny valley implications

Our research also calls for exploring specific phenomenon. We exposed earlier in the literature review, the uncanny valley theory (Mori 1970). This theory aimed at explaining people's reaction regarding robots that were designed based human-like resemblance. The theory posits that the more a robot looks like a human, in terms of physical likeness, the more it will provoke positive reaction, until a certain threshold. From that, people will start developing negative attitudes toward the robot, falling into the uncanny valley (Mori et al. 2012).

We believe that our findings mitigate the conclusion made by Mori regarding people's reaction toward robots. Our research posits that the negative attitudes elicited by the smart object did not emerge because of its physical human likeness (the objects were not physically anthropomorphized) but instead, because of their "humanlike" agentic features. The smart objects endowed with agentic capacities were stressing the barrier between humans and objects. Accordingly, we invite researchers to investigate the uncanny valley implications not in terms

## General discussion

of physical resemblance, but instead in terms agentic resemblance. A modified version of the uncanny valley that does not consider physical likeness, but agentic likeness:

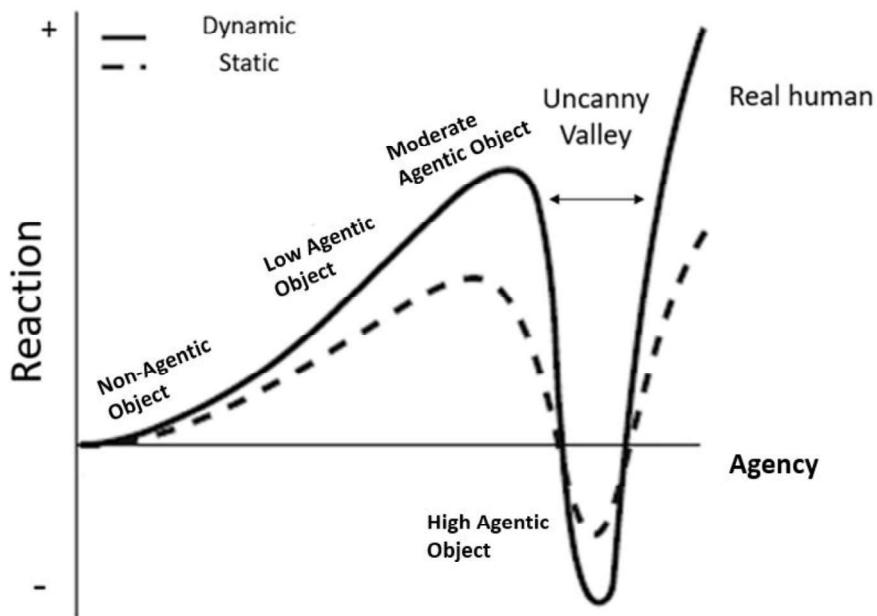


Figure 80 - The Uncanny Valley modified version

## Cross-cultural exploration

Finally, our findings call for exploring the potential mechanism across different cultures. The literature indicates that demographic variables and culture are antecedents of technology adoption (Venkatesh et al. 2003, Laukkanen 2016). Additionally, Fournier (1998) has indicated the extent to which relying on animism can help understanding the way people invest inanimate objects with meanings (Belk 2014). Accordingly, we invite researchers to explore the mechanism identified in this research, across different cultures and situations. It might be interesting to explore the extent to which different beliefs and cultures can mitigate the nature of the simulated experiences prior to usage. Cultures that originate from animistic beliefs might better apprehend non-human entities endowed with agentic capacities. Conversely, cultures that originate from human-centric beliefs (monotheism for instance), might develop more negative thoughts and more apprehension as regard non-human entities endowed with agentic capacities. Such investigations might support the interpersonal mechanism involved in anticipated interaction and explain the disparities between cultures and countries in terms of technology diffusion and acceptance.

## General discussion

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## References

## Table of contents

### Table of contents

Introduction .....	4
Part 1 – A theoretical approach of consumer-smart object interaction .....	29
Chapter 1 - Innovation and Technology Diffusion, an acceptance – resistance perspective	30
I- Technology diffusion and acceptance models .....	31
II- Resistance and negative attitudes toward technology.....	62
III- The struggle for domination and control.....	94
IV- Limits of the Human-oriented ontology in Human-Technology Interaction.....	108
Chapter 2 - Consumer-Smart object relationship .....	119
I- The Object-Oriented Ontology .....	120
II- Assemblage theory and smart objects .....	127
III- Consumer-Smart Objects Interpersonal Relationship Styles .....	148
IV- Consumer-Smart object simulated assemblages .....	167
Conclusion of Part 1 and propositions of investigations.....	178
Part 2 - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology .....	180
Chapter 1- Epistemological positioning and Methodological implications .....	182
I- Epistemological paradigm .....	183
II- Methodology .....	187
Chapter 2 - Exploring the perception of smart object's innovative capacities from a relational perspective.....	190
I - The Album-On-Line method (AOL) .....	191
II – AOL Scenarios and Sample.....	195
III- AOL Results.....	201
IV- From the AOL to Explaining the Potential Mechanism Activation .....	215
Chapter 3 - Concretization and Conceptualization – Examine and explain how the mechanism operates.....	219
I - Hypotheses and Conceptual model.....	220
II - Measurement scales.....	235
III – Concretization design .....	244
Chapter 4 – Experimental design, results, and discussion .....	246
I – Study 1 - PLS approach .....	248
II – Study 2 – Empirical support .....	288
General discussion.....	314

## Table of contents

Research contributions .....	316
Research limits .....	322
Research avenues .....	325
References .....	330
Table of contents .....	368
Appendices .....	375

## Figures

Figure 1 - Pepper Robot - <a href="https://www.softbankrobotics.com/emea/fr/pepper">https://www.softbankrobotics.com/emea/fr/pepper</a> .....	12
Figure 2 - Amazon Astro Robot - <a href="https://www.minimachines.net/actu/amazon-astro-10260214">https://www.minimachines.net/actu/amazon-astro-10260214</a>	
Figure 3 - Amazon Astro Word Cloud generated by text mining with twitteR and RStudio ..	15
Figure 4 - Research objectives and sub-objectives .....	23
Figure 5 - Research Plan .....	28
Figure 6 - Part 1 organization - A theoretical approach of consumer-smart object interaction	29
Figure 7 - Chapter 1 organization - Innovation and technology diffusion, an acceptance-resistance perspective .....	30
Figure 8 - The Innovation-Decision Process (Rogers 1995) .....	32
Figure 9 - Segments of adopters (Rogers 1995) .....	34
Figure 10 - Perceived Innovations' Attributes .....	35
Figure 11 - Determinants of the Adoption of Innovations Rate .....	37
Figure 12 - The Technology Adoption Life Cycle (Moore 1991) .....	39
Figure 13 - Theory of Reasoned Action (Ajzen & Fishbein 1980) .....	44
Figure 14 - TRA loop .....	45
Figure 15 - Theory of Planned Behavior (Ajzen 1991) .....	47
Figure 16 - TPB loop .....	48
Figure 17 - TAM first conceptual framework (Davis 1986) .....	49
Figure 18 - Original TAM (Davis 1986) .....	50
Figure 19 - Technology Acceptance Model (Davis et al. 1989) .....	51
Figure 20 - TAM 2 (Venkatesh and Davis 2000) .....	52
Figure 21 - TAM 3 (Venkatesh 2000) .....	53
Figure 22 - Compeau et al (1999) model of technology adoption .....	55
Figure 23 - Agarwal and Karahanna (2000) model of technology acceptance .....	56
Figure 24 - Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003) ..	57
Figure 25 - Ram and Sheth's model of Resistance to innovation (1989) .....	68
Figure 26 - Ram and Sheth conceptual framework applied in Consumer Resistance to smart products (Mani and Chouk 2017) .....	70
Figure 27 - Mani and Chouk extension (2018) of Ram and Sheth (1989) model of resistance to innovation in smart services .....	72
Figure 28 - The Uncanny Valley in action – Mori et al. (2012) .....	81
Figure 29 - Chapter 2 organization - Consumer-Smart object relationship .....	119
Figure 30 - The POP framework (Verhoef et al. 2017) .....	128
Figure 31 - Consumer-Smart Object Assemblage and Interactions .....	135

## Table of contents

Figure 32 - Interactions from which emerge consumer-smart objects assemblage .....	137
Figure 33- Consumer-Smart Object Relationships - Novak and Hoffman (2019). ....	145
Figure 34 - Interpersonal Circumplex Model.....	150
Figure 35 - Relationship styles defined by the Interpersonal Circumplex Model - Novak and Hoffman (2019).....	154
Figure 36 - Master-Servant Complementary Relationship style - Novak and Hoffman (2019) .....	158
Figure 37 - Partners relationship styles - Novak and Hoffman (2019) .....	162
Figure 38 - Unstable relationship styles - Novak and Hoffman (2019).....	164
Figure 39 - Expected Role and Unstable Relationship Style .....	165
Figure 40 - Mental simulation of interpersonal relationships between consumers and smart objects.....	176
Figure 41 - Part 2 organization - Studying the simulated relational outcomes of consumer-smart objects anticipated relationships: Conceptual framework and methodology .....	181
Figure 42 - Chapter 1 organization - Epistemological positioning and Methodological implications .....	182
Figure 43 - Domains of Reality regarding the Critical Realism Paradigm (Mingers 2004) ..	186
Figure 44 - Structurable Research Method in Critical Realism Research (Danermark et al. 2001, Raduescu and Vessey 2009).....	188
Figure 45 - Chapter 2 organization - Exploring the perception of smart object's innovative capacities from a relational perspective .....	190
Figure 46 - AOL Cognitive and Affective descriptions .....	196
Figure 47 - Result from the pre-test regarding the AOL descriptions .....	197
Figure 48 - AOL first step, immersion (Vernette 2007).....	199
Figure 49 - AOL individual albums procedure .....	200
Figure 50 - Cognitive and Affective collective albums .....	201
Figure 51 - AOL Cognitive Mapping – RSQ = 0.875.....	203
Figure 52 - AOL Affective Mapping - RSQ = 0.821 .....	209
Figure 53 - Linking Thoughts and Emotions from anticipated experiences .....	217
Figure 54 - Chapter 3 organization - Concretization and Conceptualization - Examine and explain how the mechanism operates.....	219
Figure 55 - Conceptual model - The model of interpersonal technology acceptance.....	234
Figure 56 - The interpersonal circumplex model (Locke and Adamic 2012) .....	238
Figure 57 - Mapping interpersonal positions .....	239
Figure 58 - Chapter 4 organization - Experimental design, results, and discussion .....	247
Figure 59 - The Smart Plug (Low agency condition).....	251
Figure 60 - Smart bulb (Moderate agency condition) .....	252
Figure 61 - Smart speaker (High agency condition) .....	253
Figure 62 - Levels of Agency conditions .....	254
Figure 63 - Random assignment procedure.....	257
Figure 64 - Study 1 introductory message .....	258
Figure 65 - Study 1 - Perceived levels of agency .....	260
Figure 66 - Study 1 - Assessing the Interpersonal circumplex model.....	264
Figure 67 - Study 1 - Expected Roles mapping .....	284
Figure 68 - Master-Servant relationship styles (Novak and Hoffman 2019) .....	285
Figure 69 - Partner relationship styles (Novak and Hoffman 2019) .....	286
Figure 70 - Unstable relationship styles (Novak and Hoffman 2019) .....	286

## Table of contents

Figure 71 - Explanation of the phenomenon .....	287
Figure 72 - The smart coffee maker .....	290
Figure 73 - Study 2 - Levels of Agency .....	291
Figure 74 - Random assignment procedure 2.....	296
Figure 75 - Study 2 - Perceived levels of agency.....	299
Figure 76 - Study 2 - Interpersonal circumplex model .....	301
Figure 77 - Mechanism through which passive resistance regarding object's agency emerges .....	315
Figure 78 - Conceptual Model .....	319
Figure 79- Operationalization of Interpersonal Circumplex Measures.....	321
Figure 80 - The Uncanny Valley modified version.....	328
Figure 81 - AOL Affective description .....	375
Figure 82 - AOL Cognitive description .....	376
Figure 83 - Study 1 - Smart plug description .....	377
Figure 84 - Study 1 - Smart bulb description .....	378
Figure 85 - Study 1 Smart speaker description .....	379
Figure 86 - Discriminant Validity (Squared Correlation < AVE) - Study 1 -Group 1 .....	380
Figure 87 - Discriminant Validity (Squared Correlation < AVE) - Study 1 - Group 2 .....	380
Figure 88 - Discriminant Validity (Squared Correlation < AVE) - Study 1 - Group 3 .....	381
Figure 89 - Path Coefficients Object's Agency -> Image Elaboration (Study 1).....	381
Figure 90 - Path Coefficients Objects' Agency -> Dominated (Study 1).....	381
Figure 91 - Path Coefficients Image Elaboration -> Dominated (Study 1) .....	381
Figure 92 - Path Coefficients Object's Agency -> Anxiety (Study 1).....	382
Figure 93 - Path Coefficients Object's Agency -> Reduced (Study 1).....	382
Figure 94 - Path Coefficients Dominated -> Reduced (Study 1) .....	382
Figure 95 - Path Coefficients Dominated -> Anxiety (Study 1) .....	382
Figure 96 - Path Coefficients Reduced -> Anxiety (Study 1) .....	382
Figure 97 - Path Coefficients Dominated -> Perceived Usefulness (Study 1).....	383
Figure 98 - Path Coefficients Reduced -> Perceived Ease of Use (Study 1) .....	383
Figure 99 - Path Coefficients Anxiety -> Perceived Usefulness (Study 1).....	383
Figure 100 - Path Coefficients Anxiety -> Perceived Ease of Use (Study 1) .....	383
Figure 101 - Path Coefficients Anxiety -> Attitude toward usage (Study 1).....	383
Figure 102 - Path Coefficients Perceived Usefulness -> Attitude toward usage (Study 1) ...	384
Figure 103 - Path Coefficients Perceived Ease of Use -> Attitude toward usage (Study 1)..	384
Figure 104 - Path Coefficients Anxiety -> Intention to use (Study 1) .....	384
Figure 105 - Path Coefficients Attitude toward usage -> Intention to use (Study 1).....	384
Figure 106 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 1 .....	385
Figure 107 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 2 .....	385
Figure 108 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 3 .....	386
Figure 109 - Study 2 - Low agency condition.....	387
Figure 110 - Study 2 - Moderate agency condition.....	388
Figure 111 - Study 2 - High agency condition .....	389

## Table of contents

### Tables

Table 1 - Smart objects capacities (Detection/Reaction/Connectivity) .....	6
Table 2 - Smart objects' operating areas (McKinsey Global Institute 2015) .....	7
Table 3 - Dimensions of smart objects' innovativeness .....	10
Table 4 - The different types of resistance (Mani and Chouk 2017) .....	13
Table 5 - Rogers and Moore's innovation diffusion theories .....	42
Table 6 - Extensive TAM reviews (Marangunić and Granić 2015).....	59
Table 7 - List of variables for predicting technology acceptance (Venkatesh et al. 2003, Kukafka et al. 2003).....	59
Table 8 – Types of resistance .....	63
Table 9 - Different expressions of consumer resistance (Mani and Chouk 2018).....	64
Table 10 - Determinants of consumer resistance (Ram 1987) .....	65
Table 11 - Barriers preventing consumers to adopt the innovation (Ram and Sheth 1989) ....	66
Table 12 - Consumer resistance toward smart objects based on their capacities (Chouk and Mani 2016).....	69
Table 13 - Rational and irrational motives behind resistance toward smart objects (Chouk and Mani 2016) .....	77
Table 14 - Resistance to innovation and smart objects - Main concepts .....	79
Table 15 - Dimensions of ambivalence toward smart objects (Ardelet et al. 2017) .....	85
Table 16 - Fear and anxiety toward technology - Main concepts .....	93
Table 17 - Different levels of smart object's intelligence (Hoffman and Novak 2018) .....	100
Table 18 - Object's complexity categorization (Barber 1996) .....	102
Table 19 - Franklin and Graesser (1997) taxonomy for autonomous agents .....	102
Table 20 - Struggle for domination and control - Main concepts .....	107
Table 21 - Human-Oriented Ontology - Main concepts.....	117
Table 22 - The Object-Oriented Ontology - Main concepts .....	126
Table 23 - Assemblage's characteristics (DeLanda 2006) .....	130
Table 24 - Example of an assemblage properties, tendencies and capacities .....	130
Table 25 - Characteristics of Consumer-IoT Assemblages (Hoffman and Novak 2015, p.17) .....	134
Table 26 - Enabling and Constraining experience from the Assemblage theory framework (Hoffman and Novak 2018) .....	140
Table 27 - Object's experiences within the assemblage (Hoffman and Novak 2018).....	143
Table 28 - Assemblage theory - Main concepts .....	145
Table 29 - Interpersonal relationships - Main concepts .....	166
Table 30 - Principles structuring the Critical Realism paradigm (Gavard-Perret et al. 2013)185	185
Table 31 - Methodological implications for Critical realism research.....	189
Table 32 - AOL sample description .....	198
Table 33 - Evocations structuring the anticipated interaction with a smart fridge from the cognitive perspective.....	205
Table 34 - Evocations structuring the anticipated interaction with a smart fridge from the affective perspective.....	211
Table 35 - Rijssdijk et al. (2007) Measurement Scale - Object's Agency .....	236
Table 36 - The interpersonal circumplex model .....	240
Table 37 - Anxiety measurement scale .....	241
Table 38 - Perceived usefulness scale .....	242

## Table of contents

Table 39 - Perceived ease of use scale .....	242
Table 40 - Attitude toward usage scale .....	243
Table 41 - Intention to use scale.....	243
Table 42 - Comparison of variance-based and covariance-based approaches in SEM (Juhel 2015).....	246
Table 43 - Levels of agentic capacities .....	249
Table 44 - Study 1 descriptions.....	254
Table 45 - Study 1 Pre-test.....	255
Table 46 - Study 1 Pre-test 2 .....	256
Table 47 - Study 1 - Anova Pre-test.....	256
Table 48 - Study 1 - total questionnaires.....	258
Table 49 - Study 1 - sample characteristics.....	259
Table 50 - Study 1 - Object's agency internal consistency.....	259
Table 51 - Study 1 - Manipulation Check .....	260
Table 52 - Study 1 - Differences in terms of agency.....	261
Table 53 - Study 1 - Overall model fit .....	262
Table 54 - Study 1 - Reliability and Convergent Validity .....	263
Table 55 - Study 1 - Anova for the main hypotheses.....	265
Table 56 - Study 1 - T-tests anxiety .....	266
Table 57 - Study 1 - T-tests attitude.....	266
Table 58 - Study 1 - T-tests intention.....	266
Table 59 - Study 1 - hypothesis H4.....	267
Table 60 - Study 1 - Multi-group t-test H4 .....	268
Table 61 - Study 1 - hypothesis H4.1 .....	269
Table 62 - Study 1 - hypothesis H5 .....	269
Table 63 - Study 1 - Multi-group t-test H4.1 .....	270
Table 64 - Study 1 - Multi-group t-test H5 .....	270
Table 65 - Study 1 - hypothesis H4.2.....	270
Table 66 - Study 1 - Multi-group t-tests H4.2 .....	271
Table 67 - Study 1 - hypothesis H4.3 .....	271
Table 68 - Study 1 - hypothesis H6.0.....	272
Table 69 - Study 1 - Multi-group t-tests H6.0 .....	272
Table 70 - Study 1 - hypothesis H6.1 .....	273
Table 71 - Study 1 - Multi-group t-test H6.1 .....	273
Table 72 - Study 1 - hypothesis H7.0.....	274
Table 73 - Study 1 - Multi-group t-tests H7.0 .....	274
Table 74 - Study 1 - hypothesis H6.2.....	274
Table 75 - Study 1 - Multi-group t-tests H6.2 .....	275
Table 76 - Study 1- hypothesis H7.1 .....	275
Table 77 - Study 1 - Multi-group t-tests H7.1 .....	276
Table 78 - Study 1 - hypothesis H8.0.....	277
Table 79 - Study 1 - Multi-group t-tests H8.0 .....	277
Table 80 - Study 1 - hypothesis H8.1 .....	277
Table 81 - Study 1 - Multi-group t-tests H8.1 .....	278
Table 82 - Study 1 - hypothesis H8.2.....	278
Table 83 - Study 1 - Multi-group t-tests H8.2 .....	279
Table 84 - Study 1 - hypothesis H9 .....	279

## Table of contents

Table 85 - Study 1 - Multi-group t-tests H9 .....	279
Table 86 - Study 1 - hypothesis H10.....	280
Table 87 - Study 1 - Multi-group t-tests H10.....	280
Table 88 - Study 1 - hypothesis H8.3.....	280
Table 89 - Study 1 - Multi-group t-tests H8.3.....	281
Table 90 - Study 1 - hypothesis H11.....	281
Table 91 - Study 1 - Multi-group t-tests H11.....	281
Table 92 - Hypotheses status.....	282
Table 93 - Study 2 descriptions.....	292
Table 94 - Study 2 - Object's agency reliability .....	293
Table 95 - Object's agency reliability 2.....	293
Table 96 - Study 2 - ANOVA object's agency .....	294
Table 97 - Study 2 total questionnaires .....	297
Table 98 - Study 2 sample characteristics .....	297
Table 99 - Study 2 - Object's agency reliability .....	298
Table 100 - Study 2 - ANOVA pre-test .....	298
Table 101 - Study 2 - Manipulation check between groups.....	299
Table 102 - Study 2 - Overall model fit .....	300
Table 103 - Study 2 - Reliability and validity.....	300
Table 104 - Study 2 - ANOVA results .....	302
Table 105 - Study 2 - T-test H1.....	303
Table 106 - Study 2 - Path coefficients Reduced -> Anxiety.....	303
Table 107 - Study 2 - Path coefficients Dominated -> Reduced.....	303
Table 108 - Study 2 - T-test H2.....	304
Table 109 - Study 2 - T-test H3.....	304
Table 110 - Study 2 - Path coefficients Anxiety -> Perceived usefulness .....	305
Table 111 - Study 2 - Path coefficients Anxiety -> Perceived ease of use .....	305
Table 112 - Study 2 - T-test H4.....	305
Table 113 - Study 2 - Path coefficients Anxiety -> Attitude toward usage .....	305
Table 114 - Study 2 - Multi-group t-tests anxiety -> attitude .....	306
Table 115 - Study 2 - t-test H5 .....	306
Table 116 - Study 2 - Hypotheses status .....	306
Table 117 - Study 2 - Expected Roles .....	308

## Appendices

*Figure 81 - AOL Affective description*

### Vivez le froid connecté

Faites de la cuisine un espace de bien-être grâce au nouveau « Réfrigérateur Intelligent KH640 ». Un espace de détente et de joie en partageant des moments uniques en famille et entre amis. Savourez le confort de ce bijou d'innovations.

Avec le KH640, imaginez le plaisir de faire ses courses en quelques clics. Plus de contrainte, libéré des corvées, faites tout depuis votre réfrigérateur.

L'assistant intelligent « Fridget » fera de la cuisine un endroit dynamique et convivial. Il se fera un plaisir de vous répondre et faire de vos échanges une expérience unique d'interaction.

Régalez-vous grâce aux recettes équilibrées de Fridget. Prenez du temps pour vous et profitez de la vie grâce au confort offert par le KH640.

Détendez-vous en le laissant gérer l'ensemble de vos produits connectés, tels que l'aspirateur robot, les luminaires, le four ou encore la machine à laver. Le KH640 est le compagnon idéal de la cuisine de demain.



## Appendices

*Figure 82 - AOL Cognitive description*

### **Bénéficiez du réfrigérateur connecté**

Le « Réfrigérateur Intelligent KH640 » est un réfrigérateur connecté, possédant les dernières technologies d'intelligence artificielle. Equipé de son écran tactile OLED et de la technologie Side Cooling, profitez de ce qu'il y a de plus performant.

Avec sa grande capacité de stockage et son revêtement intérieur, vous obtiendrez ce qui se fait de mieux en matière de réfrigérateur.

Le KH640 possède l'application « Recettes », permettant d'accéder à une liste de recettes suggérées selon les aliments présents dans le réfrigérateur.

Son écran OLED permet de visualiser l'intérieur du KH640 depuis un smartphone. Plusieurs autres fonctionnalités permettent également de faire les courses, de consulter son agenda, ses emails, de regarder la télévision ou encore d'accéder à internet.

Le KH640 peut également contrôler les autres objets connectés environnant tels que l'aspirateur robot, les luminaires, le four ou encore la machine à laver. Le KH640 est le produit qui améliorerait n'importe quelle cuisine.



## Appendices

Figure 83 - Study 1 - Smart plug description

### **Votre maison, simplement connectée**



Plus besoin de parcourir votre maison pour vous assurer que tout soit bien éteint avant de sortir... Avec la nouvelle prise connectée « K-Smart Plug », facilitez-vous la vie et accédez à distance à vos appareils électriques en un clic ! Avec l'application pour smartphone, allumez ou éteignez vos appareils électriques, où que vous soyez.

Branchez, profitez... Transformez l'ensemble de vos appareils en objets simplement connectés à votre smartphone et profitez du contrôle à distance, le tout sans installation de votre part.

Utilisez le K-Smart Plug pour suivre votre consommation instantanément avec sa fonction *Monitoring* et gérez au mieux votre facture d'électricité.

Choisissez les heures de mise en marche de la cafetière par exemple, afin de la trouver allumée au réveil le matin. Le K-Smart Plug vous permet d'accéder à vos objets et ne fera rien sans que vous ne l'ayez décidé.

Pas besoin d'être électricien pour utiliser le K-Smart Plug. Connectez vos appareils en toute simplicité, de manière pratique, sans vous soucier d'un quelconque entretien.

Une installation simple et une prise en main intuitive, profitez du meilleur du connecté en conservant le contrôle sur vos appareils même à distance.

## Appendices

*Figure 84 - Study 1 - Smart bulb description*

### **L'éclairage, connecté à vos envies**



Faites de votre maison un lieu de vie encore plus chaleureux et connecté grâce à l'ampoule connectée « K-Smart Bulb ». Créez en un clic l'ambiance idéale pour toutes vos occasions.

K-Smart Bulb n'est pas seulement une ampoule connectée, mais un véritable outil d'assistance accessible depuis votre smartphone. Découvrez la lumière autrement, il vous proposera un large éventail de couleur et vous aidera à choisir ce qui ira le mieux chez vous.

Prenez le contrôle de la lumière tout en gardant les mains libres à l'aide de la commande vocale et entrez dans l'ère de l'éclairage intelligent.

Le K-Smart Bulb est connecté son environnement de sorte à vous proposer le meilleur éclairage possible. Une lumière douce pour un réveil en douceur le matin, vous stimuler pour bien débuter votre journée ou encore vous accueillir chaleureusement de retour à la maison. Laissez-le faire !

Le K-Smart Bulb s'adapte à vos envies même sans intervention de votre part. Programmez l'ouverture de vos volets par exemple, il s'adaptera à la luminosité pour une meilleure gestion de l'éclairage.

Cette ampoule connectée et interactive transformera votre quotidien en toute simplicité.

## Appendices

*Figure 85 - Study 1 Smart speaker description*

### **Une maison connectée, et plus encore**



Transformez votre lieu de vie en véritable maison du futur. Rendez votre maison intelligente et autonome à l'aide de l'assistant connecté « K-Smart Assistant ». Interagissez avec une maison intelligente !

A la maison laissez le commander, il vous assistera partout. Eteindre les lumières, voir qui est à la porte, régler la température en fonction de la météo et bien plus encore. Obtenez de l'aide sans même avoir à bouger le petit doigt en l'activant avec la voix et laissez-le prendre ses propres décisions.

Commandez l'ensemble des équipements connectés de la maison depuis le K-Smart Assistant. Ou bien faites le choix de le laisser gérer vos objets connectés, votre journée, vos déplacements et bien d'autres choses encore, tel un réel assistant domestique.

Votre maison se débrouillera très bien toute seule et accomplira automatiquement même les tâches les plus complexes.

Le K-Smart Assistant est totalement indépendant et intelligent, il perçoit parfaitement son environnement. Il apprend et s'adapte aux changements grâce à ses capteurs haute précision tout en améliorant les prises de décision au fil du temps, jour après jour.

C'est si simple de se lancer, il vous suffit de lui parler !

## Appendices

Figure 86 - Discriminant Validity (Squared Correlation < AVE) - Study 1 - Group 1

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,088	<b>1</b>							
Dominated	0,258	0,031	<b>1</b>						
Reduced	0,060	0,024	0,316	<b>1</b>					
Anxiety	0,059	0,056	0,055	0,074	<b>1</b>				
Perceived Usefulness	0,002	0,102	0,004	0,032	0,096	<b>1</b>			
Perceived Ease of Use	0,084	0,242	0,006	0,011	0,112	0,164	<b>1</b>		
Attitude toward Usage	0,001	0,077	0,008	0,032	0,108	0,668	0,132	<b>1</b>	
Intention to Use	0,000	0,069	0,015	0,035	0,111	0,524	0,108	0,688	<b>1</b>
<b>AVE</b>	<b>0,594</b>	<b>0,686</b>	/	/	<b>0,669</b>	<b>0,822</b>	<b>0,754</b>	<b>0,940</b>	<b>0,964</b>

Figure 87 - Discriminant Validity (Squared Correlation < AVE) - Study 1 - Group 2

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,010	<b>1</b>							
Dominated	0,147	0,008	<b>1</b>						
Reduced	0,011	0,057	0,216	<b>1</b>					
Anxiety	0,001	0,055	0,027	0,085	<b>1</b>				
Perceived Usefulness	0,070	0,125	0,021	0,022	0,039	<b>1</b>			
Perceived Ease of Use	0,011	0,116	0,008	0,004	0,092	0,195	<b>1</b>		
Attitude toward Usage	0,018	0,171	0,013	0,034	0,055	0,598	0,111	<b>1</b>	
Intention to Use	0,002	0,186	0,000	0,057	0,069	0,530	0,098	0,653	<b>1</b>
<b>AVE</b>	<b>0,502</b>	<b>0,726</b>	/	/	<b>0,715</b>	<b>0,798</b>	<b>0,837</b>	<b>0,930</b>	<b>0,970</b>

## Appendices

Figure 88 - Discriminant Validity (Squared Correlation < AVE) - Study 1 - Group 3

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,039	<b>1</b>							
Dominated	0,025	0,055	<b>1</b>						
Reduced	0,000	0,011	0,087	<b>1</b>					
Anxiety	0,006	0,000	0,108	0,283	<b>1</b>				
Perceived Usefulness	0,024	0,105	0,032	0,142	0,127	<b>1</b>			
Perceived Ease of Use	0,020	0,194	0,001	0,070	0,064	0,274	<b>1</b>		
Attitude toward Usage	0,005	0,084	0,003	0,197	0,228	0,678	0,242	<b>1</b>	
Intention to Use	0,004	0,067	0,016	0,167	0,125	0,544	0,153	0,753	<b>1</b>
<b>AVE</b>	<b>0,476</b>	<b>0,728</b>			<b>0,727</b>	<b>0,802</b>	<b>0,808</b>	<b>0,928</b>	<b>0,976</b>

Figure 89 - Path Coefficients Object's Agency -> Image Elaboration (Study 1)

Object's Agency -> Image Elaboration	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.297	0.078	-3.790	-0.296	0.000	0.095	0.084	-3.532	[-0.482; -0.140]
Group 2	0.099	0.082	1.205	0.109	0.230	0.020	0.091	1.088	[-0.124; 0.263]
Group 3	0.197	0.081	2.447	0.212	0.016	0.050	0.067	2.931	[0.063; 0.339]

Figure 90 - Path Coefficients Objects' Agency -> Dominated (Study 1)

Object's Agency -> Dominated	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.500	0.074	6.721	0.493	0.000	0.266	0.075	6.700	[0.331; 0.637]
Group 2	0.378	0.076	4.941	0.378	0.000	0.164	0.082	4.606	[0.187; 0.516]
Group 3	0.117	0.081	1.441	0.102	0.152	0.081	0.085	1.374	[-0.130; 0.252]

Figure 91 - Path Coefficients Image Elaboration -> Dominated (Study 1)

Image Elaboration -> Dominated	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.028	0.074	-0.372	-0.028	0.711	0.266	0.095	-0.291	[-0.170; 0.260]
Group 2	0.054	0.076	0.706	0.055	0.481	0.164	0.091	0.590	[-0.140; 0.210]
Group 3	0.211	0.081	2.598	0.102	0.218	0.010	0.076	2.779	[0.075; 0.367]

## Appendices

Figure 92 - Path Coefficients Object's Agency -> Anxiety (Study 1)

Object Agency -> Anxiety	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.178	0.091	1.958	0.173	0.052	0.124	0.121	1.469	[-0.103; 0.456]
Group 2	-0.023	0.086	-0.272	-0.022	0.786	0.101	0.089	-0.262	[-0.213; 0.152]
Group 3	0.045	0.069	0.653	0.053	0.515	0.322	0.075	0.607	[-0.103; 0.207]

Figure 93 - Path Coefficients Object's Agency -> Reduced (Study 1)

Object Agency -> Reduced	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.054	0.079	-0.687	-0.057	0.493	0.337	0.075	-0.721	[-0.214; 0.126]
Group 2	-0.084	0.079	-1.064	-0.091	0.289	0.233	-0.091	-1.011	[-0.279; 0.072]
Group 3	-0.035	0.080	-0.439	-0.051	0.661	0.107	0.112	-0.312	[-0.234; 0.173]

Figure 94 - Path Coefficients Dominated -> Reduced (Study 1)

Dominated -> Reduced	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.590	0.079	7.455	0.600	0.000	0.337	0.070	8.441	[0.467; 0.772]
Group 2	0.497	0.079	6.314	0.496	0.000	0.233	0.081	6.104	[0.334; 0.664]
Group 3	0.301	0.080	3.773	0.300	0.000	0.107	0.077	3.900	[0.078; 0.457]

Figure 95 - Path Coefficients Dominated -> Anxiety (Study 1)

Dominated -> Anxiety	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.024	0.107	0.228	0.016	0.820	0.124	0.108	0.224	[-0.216; 0.301]
Group 2	0.045	0.097	0.470	0.049	0.639	0.101	0.106	0.427	[-0.162; 0.324]
Group 3	0.181	0.073	2.491	0.169	0.014	0.322	0.069	2.621	[0.032; 0.305]

Figure 96 - Path Coefficients Reduced -> Anxiety (Study 1)

Reduced -> Anxiety	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.215	0.095	2.270	0.206	0.025	0.124	0.102	2.098	[-0.007; 0.445]
Group 2	0.273	0.090	3.045	0.263	0.003	0.101	0.081	3.392	[0.069; 0.413]
Group 3	0.478	0.072	6.683	0.479	0.000	0.322	0.062	7.685	[0.347; 0.609]

## Appendices

*Figure 97 - Path Coefficients Dominated -> Perceived Usefulness (Study 1)*

Dominated -> Perceived Usefulness	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.011	0.081	0.134	0.015	0.893	0.121	0.102	0.106	[-0.169; 0.257]
Group 2	0.182	0.081	2.258	0.166	0.025	0.085	0.086	2.114	[-0.011; 0.370]
Group 3	0.333	0.077	4.336	0.328	0.000	0.230	0.062	5.406	[0.160; 0.443]

*Figure 98 - Path Coefficients Reduced -> Perceived Ease of Use (Study 1)*

Reduced -> Perceived Ease of Use	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.014	0.081	-0.175	-0.030	0.861	0.126	0.078	-0.181	[-0.211; 0.123]
Group 2	0.032	0.082	0.386	0.017	0.700	0.112	0.084	0.376	[-0.197; 0.189]
Group 3	-0.182	0.093	-1.957	-0.178	0.052	0.102	0.091	-1.994	[-0.360; 0.069]

*Figure 99 - Path Coefficients Anxiety -> Perceived Usefulness (Study 1)*

Anxiety -> Perceived Usefulness	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.313	0.081	-3.875	-0.325	0.000	0.121	0.102	0.106	[-0.169; 0.257]
Group 2	-0.226	0.081	-2.809	-0.230	0.006	0.085	0.098	-2.303	[-0.419; 0.015]
Group 3	-0.466	0.077	-6.067	-0.461	0.000	0.230	0.056	-8.363	[-0.567; -0.332]

*Figure 100 - Path Coefficients Anxiety -> Perceived Ease of Use (Study 1)*

Anxiety -> Perceived Ease of Use	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.330	0.081	-4.090	-0.324	0.000	0.126	0.106	-3.120	[-0.524; -0.058]
Group 2	-0.312	0.082	-3.798	-0.306	0.000	0.112	0.128	-2.432	[-0.549; -0.031]
Group 3	-0.157	0.093	-1.683	-0.167	0.095	0.102	0.097	-1.607	[-0.372; 0.020]

*Figure 101 - Path Coefficients Anxiety -> Attitude toward usage (Study 1)*

Anxiety -> Attitude toward usage	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.078	0.051	-1.531	-0.095	0.128	0.684	0.059	-1.329	[-0.248; 0.018]
Group 2	-0.094	0.055	-1.718	-0.089	0.088	0.615	0.079	-1.187	[-0.256; 0.080]
Group 3	-0.206	0.047	-4.373	-0.202	0.000	0.724	0.042	-4.941	[-0.311; -0.107]

## Appendices

*Figure 102 - Path Coefficients Perceived Usefulness -> Attitude toward usage (Study 1)*

Perceived Usefulness -> Attitude toward usage	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.786	0.053	14.901	0.783	0.000	0.684	0.051	15.461	[0.662; 0.907]
Group 2	0.770	0.058	13.258	0.765	0.000	0.615	0.049	15.619	[0.655; 0.870]
Group 3	0.715	0.053	13.386	0.719	0.000	0.724	0.037	19.084	[0.615; 0.799]

*Figure 103 - Path Coefficients Perceived Ease of Use -> Attitude toward usage (Study 1)*

Perceived Ease of use -> Attitude toward usage	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.019	0.053	0.356	0.013	0.722	0.684	0.066	0.287	[-0.121; 0.133]
Group 2	-0.035	0.060	-0.592	-0.023	0.555	0.615	0.068	-0.518	[-0.146; 0.133]
Group 3	0.066	0.052	1.273	0.064	0.205	0.724	0.051	1.289	[-0.042; 0.168]

*Figure 104 - Path Coefficients Anxiety -> Intention to use (Study 1)*

Anxiety -> Intention to use	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	-0.068	0.048	-1.406	-0.070	0.162	0.697	0.039	-1.739	[-0.149; 0.011]
Group 2	-0.078	0.050	-1.574	-0.078	0.118	0.651	0.048	-0.198	[-0.198; 0.010]
Group 3	0.078	0.046	1.687	0.074	0.094	0.759	0.031	1.288	[-0.056; 0.220]

*Figure 105 - Path Coefficients Attitude toward usage -> Intention to use (Study 1)*

Attitude toward usage -> Intention to use	Path coefficient	Standard Error	t	Path coefficient (Bootstrap)	Pr >  t	R <sup>2</sup>	Bootstrap (S.E)	CR	Intervals
Group 1	0.807	0.048	16.654	0.807	0.000	0.697	0.036	22.454	[0.728; 0.869]
Group 2	0.790	0.050	15.928	0.783	0.000	0.651	0.046	17.017	[0.674; 0.869]
Group 3	0.905	0.046	19.567	0.074	0.000	0.759	0.031	28.764	[0.832; 0.972]

## Appendices

*Figure 106 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 1*

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,016	<b>1</b>							
Dominated	0,038	0,001	<b>1</b>						
Reduced	0,021	0,054	0,280	<b>1</b>					
Anxiety	0,055	0,018	0,069	0,084	<b>1</b>				
Perceived Usefulness	0,012	0,144	0,000	0,062	0,051	<b>1</b>			
Perceived Ease of Use	0,027	0,199	0,011	0,096	0,149	0,251	<b>1</b>		
Attitude toward Usage	0,022	0,120	0,000	0,100	0,066	0,698	0,262	<b>1</b>	
Intention to Use	0,041	0,139	0,045	0,034	0,032	0,463	0,061	0,489	<b>1</b>
<b>AVE</b>	<b>0,460</b>	<b>0,764</b>			<b>0,723</b>	<b>0,826</b>	<b>0,814</b>	<b>0,949</b>	<b>0,959</b>

*Figure 107 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 2*

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,025	<b>1</b>							
Dominated	0,067	0,005	<b>1</b>						
Reduced	0,000	0,003	0,187	<b>1</b>					
Anxiety	0,002	0,002	0,045	0,104	<b>1</b>				
Perceived Usefulness	0,002	0,091	0,000	0,124	0,116	<b>1</b>			
Perceived Ease of Use	0,003	0,040	0,011	0,087	0,108	0,198	<b>1</b>		
Attitude toward Usage	0,005	0,099	0,005	0,152	0,081	0,758	0,159	<b>1</b>	
Intention to Use	0,002	0,150	0,004	0,092	0,065	0,558	0,104	0,545	<b>1</b>
<b>AVE</b>	<b>0,465</b>	<b>0,776</b>			<b>0,699</b>	<b>0,859</b>	<b>0,816</b>	<b>0,950</b>	<b>0,968</b>

## Appendices

*Figure 108 - Discriminant Validity (Squared Correlation < AVE) - Study 2 - Group 3*

	Object Agency	Image Elaboration	Dominated	Reduced	Anxiety	Perceived Usefulness	Perceived Ease of Use	Attitude toward Usage	Intention to Use
Object Agency	<b>1</b>								
Image Elaboration	0,009	<b>1</b>							
Dominated	0,023	0,002	<b>1</b>						
Reduced	0,000	0,066	0,133	<b>1</b>					
Anxiety	0,007	0,004	0,013	0,070	<b>1</b>				
Perceived Usefulness	0,003	0,058	0,022	0,019	0,166	<b>1</b>			
Perceived Ease of Use	0,000	0,090	0,011	0,011	0,117	0,219	<b>1</b>		
Attitude toward Usage	0,004	0,037	0,034	0,026	0,224	0,663	0,175	<b>1</b>	
Intention to Use	0,001	0,050	0,026	0,025	0,142	0,443	0,079	0,602	<b>1</b>
<b>AVE</b>	<b>0,410</b>	<b>0,764</b>			<b>0,723</b>	<b>0,826</b>	<b>0,814</b>	<b>0,949</b>	<b>0,959</b>

## Appendices

*Figure 109 - Study 2 - Low agency condition*

### **Votre café, simplement connecté**



Profitez d'un café d'exception avec la machine à café connectée « K-Smart CoffeeMaker » et facilitez-vous la vie en accédant à votre cafetière connecté à distance depuis votre smartphone et son application mobile dédiée. Personnalisez vos boissons ou choisissez parmi une liste de 18 boissons proposées.

Branchez, profitez... Transformez votre instant café en véritable moment d'évasion vers le futur en toute simplicité, sans configuration de votre part.

Réglez l'intensité de votre café, le mode de pré-infusion, la température de votre boisson ou encore la quantité de mousse, depuis votre smartphone et gardez le contrôle sur votre café du début à la fin.

L'application vous permet non seulement de personnaliser vos boissons, mais aussi d'accéder aux réglages de votre machine. Gérez l'allumage ou encore les heures de mise en marche du K-Smart CoffeeMaker, à distance.

Le K-Smart CoffeeMaker vous permet également de rester à la page avec ses mises à jour hebdomadaires. Vous pourrez gérer la maintenance à distance en lançant ses programmes dédiés ou encore vérifier son état de fonctionnement à tout moment de la journée. Conservez le contrôle !

Grâce au K-Smart CoffeeMaker, bénéficiez du café de demain, dès aujourd'hui !

## Appendices

*Figure 110 - Study 2 - Moderate agency condition*

### **Le café, connecté à vos envies**



Faites de votre cuisine un espace encore plus chaleureux et connecté grâce à la machine à café connectée « K-Smart CoffeeMaker ». Dégustez en un clic un café unique pour toutes vos occasions et offrez-vous le meilleur du connecté.

Le K-Smart CoffeeMaker n'est pas seulement une machine à café connectée, mais un véritable outil d'assistance accessible depuis votre smartphone. Découvrez le café autrement, il vous proposera un large éventail de boissons et vous aidera à choisir ce qui ira le mieux pour vous.

Prenez le contrôle de votre machine tout en gardant les mains libres à l'aide de la commande vocale, et entrez dans l'ère du café intelligent.

Le K-Smart CoffeeMaker est connecté à son environnement de sorte à vous proposer la meilleure expérience possible. Un café pour vous stimuler au réveil le matin ou bien pour vous accueillir chaleureusement de retour à la maison. Laissez-le faire !

Le K-Smart CoffeeMaker s'adapte à vos envies, même sans intervention de votre part. Programmez votre agenda sur votre smartphone il s'adaptera à celui-ci et vous proposera une boisson adapté à chaque moment de la journée.

Cette machine à café connectée et interactive transformera votre quotidien en toute simplicité.

## Appendices

*Figure 111 - Study 2 - High agency condition*

### **Un café connecté, et plus encore**



Transformez votre lieu de vie en véritable maison du futur. Profitez d'une cuisine intelligente et autonome à l'aide de la machine à café connectée « K-Smart CoffeeMaker ». Interagissez avec une machine à café intelligente !

A la maison laissez-le gérer, il vous assistera partout. Il manque du café à moudre ? Le K-Smart CoffeeMaker se chargera de passer commande automatiquement. Obtenez de l'aide sans même avoir à bouger le petit doigt en l'activant avec la voix et laissez-le prendre ses propres décisions.

Laissez-le contrôler vos autres objets connectés de la maison. Le K-Smart CoffeeMaker pourra adapter l'éclairage en fonction des boissons pour une véritable expérience immersive. Vous pouvez aussi le laisser faire vos courses, gérer vos rendez-vous et bien d'autres choses encore, tel un réel assistant domestique.

Votre maison se débrouillera très bien toute seule grâce à lui, et accomplira de façon autonome même les tâches les plus complexes.

Le K-Smart CoffeeMaker est indépendant et intelligent, il perçoit aisément son environnement. Il apprend et s'adapte aux changements grâce à ses capteurs tout en améliorant les prises de décision jour après jour.

C'est si simple de se lancer, il vous suffit de le laisser gérer !

