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Université Paris Descartes

Ecole Doctorale 261 “Cognition, Comportements, Conduites Humaines”

Laboratoire Adaptations Travail Individu (LATI, Université Paris Descartes)

Laboratoire d’Innovation Numérique pour les Entreprises et les Apprentissages au service de la Compétitivité des Territoires (LINEACT, CESI)

COLLECTIVE FLOW

SOCIOCOGNITIVE MODEL OF OPTIMAL COLLABORATION

By Milija Šimleša

A Dissertation for the degree of Doctor of Philosophy in Psychology

Under the supervision of Professor (HDR) Stéphanie Buisine and
Doctor (Ph.D.) Jérôme Guegan

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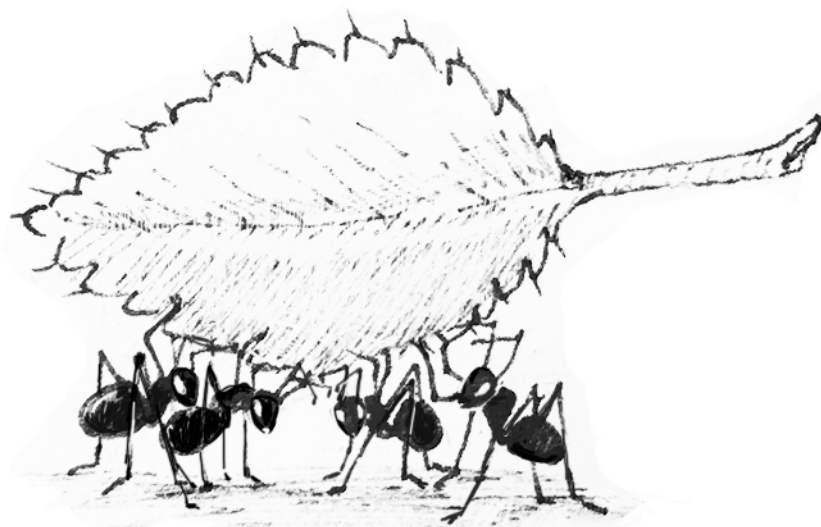
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COLLECTIVE FLOW: Sociocognitive Model of Optimal Collaboration



In memory of my *deda*, grandpa Boško, a world-class storyteller and the best flow partner in play.

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Abstract

With the increasing pressure to innovate, companies are led to find solutions how to increase the creativity of the teams working on innovation projects in a sustainable way. Research has shown that the flow (Csikszentmihalyi, 1975-2000), the optimal psychological experience of hyperfocused human functioning has benefits on subjective eudaemonic well-being as well as objective performance. However, the topic is poorly explored when it comes to flow experience in social settings. Therefore we decided to address the concept of collective flow. Funded by a French company SBT Human(s) Matter, this research project has also an applicative goal of gathering more knowledge about flow and team creativity in order to improve sustainable well-being and reach optimal collaboration for SBT's clients.

We define collective flow as a state manifesting when a group acts as a whole. The members of the group are absorbed in the common activity, are coordinating efficiently and feel good together. Subsequently, we have built a sociocognitive model that conceptualizes collective flow as a process mainly relying on motivational and social identification processes, and triggered by specific preconditions such as team members' empathy, collective ambition and shared group identity.

Four major laboratory studies and few field tests allowed us to test our theoretical model and therefore test our hypotheses. The research was mainly conducted with French engineering students working on innovation projects, ranging in length from a half-day to a whole week.

Results of the first, correlational study, show that average level of Theory of Mind of group members does not predict neither the collective flow nor the creative output of the groups. This challenges previous findings related to collective intelligence of teams. However, analyses indicate that collective flow can be predicted by intrinsic motivation and social identification relative to group membership. Moreover, we have found that creativity of groups is predicted by individual flow experience.

Next, the results of the second, experimental study, which manipulated the level of action identification (high versus low) showed that high level action identification boosts social identification, intrinsic motivation, and flow of individual group members. Also, mediation analysis indicates that the effect of action identification on flow experience is mediated by social identification and intrinsic motivation.

Third, experimental study testing the impact of social identity showed that, contrary to our expectations, the salience of social identity cues (wearing special T-shirts) neither impacts collective flow nor the creative output of the teams. Just like in the first study we found that intrinsic motivation and social identification are significant predictors of both individual and collective flow. However, collective flow did not seem to be predicted by the individual flow of group members.

Finally, the fourth experimental study exploring flow experience in a Computer-Mediated Communication (CMC) setting, relying on Social Identity model of Deindividuation Effects, tested online group creativity in anonymous, identified, synchronous and asynchronous virtual environment. Our results show that asynchronous mode of collaboration is not a flow-killer and that synchronous mode is not a flow booster. This means that individuals engaged in a collective task can indeed experience flow even when working remotely and asynchronously.

Consistent in all four studies, our results show that flow in group settings is predicted by intrinsic motivation and social identification. Collective team ambition is also likely to considerably increase the experience of flow in team context. Lastly, our results concerning the impact of collective flow on creativity are less clear, indicating that in some cases the experience of individual flow boosts the creativity. However, this might be more complex and therefore provides a good reason to seek further refinement and better understanding not only in laboratory, but also in real innovation teams.

Résumé

Face à la pression à innover, les entreprises cherchent à augmenter la créativité des équipes travaillant sur les projets d'innovation tout en favorisant leur bien-être de façon durable. La littérature suggère que le Flow (Csikszentmihalyi, 1975-2000), l'expérience d'hyperconcentration et de fonctionnement optimal humain, est bénéfique à la fois au bien-être subjectif eudémonique et à la performance objective des individus. Toutefois, le sujet est assez peu exploré quand il s'agit de l'expérience du Flow dans des contextes sociaux. Par conséquent, l'objectif de la thèse est de contribuer à la compréhension du concept du Flow Collectif. Soutenu par l'entreprise SBT Human(s) Matter, ce projet de recherche a aussi l'objectif de transférer ces avancées de connaissances sur le Flow et la créativité de l'équipe afin d'améliorer le bien-être à long-terme et d'atteindre la collaboration optimale pour les clients de SBT.

Nous définissons le Flow Collectif comme un état se manifestant quand le groupe agit comme un tout. Les membres de l'équipe sont absorbés dans l'activité commune, se coordonnent efficacement et se sentent bien ensemble. Ensuite, nous avons construit un modèle sociocognitif qui conceptualise le Flow Collectif comme un processus reposant principalement sur les processus attentionnels, motivationnels et socio-identitaires, déclenchés par les préconditions spécifiques comme l'empathie des membres de l'équipe, l'ambition collective et une identité partagée du groupe.

Six expérimentations en laboratoire et quatre études de terrain nous ont permis de tester notre modèle théorique et nos hypothèses. La recherche a été principalement menée avec des élèves ingénieurs français travaillant sur des projets d'innovation, d'une durée d'une demi-journée à une semaine entière.

Les résultats de nos premières expérimentations montrent que le niveau moyen de théorie de l'esprit des membres de groupe ne prédit ni le flow collectif ni la performance créative des groupes. Cela va à l'encontre des recherches antérieures liées à l'intelligence collective des groupes. Cependant, les analyses indiquent que le Flow Collectif peut être prédit par la motivation intrinsèque et l'identification sociale des membres du groupe. En outre, la créativité des groupes est prédite par l'expérience individuelle du Flow.

Les résultats de la deuxième étude expérimentale, qui a manipulé le niveau d'ambition/abstraction (identification de l'action haute vs. basse) a montré qu'un niveau élevé d'identification de l'action stimule l'identification sociale, la motivation intrinsèque et le Flow des membres du groupe. Aussi, une analyse de médiation indique que l'effet de l'identification de l'action sur l'expérience du Flow est médiée par l'identification sociale et la motivation intrinsèque des membres du groupe.

Les études expérimentales testant l'impact de l'identité sociale ont montré que, contrairement à nos attentes, la saillance des indices d'identité sociale (porter des T-shirts

spéciaux) n'impacte ni le Flow Collectif ni la performance créative des équipes. Comme dans la première étude, nous observons que la motivation intrinsèque et l'identification sociale sont des prédicteurs du Flow, au niveau individuel et collectif. Cependant, le Flow Collectif ne semble pas être prédit par le Flow individuel des membres de l'équipe.

Finalement, notre dernière étude expérimentale explorant l'expérience du Flow dans la communication médiatisée par ordinateur, en se fondant sur le modèle SIDE, a testé la créativité collective en ligne dans des environnements virtuels anonymes, identifiés, synchrones et asynchrones. Nos résultats montrent que le mode de collaboration asynchrone n'entrave pas le Flow et que le mode synchrone ne le favorise pas non plus. Cela veut dire que les individus engagés dans une tâche collective peuvent faire l'expérience du Flow même en travaillant à distance et de manière asynchrone.

De façon cohérente sur l'ensemble des études, nos résultats montrent que le Flow dans un contexte de groupe est prédit par la motivation intrinsèque et l'identification sociale des membres du groupe. L'ambition collective de l'équipe est aussi susceptible d'augmenter considérablement l'expérience du Flow. Enfin, nos résultats concernant l'impact du Flow Collectif sur la créativité sont moins clairs, indiquant que, dans certains cas, l'expérience du Flow individuel favorise la créativité. Néanmoins, ceci peut être plus complexe et ainsi représente une perspective d'approfondissement sérieuse pour acquérir une meilleure compréhension du phénomène, non seulement en laboratoire, mais aussi dans de vraies équipes d'innovation.

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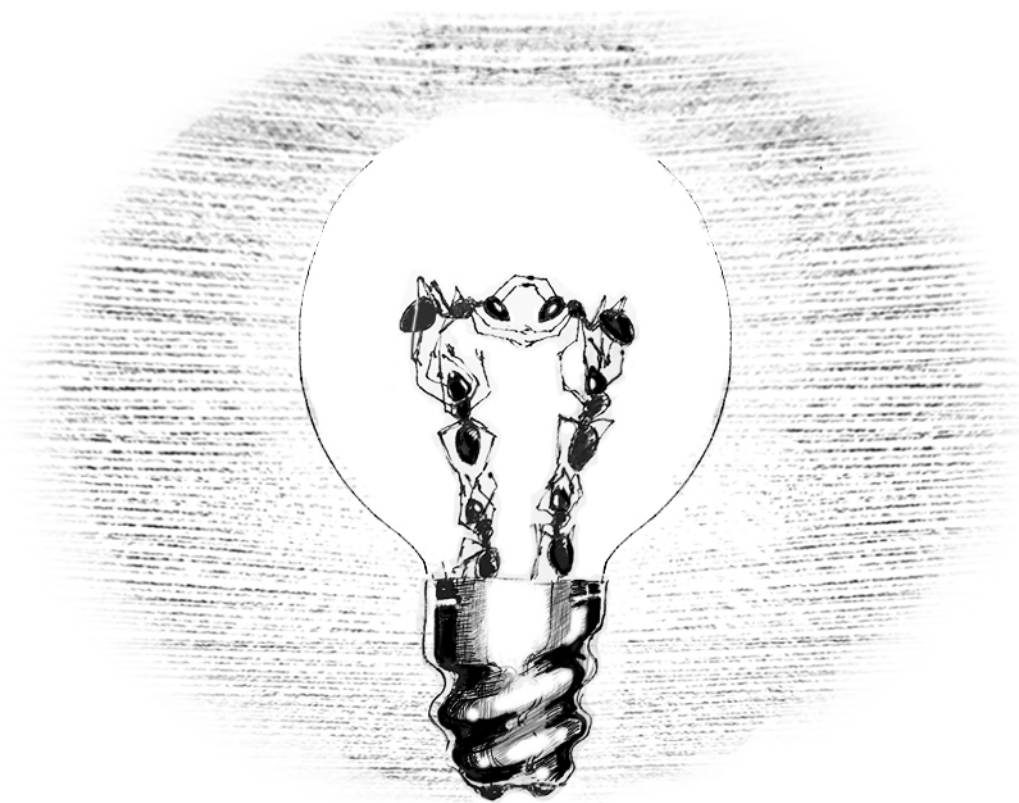
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CHAPTER 1: Motivations for the CIFRE research project



hello, we're here to help you folks

In order to survive on the competitive market, businesses are led to innovate constantly. Companies are starting to host business incubators, idea wikis, take care to mine customer insights, give awards to successful innovators, and rush to plant an outpost in Silicon Valley. However, they still struggle to meet their growth goals and to attract enough customers (Hamel & Tennant, April 27 2015). Innovation is particularly difficult – many projects end up losing money, frustrating collaborators, and going nowhere – yet companies and governments spend billions of dollars annually pursuing innovation (Furseth & Cuthbertson, August, 2018). Innovation is vital because it gives companies an edge in penetrating new markets and leading to bigger opportunities. Aside from products, innovation is also about new services, business models, production processes, functions and commercialization (Henderson, May 8, 2017).

One of the most common question asked by senior managers is “How can we find more innovative people – energetic, dynamic, full of ideas and knowing how to present these ideas well” (Satell, February 13, 2018). Nevertheless, the innovation projects are mostly, if not always, led by teams, and almost never by lone individual geniuses. As such, the process of innovation in business is a human matter and a social issue. Consequently, much of the success and failure of a novel corporate idea will heavily depend on the nature and quality of human interactions of people involved in the activity.

In order to improve the probability of innovative breakthroughs as well as smaller incremental innovation there is a striking necessity to better understand how teams function and how teamwork is carried out. Understanding team behavior in a corporate environment is becoming increasingly important in research as well as in firms, which are moving toward a greater team orientation. Ability to effectively cooperate and coordinate collective efforts is critical to the success. Therefore, it is necessary to study innovation teams as groups working on a common project, which is, often, a part of larger organizational strategy for growth and/or survival. Innovation is real work, and therefore should be managed like any other corporate activity, but has its specificities: it is the means by which new wealth-producing resources are created or by which existing resources are endowed with enhanced potential for creating wealth (Drucker, August, 2002).

Grasping human complexity as individuals but also the complicatedness and entanglement of human interpersonal relations that tellingly increase innovative output and as such create new wealth-producing resources arises as a major challenge to business success. This means investing considerable efforts in understanding kind, generous, energized and inspired exchanges, relationships and interactions in workgroups. How do we empower the people that are already in the organization? How do we create a work environment where these employees thrive? How to promote psychological safety while facing financial risks?

In macroeconomic terms, innovation is recognized as a dominant factor of economic growth (OECD, 2005). In particular, it is considered as inevitable for saving the industry of the Western world (Midler et al., 2012). It is also one of the rare consensual notions in business: innovation allows reinforcing the competitiveness of organizations, answering user

needs and expectations, creating qualified jobs and motivating employees (Amabile & Kramer, 2011; Buisine, et al., 2017). Radical innovations are shaping global mutations and progressive innovation continuously supplies the economic change (Davies & Buisine, 2017).

In order to enable for innovation, it is necessary to foster creativity, one of its main components. One of the most effective ways to facilitate innovation is to create favorable conditions for expressing employee creativity in organizations. Creativity is at the root of any innovation: necessary and irreplaceable precondition for conceiving a new product or a service. But not only: it is also crucial for all other dimensions of work: organization, management, strategy, etc. In the quest of market competitiveness and success, all organizations need the creative capacities of their human employees (Eskildsen et al., 1999).

Creativity is the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints) (Sternberg, 1998; Guegan et al., 2017). It involves the production of original, potentially operational ideas to solve a given problem (Bourgeois-Bourgine et al., 2017). In turn, its cognitive foundation - the creative process - is a sequence of thoughts and behavior leading to novel, adaptive production (Farid et al., 1993; Torrance, 1963). Creativity expressed by a single individual involves various intellectual abilities such as: (1) identifying and defining problems, (2) selectively encoding various task-relevant environmental aspects, (3) using analogies and comparisons to establish links between different domains, (4) selectively combining elements to generate new, hybrid ideas, (5) generating solutions by using divergent thinking, (6) self-evaluating and/or monitoring the progress, and (7) abandoning, if needed, the initial idea in order to explore some new possibilities (Lubart & Mouchiroud, 2003). According to the multivariate approach to creativity there are cognitive, conative, affective and environmental resources that, by their combination contribute to creative potential expression (Lubart et al., 2015; Bourgeois-Bourgine et al., 2017).

Collective creativity enables an organization to increase informational diversity and cognitive resources in order to enrich the creative process. A creative team can rely on a larger amount of knowledge and more extensive combinational possibilities (Cox & Blake, 1991). However, the collective creativity requires additional coordination phases between group members' creative efforts and thus is more complex than individual creativity. In organizational settings, collective creativity is often structured as a sequence of diverging and converging phases (Osborn, 1963).

Every person is affected by the surroundings of its body and mind. In reality, "the spatiotemporal context in which creative persons live have consequences that go unnoticed" (Csikszentmihalyi, 2013, p.127). Being at the right place at the right time, meeting right people and having necessary material and psychosocial resources for executing the creative work seems paramount for nurturing creativity. Some environments have a greater density of interaction. They provide more excitement and, "therefore prompt the person who is already inclined to break away from conventions to experiment with novelty more readily" (Csikszentmihalyi, 2013, p.129).

Psychological explanatory models of creativity, for a long time tended to associate creativity exclusively with cognitive mechanisms (such as divergent thinking) and personality traits (like openness to experience) but were failing to properly engage with the social and material aspects (with a few exceptions, e.g., Csikszentmihalyi, 1988). As highly social beings, humans live and work in communities, are members of a society, and a system. If not determined, then surely they are very much influenced by social, ideological, economic and material factors. Creativity, as a high-level evolutionary phenomenon occurring in human activities, is not spared from the influence of context (Šimleša, 2015).

Only in the last two or three decades, an explicit social psychology of creativity has emerged (e. g., Amabile, 1983; 1996) - realizing the importance of environmental factors, such as societies, family environment, and schools on creativity (Niu & Sternberg, 2003). One of the pioneers of the social psychology of creativity is Teresa Amabile who spent a great portion of her career studying the effect of the social environment on student's motivation (intrinsic and extrinsic) and their creativity (Niu & Sternberg, 2003). Amabile's view is that all those contextual variables have a cumulative effect, which determines a person's motivational orientation, and consequently partially determines the person's creativity (Niu & Sternberg, 2003; Šimleša, 2015).

The expression of creativity seems to be sensitive to the culture, tradition or country where the creative person works and where her creations are being evaluated. Cross-cultural comparisons (e.g., Lubart, 1990; Sternberg & Lubart, 1996) and anthropological case studies (e.g., Maduro, 1976; Silver, 1981; Sternberg & Lubart, 1996) have demonstrated cultural variability in the expression of creativity. Moreover, the studies have shown that cultures differ simply in the amount that they value the creative enterprise (Sternberg & Lubart, 1996).

Finally, thanks to all this research, the environmental variables received the place they deserve in the study of creativity. Environment can support or impair creativity in at least three ways – by helping come up to creative ideas, by supporting and pushing those ideas, and by serving as a basis for evaluating the ideas as they are developed (Sternberg & Lubart, 1992). The very nature of creativity is context-dependent, and the interaction among the three factors – domain, field and individual – is very important (Csikszentmihalyi, 1988, 1996; Šimleša, 2015).

In order to express creative ideas we need, at least, a favorable organizational context (Amabile & Pratt, 2016), which will help project teams and its members to express their creativity. Innovation, just like any other businesses, seeks to be in a healthy state. Empirical findings suggest that if the company employees are in good state of health and well-being, this is very likely to contribute to their successful job performance (Economic and Social Research Council, 2006; MacDonald, 2005; Baptiste, 2007). For example, George (1989, 1996) found that absenteeism was more strongly influenced by low levels of positive affect (morale) than by the levels of negative affect (distress) (Cotton & Hart, 2003). Moreover, George showed that not only do group emotions exist (George, 1990), calling this "group affective tone") but that these emotions can influence work outcomes, such as organizational

spontaneity (George & Brief, 1992), for example. From this, we could draw a conclusion that, rather than trying to reduce stressors and ill-being at workplace, the efforts to enhance positive work experience can have much better long-term results on employee engagement and performance. Simply, in striving to prosperity and/or survival on market, companies wanting to innovate have to maintain their workers alive, healthy and happy. “An engaged employee is aware of business context, and works with colleagues to improve performance within the job for the benefit of the organization” (Robertson, 2009, p. 236).

Attracting, recruiting and keeping new highly skilled talents is currently becoming more and more challenging for the employers - in the era of open peer-reviews such as Glassdoor platform. Hence, the quality of work-life in most firms has become a public matter. According to *Happy At Work Index 2018*, an impactful ranking-list of well-being in companies, 65 percent of French employees declare being rather happy at work – slightly more than in the previous year (Mediavilla, June, 2018), which is rather encouraging. From the larger perspective, *Great Place to Work*, another European index of well-being at workplace measures the quality of life in office in 19 European countries and rewards those that treat their workers the best. This yearly survey measures both the appreciation of employees’ work conditions, work environment, but also assesses managerial practices in the company. In 2018 edition of this survey, among 225 competitors, only 21 were French, which is less than in the previous year. At the same time, three times more laureates come from Scandinavia, and twice as more from UK. These results are rather deceiving for French industrial groups and certainly point out at growing need to invest into their employer branding (Nguyen, June, 2018). Struggling to fetch a label of being pleasant and humanly fulfilling, French companies are doing better each year. Still, this national increase is not good enough compared to other countries, and should be addressed seriously and tackled with strategy by leaders and other responsible stakeholders.

Positive organizational scholarship emphasizes positive organizational phenomena leading to enhanced human well-being and are quite distinct from traditional organizational studies. The research in this field “seeks to understand what represents and approaches the best of the human condition” (Cameron & Dutton, 2003, p. 4). Within this emergent field, scholars study the importance of the positive features of human functioning, such as the experience of positive emotions, self-confidence, hope, and goal-fulfillment for psychological and societal well-being (e.g., Diener et al., 2003; Seligman & Csikszentmihalyi, 2014; Luthans & Avolio, 2003; May et al., 2003).

When talking about well-being in the workplace, we are aiming at eudaemonic (active joy) rather than hedonic well-being (passive pleasure). “Eudaemonic well-being, reflects the Aristotelian concept of eudaemonia: a view of human happiness that assesses the goodness of life based on believing in a manner that actively expresses excellence of character or virtue” (Haybron, 2000, p. 210). Eudaemonia occurs when one feels intensive involvement, special fit with an activity, and intensively alive (Waterman, 1993). Eudaemonic engagement is closely related to peak experiences of deep motivation, and joy that have been observed in

artists at work (but also in other types of work), or what Csikszentmihalyi (2003) names *the flow*.

Flow, the state of great performance, conducive to creativity, human fulfillment and related to eudaemonic well-being can be regarded as a powerful lever to sustainable workplace well-being as well as a catalyzer for enhanced creative output in innovation teams. Between 1990 and 1995, Mihalyi Csikszentmihalyi and his students videotaped interviews with a group of ninety-one exceptional individuals, excelling by their creativity and having profoundly changed the course of the human history by their innovations (fourteen Nobel prizes shared among respondents). In his book, Csikszentmihalyi (2013) points out:

Creative persons differ from one another in a variety of ways, but in one respect they are unanimous: They all love what they do. It is not the hope of achieving fame or money that drives them; rather, it is the opportunity to do the work that they enjoy doing. Jacob Rabinow explains: “You invent for the hell of it. I don’t start with the idea, ‘What will make money?’ This is a rough world, money’s important. But if I have to trade between what’s fun for me and what’s money-making, I’ll take what’s fun.” The novelist Naguib Mahfouz concurs in more genteel tones: “I love my work more than I love what it produces. I am dedicated to the work regardless of its consequences. We found the same sentiments in every single interview.” (Csikszentmihalyi, 2013, p. 107)

Motivated intrinsically, employees and work teams in the state of flow are able to work harder and have more fun than those motivated by extrinsic rewards, or even worse – threatened by an eventual penalty. Business wise, according to research by McKinsey, in flow, we are five times more productive than normal (Cranston & Keller, January 2013). According to *Forbes*, flow is good for business, for the bottom line, and for individuals – but creating it is the responsibility of both organizations and individuals (Preston, September 29, 2016).

One of the early birds in implementing cognitive science and positive organizational science in their products and services, French company SBT Human(s) Matter was interested in gathering more knowledge about flow and team creativity, and thus funded the present research in order to better understand the sociocognitive phenomena conducive to sustainable employee well-being and valuable creativity. In the framework of ANRT CIFRE contract (Industrial Agreement of Training through Research), we pursued a three-year research project, which is in line with the company’s strategic vision, values and target market.

With several offices distributed in France (Lyon, Paris, Toulouse, Grenoble) and abroad (New York, Hong Kong, Casablanca), SBT Human(s) Matter is a hive of different professions, skills and know-hows offering products and services conducive to individual and organizational fulfillment of their clients and partners. SBT Human(s) Matter explicits its vision as follows:

Human beings have been put at the service of organizations' performance and it doesn't work anymore. In parallel, human beings have never been as knowledgeable, curious and skilled as they are today. Human beings have never been as augmented as they are today thanks to new usages coming from innovative digital technologies. Human beings have never been as understood as they are today thanks to recent discoveries from cognitive sciences.

Human fulfillment is becoming the key to social organizations' vitality. We are a unique gathering of expertise, know-how, and skills united around one objective: reinvent the way we take care of people.

We design and craft innovative experiences for work & life fulfillment.
We bring back vitality to social organizations (SBT Human(s) Matter website).

Offering consulting services, training, coaching, human resources assessment, cognitive training, learning interface conception and many more products and services, SBT Human(s) Matter is engaged in four fields of intervention:

TRANSFORM

Workplace has to get back to being a place for human emancipation and fulfillment. SBT Human(s) Matter helps building the conditions for individual fulfillment in order to create sustainable competitive advantage.

EMPOWER

Human beings are creating the performance of an organization. Therefore, SBT Human(s) Matter supports businesses in the identification of their talents, and advises them on how to express their full potential.

LEARN

Knowledge, skills and mindset are businesses' most valuable capabilities. Hence, SBT Human(s) Matter designs, sets-up and rolls-out innovative and engaging tailor-made learning experiences.

CARE

Feeling good in your brain is critical for a healthy life. Brain science opens up perspectives in terms of care and treatment. SBT Human(s) Matter designs and delivers original activities for cognitive stimulation.

Finally, the company dedicates more than 10% of their turnover to innovation - investing in R&D projects, exploring the benefits from cognitive neurosciences and digital technologies as well as on developing innovative products and business models. These projects are incubated within Studio #BrainTech, our startup studio. SBT has been granted from several national or regional project tenders (FUI, ANR, etc.) as leader or member of high level consortiums.

Precisely, in the context of conceiving and animating innovation workshops for client managers, SBT Human(s) Matter had a specific need to further the understanding of sociocognitive bases of team creativity and team well-being. To this end, the present research project focuses on the notion of **collective flow**, which we define as a state manifesting when a group acts as a whole. The members of the group are absorbed in the common activity, are coordinating efficiently, feel good together and are productive. Resembling to a jazz band improvisation, this joyful state of complete immersion in common activity is a very special moment when team spirit rises to a completely new level resulting in rich, surprising and novel co-creation. The study of collective flow as interactional synchrony with high creativity potential thus appeared to us as a privileged path to answering SBT's brief: *how to make teams happy and creative at the same time*.

A twofold aim of this research project is therefore: (1) scientific, and (2) applied. As a research contribution we intend to further the understanding of psychosocial phenomenon of collective flow and capture the environmental conditions likely to enable it. In terms of application, we aspire to improve SBT's methodological and consulting skills in designing, conducting and animating client innovation workshops and seminars.

Outline

This dissertation is composed of eight chapters including this one. In the following chapters, we will cover a literature overview, research question, four major empirical studies (*Chapter 4, 5, 6 and 7*) and a discussion.

Chapter 2 is an extensive literature review of individual and collective flow, which allowed us to identify recurrent, salient and important theoretical elements necessary for constructing a theoretical conceptualization of this phenomenon. The resulting conceptualization contains a dynamic representation of individual and collective flow prerequisites, mediating factors as well as flow outcomes.

Chapter 3, which follows the literature synthesis, is devoted to organizing identified elements into a logically coherent system. In this chapter, we propose a model designed as an Inputs-Processes-Outputs scheme with retroaction loops, we explicit the research question and confront these to an ecological, field reality, which in turn allows us to land our research hypotheses.

Chapter 4 presents three empirical studies examining our first hypothesis: the impact of social sensitivity skills and dispositions on collective flow. Here, we are examining the significance of human capacity to take someone else's perspective (empathy, theory of mind) in the context of innovation workshops. After explaining concepts and technical vocabulary, we present a small-scale experimental pilot study, a larger scale correlational study testing our

hypotheses and a third field study which attempts to further extend our results in a complex, ecological environment of a hackathon.

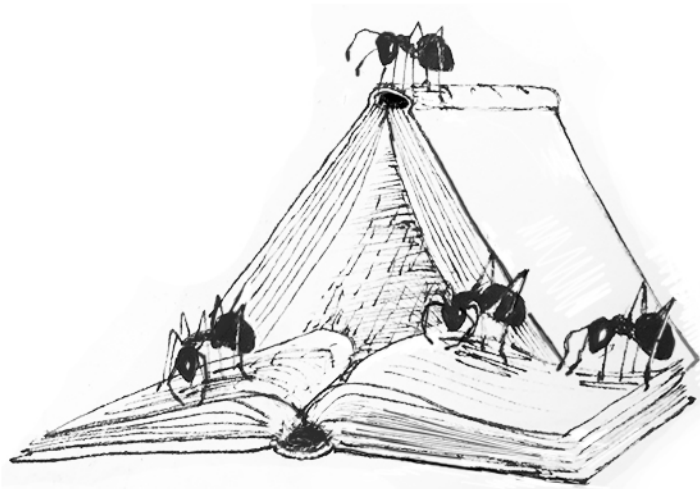
Chapter 5 examines our second hypothesis: the importance of task ambitiousness/abstraction (action identification level) for collective flow experience. In this chapter, we present one laboratory experiment in the context of creative teamwork, which allowed us to vary the levels of action identities in a controlled environment and to deduce causal effects between the collective flow inputs and outputs. Next, we present one quasi-experimental field study, which was more of an illustrative example how to manipulate action identification levels in a fun context of teambuilding.

Chapter 6 describes two experimental studies that intent to provide answers to our third hypothesis concerning the impact of *wenness* (group identity) on collective flow. These were laboratory studies and ought to assess this relationship in nominative, physically present teams. In both studies, we manipulated the salience of social identity cues: in the pilot study, in teams participating to a creativity workshop, and in the following study, in seven-day hackathon teams.

Chapter 7, similarly to *Chapter 6*, offers an empirical examination of our third hypothesis but in the framework of remote collaboration. For this laboratory experiment we used an online platform for collaborative creativity and thus investigated the effect of social identity on collective flow, in the circumstance of computer-mediated communication both in synchronous (real-time) and asynchronous (sequential) collaboration mode.

Finally, *Chapter 8* provides an integration of our findings, explores their theoretical and practical implications and concludes by offering ideas for future research as well as recommendations for field application.

CHAPTER 2: Literature Review



This chapter offers a literature review on flow well as a summary of the existing literature on flow in social settings. The following paragraphs are issued directly from our paper published in *Europe's Journal of Psychology*¹. The first section reviews the research on flow in order to clarify the concept and offers a novel view on flow as a cognitive process and its proposed conceptualization in the form of an I-P-O model (inputs – processes - outputs). Lastly, we will review the sparse but growing literature about flow in social settings, team flow, group flow and collective flow. A minor part of the literature review on collective flow comes from our contribution to EFRN's (European Flow Research Network) scoping review submitted to the *Journal of Happiness Studies*² (in collaboration with Jef van den Hout in its section *Interindividual Flow*).

Flow and its mechanism

While studying the creative process (Nakamura & Csikszentmihalyi, 2002), Csikszentmihalyi began to investigate a psychological phenomenon that he named *flow* (Csikszentmihalyi, 1993; Csikszentmihalyi, 2008; Csikszentmihalyi & LeFevre, 1989; Ghani & Deshpande, 1994). Flow corresponds to a state of optimal experience and maximal concentration, when people act at the peak of their capacity. It can result in high levels of performance, creativity and pleasure. A wide variety of enjoyable human activities encompassing various domains share the same flow characteristics (Csikszentmihalyi, 1994).

Csikszentmihalyi and other researchers discovered this phenomenon by interviewing people who have left a significant trace in history with considerable achievements in literature, science, music, rock climbing, dancing, and chess (Csikszentmihalyi, 2013), as well as in other domains such as sailing, line-work in industry (Csikszentmihalyi, 2008), and computer programming (Rogulja et al., 2011). The account of the flow state is particularly robust and confirmed through numerous studies (Csikszentmihalyi, 2013; Csikszentmihalyi & Robinson, 1990; Perry, 1999). An eminent pianist performing in front of an audience could describe her psychological state as a fulfilling, absorbing experience of merging action and awareness while moving her fingers across the keyboard, interpreting the piece and sharing beauty with her audience. If we were to ask a chess player how it feels when a tournament is going well, he would probably give a similar description to the pianist of a good concert.

¹ Šimleša, M., Guegan, J., Blanchard, E., Tarpin-Bernard, F., & Buisine, S. (2018). The Flow Engine Framework: A Cognitive Model of Optimal Human Experience. *Europe's Journal of Psychology*, 14(1), 232-253. doi:10.5964/ejop.v14i1.1370

² Peifer, C., Wolters, G., Harmat, L., Heutte, J., Tan, J., Freire, T., Tavares, D., Fonte, C., Orsted Andersen, F., van den Hout, J., Šimleša, M., Pola, L., Ceja, L., & Triberti, S. Flow-research in the new millennium – A Scoping Review. Unpublished Manuscript.

Flow both improves subjective well-being and has a potential for socially useful consequences (Csikszentmihalyi, 1994) since it provides the promise of a full life worth living. The more time that is spent in this state, the better the quality of life is: people experiencing flow report higher levels of concentration, creativity and positive emotions (Nakamura & Csikszentmihalyi, 2002). A wide range of empirical evidence indicates the adaptive importance of positive affects. Positive affects bring numerous, interdependent benefits besides mere pleasure (Fredrickson & Losada, 2005). For example, positive feelings reshape people's mindsets: research has shown that induced positive affect stretches the scope of attention (Fredrickson & Branigan, 2005; Rowe et al., 2005), broadens behavioral range (Fredrickson & Branigan, 2005), boosts creativity (Isen et al., 1987), and increases intuition (Bolte et al., 2003).

Flow appears to be important for human well-being. Scientific understanding of flow therefore becomes a requisite for contributing to the improvement of human lives. Describing, explaining and predicting this phenomenon may help act upon and change behaviors for the better.

Three decades of empirical research on this topic have yielded results and insights about domain-related flow, notably music (e.g. Byrne et al., 2003; MacDonald et al., 2006; Wrigley & Emmerson, 2013), sports (e.g. Catley & Duda, 1997; Kimiecik & Jackson, 2002; Stein et al., 1995), education (e.g. Bakker, 2005; Clarke & Haworth, 1994; Lee, 2005), video games (e.g. Bryce & Rutter, 2001; Cowley et al., 2008; Thin et al., 2011; Weibel et al., 2008), work (e.g. Fullagar & Kelloway, 2009; Lavigne et al., 2012; Nielsen & Cleal, 2010), and other domains. These empirical studies assessed flow with standard measures such as experience sampling method or ESM (Csikszentmihalyi & Hunter, 2003; Csikszentmihalyi & Larson, 1987; Csikszentmihalyi et al., 1977; Hormuth, 1986; Larson & Csikszentmihalyi, 1983). This method consists of equipping respondents with an electronic pager and a booklet of self-report forms. Participants wear the pager and whenever it beeps, they have to fill out a page of booklet indicating their activity, location, companionship and the quality of experience at that moment on a variety of dimensions (task type, challenges and skills, quality of experience, affect, potency, concentration, creativity, motivation, satisfaction, relaxation, etc.). There are several other methods to measure flow such as The Flow Scale (Mayers, 1978), The Flow Questionnaire and Flow Scale (Delle Fave & Massimini, 1988), Activity Flow State Scale – AFSS (Payne et al., 2011), Dispositional Flow Scale-2 (Jackson & Eklund, 2002), Flow Short Scale (Rheinberg et al., 2003), and some other paper-and-pencil scales used in sports (Jackson & Marsh, 1996) or psychotherapy (Parks, 1996).

Characteristics of Flow

This state, which enables individuals to achieve an ordered state of mind and that is highly enjoyable (Csikszentmihalyi, 2008), is characterized by the following features: (1) balance between perceived challenges and perceived skills, (2) clear proximal goals, (3) immediate feedback, (4) intrinsic motivation, (5) hyper-focus, (6) temporary loss of reflective self-awareness, (7) distortion of time perception, (8) feeling of control, and (9) merging of action and awareness (Nakamura & Csikszentmihalyi, 2002), to which may be added a tenth

characteristic (10) attentional-involvement (Abuhamdeh & Csikszentmihalyi, 2012a).

Hamari and Koivisto (2014) have suggested that flow should be regarded as divided between the conditions for reaching the flow and the psychological outputs that follow from reaching the optimal experience. Some flow dimensions are considered conceptually closer to one another. For example, theorizations have considered challenge-skill balance, clear goals, control and feedback as conditions required to attain flow, while loss of self-consciousness, time distortion, concentration, and merging action-awareness have been regarded as outcomes (Csikszentmihalyi, 2008; Hamari & Koivisto, 2014; Nakamura & Csikszentmihalyi, 2002). Furthermore, evidence from psychometric data, such as a stronger covariance between certain dimensions and weaker covariance between other dimensions, is consistent with the idea that there might be conceptual diversity of flow dimensions (Boffi et al., in press; Fournier et al., 2007; Hamari & Koivisto, 2014).

Csikszentmihalyi (2014) seems to differentiate the conditions (clear goals, skill-challenge balance, and immediate feedback), characteristics (concentration, merging action and awareness, loss of reflective self-consciousness, control, time distortion, and autotelic experience) and outcomes (persistence, commitment, achievement, less anxiety, etc.) of the flow experience. However, this differentiation between the conditions, characteristics and outcomes was never directly clearly framed in a theoretical model. Similarly, Landhäusser and Keller's (2012) model organizes the flow experience as a sequence of (1) preconditions (i.e., goals, feedback, demand- skill balance), (2) components of the experience (e.g., sense of control, reduced self-consciousness) and (3) consequences of flow (i.e. affective, cognitive, physiological, and quality of performance). Possible retroactions from the experience and consequences of flow onto the preconditions of further flow experience in an auto-alimentation phenomenon are not considered in this model. Moreover, cognitive functions are categorized as consequences of flow, suggesting that flow is viewed as a fully-fledged process emerging independently from them. Our approach mainly differs in two respects.

Firstly, we believe that flow experience arises from the combination of favorable contextual factors (preconditions) and activation of specific cognitive functions (attentional and motivational processes) likely to mediate and/or moderate flow process. This may result in a more parsimonious and dynamic model drawing on both previous flow research, which has mainly taken place in domains of positive psychology and applied sciences (e.g., education, sports, information technologies and management), and the framework of cognitive psychology. This attempt to link flow to fundamental cognitive processes may also offer a conceptualization of flow inside, instead of beside, the domain of cognitive psychology.

Secondly, the continuous evolution of challenge-skill balance refreshed by constant feedback and adaptation to changing proximal goals leads us to believe that flow is a dynamic psychological process, rather than a mere state. The task of the person experiencing flow in real-time provides a dynamic context for interactions between the doer, his/her environment and the activity. The flow process, already vividly described in literature (e.g., Csikszentmihalyi, 2008, 2013), lacks a cognitive explanation at the present moment. Given

these issues, we argue that a theoretical model describing the functional nature of flow is needed in order to give a comprehensive explanation of this concept in a dynamic framework. Now that we are able to name, depict, notice, and recognize it, the next mandatory phase is explaining it. This indispensable step in studying psychological phenomena opens new possibilities for predicting flow and acting upon it. To the best of knowledge, there have been no other attempts to produce a dynamic and cognitive conceptualization of flow.

Our Theoretical Model

Just as an engine converts gasoline into motion, flow inputs are ignited by strokes of core processes, producing flow dynamics which consequently generates changes to the status quo: absorption, achievement and positive feelings. This theory seeks to provide a functional mechanism for the process of flow by using an I-P-O (Inputs-Processes-Outputs) framework with added retroaction loops. I-P-O models have demonstrated their utility in the context of empirical research (e.g., Campion et al., 1993; Gladstein, 1984; Guzzo & Dickson, 1996) and they seem particularly appropriate to study causal systems in terms of mediating and moderating variables. In this respect, the analysis of mediators and moderators has long been recognized as fruitful in theoretical, strategic and statistical ways to offer a deeper comprehension of psychological phenomena (Baron & Kenny, 1986).

Inputs, the fuel of the flow engine, stand for conditions that exist prior to the task or so-called performance episode. Performance episodes can be defined as periods over which performance accrues and feedback is available, while processes stand for how inputs are transformed into outputs. Finally, outputs are all results and by-products of activity (Mathieu et al., 2000). This I-P-O model should not be understood literally as a strictly sequential, time-dependent model. Rather, it should be taken as a logical structure allowing simultaneous change in parameters appearing in different structural sections, interdependency and feedback loops.

I-P-O Flow Framework

The model consists of three structural sections: inputs, core processes and outputs. Among inputs, the I-P-O model incorporates (1) the skill-challenge balance, (2) clear proximal goals and immediate feedback. Core processes rely on two key cognitive processes that are: (1) attention, and (2) motivation. Finally, outputs consist of three sets of flow outcomes: (1) subjective experience of absorption, (2) task achievements, the fruits of invested effort, and (3) positive affects (see Figure 1).

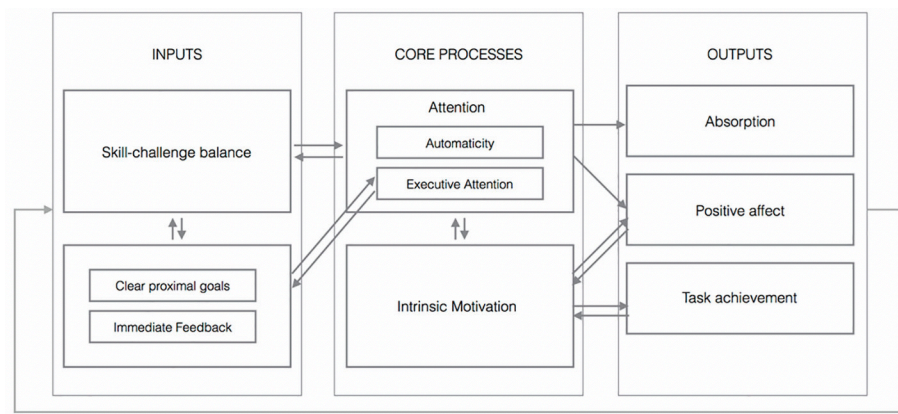


Figure 1. Flow Engine Framework.

Note. The simple arrows represent causal relationships between elements. The double arrows represent the loops of interdependence.

Inputs

Inputs reflect the resources that individuals have at their disposal for entering the process of flow. These are time-independent, rather than chronological, dimensions that seem like logical pre-requirements for engaging in a flow-genic activity. Similarly to Landhäusser and Keller (2012), we posit that these inputs comprise: (1) challenge-skill balance, (2) clear proximal goals and immediate feedback, which are merged into a single precondition.

Balance Between Perceived Challenges and Perceived Skills

In order to get into the flow, a person's perceived skills must match the perceived difficulty of the task – "a sense that one is engaging challenges at a level appropriate to one's capacities" (Nakamura & Csikszentmihalyi, 2002, p. 90). If the doer underestimates or overestimates his skills or challenges, reaching a state of flow is not possible. Playing a difficult piece that has not been practiced enough represents a big challenge. If the pianist does not have enough skills to overcome the challenges of the piece, the result will be a state of anxiety or even panic. On the contrary, if she is assigned pieces that are too simple, she risks falling into states of boredom and apathy. However, if the difficulty of the piece corresponds to her skills (technique, work, practice, sensibility, etc.), the musician is more likely to enter the zone of optimal experience. An initial balance between challenges and skills or a very slight misbalance between them (zone of control or zone of excitement) provides a starting point for an absorbing autotelic experience, meaning that it is done for the sake of doing rather than for the sake of something else. Without this pre-condition, there is no flow. For example, if perceived challenges are considerably superior to perceived skills, the person would be unable to invest his attention in the effective way, and will rather get lost in self-reflective rumination and sensations of anxiety.

Clear Proximal Goals and Immediate Feedback

The person experiencing flow needs clear proximal goals of where the action is leading her/him (Nakamura & Csikszentmihalyi, 2002), where she/he is heading and what the next step is.

Landhäusser and Keller (2012) argue that flow inputs can be simplified and reduced to perceived skills and challenges. Proximal goals refer here to small within-activity goals that arise out of the interaction and that are identifiable thanks to continuous feedback rather than the structure of the task. This means that the structure of the task unfolds during the experience itself. Depending on the task, it can be more or less transparent and visible. For example, while playing a known piece, the musician will have a clearer view of the structure of the task, meaning the sequence of proximal goals. On the contrary, a skier on a new slope will have a less transparent image of the sequence of his proximal goals. For this reason, we reckon that the component of clear proximal goals should be maintained independently from skill-challenge balance even though they are obviously very much related. In the context of a musical performance, clear proximal goals can be translated in terms of expressing a certain emotion in a given sequence, or giving a certain color to a staccato that is supposed to depict grasshoppers. Clear proximal goals allow certain cognitive and conative unburdening to the person so that her or his emergent long-term goals do not encumber her or his consciousness while doing the task. Thus, these small proximal goals are indirectly related to motivational process as well.

In our view, clear proximal goals and immediate feedback are gathered in a single input because we consider them as closely interdependent: proximal goals may not be perceived without feedback on the activity, and immediate feedback may contribute to triggering flow only in conjunction with clear proximal goals. Like a signal that is looped back to update a process within itself, immediate feedback on an activity progression is necessary in order to optimally engage with an activity. Clear feedback helps the musician to adapt her or his performance to the context, which is itself largely dependent on her or his experience, skills and knowledge. The person has an immediate feedback of how well her or his action is progressing (Nakamura & Csikszentmihalyi, 2002); at any time, she or he can evaluate whether the previous sequence was done well or not. Our pianist will probably have a rather good track of whether her playing was good or not. A false note, dissonance, uncontrolled change of rhythm or inappropriate color of tone will be immediately heard and recognized as a failure. Furthermore, a perfectly performed piece will be instantly perceived as well. According to these contextual cues, the pianist will be able to adjust her action, to correct, highlight certain moments or to bedim them. Immediate feedback is also closely related to the notion of challenge-skill balance. New feedback (either external or subjective) provides new environmental cues on the relationship between the person's actual skills and contextual challenges. The continuity of immediate feedback is dependent on attentional involvement as well: without paying close attention to what we are doing, we cannot really have an idea of how well we are doing. In this sense, we can imagine that instant feedback

mediates between skill-challenge balance, on the one hand, and attentional involvement on the other.

Core Processes

Core processes are the mediating and/or moderating mechanisms that transform inputs into outputs. In our model, those processes designate instantiations of certain fundamental cognitive mechanisms. If we imagine that inputs are the fuel for flow, then we could comparably say that core processes are ignition to the flow engine. Our schema of flow mechanics includes two core processes: (1) attention, and (2) motivation.

Attentional Process

The first core process in our model is attentional involvement. The flow experience relies on a unique configuration of attentional mechanisms. Attentional involvement was found to be a mediating variable for the relationship between optimal challenge and enjoyment, as well as the relationship between competence valuation and enjoyment. Using Experience Sampling Method, Abuhamdeh and Csikszentmihalyi (2012a) examined the relationship between challenge and enjoyment on undergraduate students. The measure comprised questions concerning enjoyment (e.g., “were you enjoying yourself?”), balance of challenges and skills (e.g., “how challenging was the activity?”), and competence valuation (e.g., “was doing well important to you?”). Their analysis indicated that attentional involvement accounts for 62% of the total effect between skill-challenge balance and enjoyment. Moreover, the attentional involvement fully mediated the relationship between competence valuation and enjoyment, accounting for 80% of the total effect. This means that when attentional involvement increases, a large part of attentional resources are devoted to the task, and features of activity engagement can therefore be experienced more fully (Abuhamdeh & Csikszentmihalyi, 2012a). This finding highlights the importance of attentional involvement in intrinsic motivation processes.

In this chapter, we have gone a step further in discussing the nature of this attentional involvement. The component of attentional involvement in flow is unlikely to correspond to sustained or directed attention (e.g., Posner, 1994) – those that enable maintaining vigilance, selective and focused attention response persistence, and effort despite changing conditions. Otherwise, it would not be described as a phenomenon of effortless attention (see Bruya, 2010). Hence, attentional involvement in flow is closer to some less costly, more implicit attentional mechanisms with eventual ad-hoc interventions of certain control mechanisms.

In our flow model, the attentional component is composed of two sub-components: automatic attention, referring to implicit investment in the task, and executive attention, referring to explicit intervention of executive control. Dietrich (2004), for instance, proposes a neurocognitive account of flow as a special case of transient hypofrontality – a state where the focused part of the brain (explicit system), which is responsible for top-down processes, rests

while other parts and functions, responsible for bottom-up processes (implicit system), become more predominant. Dietrich (2004) differentiates two distinct information-processing systems: (1) the explicit system and, (2) the implicit system. Dietrich (2004) proposes classifying the flow state as a period where a highly practiced skill that is represented in the implicit system's knowledge base is implemented without interference from the explicit system. It is proposed that a necessary prerequisite to the experience of flow is a state of transient hypofrontality that enables the temporary suppression of the analytical and meta-conscious capacities of the explicit system.

Flow would then be defined as a “state of hypofrontality with the notable exception of executive attention, which enables the one-pointedness of mind by selectively disengaging other higher cognitive abilities of the prefrontal cortex” (Dietrich, 2004, p. 757).

Schematically, if we imagine flow as a constant micro-disbalance between perceived skills and challenges, we could represent it as an upward, wavy motion through the flow channel (see Figure 2).

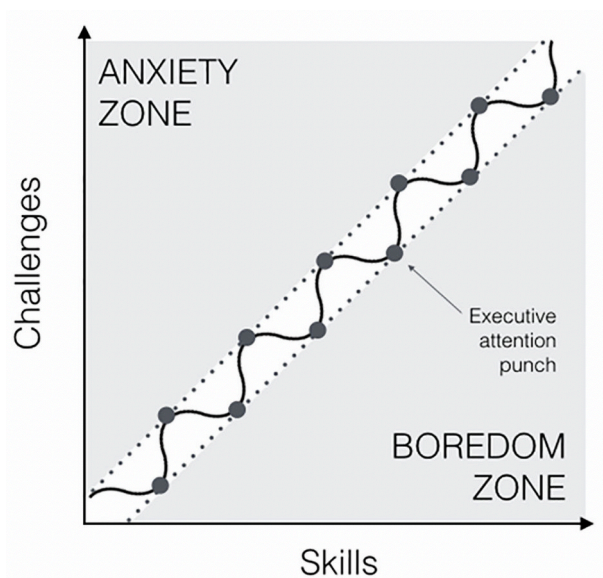


Figure 2. The flow channel and micro-disbalance between skills and challenges.

Inside the channel, the person would function on an autopilot, in a state of hypofrontality. However, once the skill has evolved, the trend will head downwards to boredom zone - which potentially brings task-irrelevant thoughts (Smallwood et al., 2004). In order to maintain the flow, an executive punch is needed such that fresh challenges readjust to match these newly strengthened skills. Conversely, if the challenge exceeds the skills, drawing the person into the anxiety zone, a special effort is needed to bring the requirements back into the channel where they match the skills. Overall, attentional involvement in the flow process mostly corresponds to automatic processing where the person feels she or he operates without explicit effort. This suggests that the prefrontal cortex is not required for the successful execution of the task (Dietrich, 2004), in the short term. In the long term, this state

of hypofrontality is occasionally interrupted by an executive intervention that aims to restore the implicit, hypofrontal state.

Recent, but scarce literature about neural correlates of flow yield unclear and contradicting neuroimaging results when it comes to the hypofrontality hypothesis. On the one hand Ulrich and colleagues (2014) found decreased activity in the medial prefrontal cortex, implying that there is decreased self-referential processing while in flow. On the other hand, Harmat et al. (2015) find no association between cortical oxygenation and flow, and therefore no support that flow is related to a state of hypofrontality. However, it is very important to point out the methodological and instrumental differences between these two studies in terms of the administered task (mental arithmetic task in the first case and a Tetris game in the second), neuroimaging instruments (magnetic resonance imaging versus functional near-infrared spectroscopy) and experimental subjects (exclusively male sample versus exclusively female sample). The great methodological discrepancies between the studies make it very risky to draw conclusions on the neural basis of hypofrontality in either case. More studies are required in this field to gain better understanding of the neural basis of the flow process.

Motivation

To be motivated means to be moved to act, to accomplish or simply to do something. “A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated” (Ryan & Deci, 2000, p. 54). Being involved in an activity providing flow requires a certain kind and level of motivation that moves the doer’s will to continue being invested in the activity. Initial clear proximal goals allow the emergent higher-order motivation to take place and to ignite flow mechanics. Once in place, motivation, together with attention, allows one to maintain the momentum in flow activities.

There are essentially two types of motivation: (1) intrinsic motivation, which refers to being involved in an activity because it is interesting in itself or enjoyable, and (2) extrinsic motivation, which refers to doing something because it leads to a detachable outcome (Ryan & Deci, 2000).

Intrinsic motivation means being motivated for an activity purely for the sake of that activity (Deci & Ryan, 1985; Lepper et al., 1973). People pursue intrinsically motivated activities voluntarily, when external constraints are absent (Deci & Ryan, 1985; Harackiewicz et al., 1984). These activities are pursued for the enjoyment of experience (Abuhamdeh & Csikszentmihalyi, 2012a). Amabile (1996) defines as intrinsic any motivation stemming from a person’s positive reaction to qualities of the task itself, while defining extrinsic motivation as any motivation that arises from sources external to the task. According to this author’s *Intrinsic Motivation Hypothesis*, the intrinsically motivated state is conducive to creativity, whereas the extrinsically motivated state is mostly detrimental to creativity with very few exceptions concerning external motivators, in service of intrinsics, that are perceived as informational, enabling or socially empowering (e.g., recognition). Deci (1971) also found

that extrinsic motivators do not all work the same way and not all of them hinder intrinsic motivation: for example, rewards such as social approval do not seem to affect a person's intrinsic motivation as negatively as monetary rewards do (Deci, 1971).

Insofar as flow activity is autotelic (done for the sake of doing) and associated with creative achievements, it is considered to involve intrinsic motivation. Motivation, together with activity type, has been found to be a moderating factor in a relation to perceived challenge and reported enjoyment (Abuhamdeh & Csikszentmihalyi, 2012b). Moreover, the link between challenge and enjoyment was stronger for intrinsically motivated, goal-directed activities than it was for non-intrinsically motivated, goal-directed activities and intrinsically motivated, non-goal directed activities.

The involvement of intrinsic motivation in flow is also consistent with the absorbing aspect of the flow experience: although flow activities can be motivated by a spark of some kind of extrinsic goal in terms of contextual precondition factors, during the task execution (or core process) there is no space in the subject's consciousness for contemplation of extrinsic goals. In line with this argument, Amabile (1996) draws a conceptual link between types of motivation and attentional involvement in order to account for the underlying cognitive mechanism. The difference between extrinsic and intrinsic motivation is compared to the difference between divided and undivided attention to task-relevant information and to a task itself. Attentional resources are not limitless: an extrinsically motivated person will use at least some of those resources to monitor whether the action meets the extrinsic goal (Amabile, 1996). Consequently, extrinsically motivated people will be less able to completely focus their attention to the task and task-relevant environmental cues than intrinsically motivated people. Intrinsic motivation while narrowly linked to the attentional processes, can be seen as a catalyst of the flow process. Therefore, in our model, intrinsic motivation represents a very important moderating variable of the attentional mediation between inputs and outputs.

Outputs

Psychological outputs from reaching the optimal experience follow three sets of outcomes: (1) Subjective experience of absorption, related to phenomenon of hyper focus, lack of reflective self-awareness and time distortion, (2) positive affects such as satisfaction, pleasure, joy, feeling alive; and (3) results, the fruits of invested effort such as relative performance, creativity and other forms of achievements. Outcomes of flow may nourish the inputs in the sense of creating a virtuous circle of flow.

Absorption

While attentional involvement refers to a core process in flow, composed of two mechanisms (automaticity and executive attention), the absorption refers to a subjective feeling resulting from the flow process. Experience of absorption covers the following

characteristics: lack of self-awareness, hyper-focus and distortion of temporal experience. Completely agreeing with van den Hout et al. (2018) that those elements are wholly emergent and thus cannot be considered prerequisites of the flow experience, we have placed them among the flow process outputs. We argue that those three characteristics are similar enough to be grouped into one output and for the sake of parsimony, we decided to group them under the umbrella term absorption.

Tellegen and Atkinson (1974) interpret absorption as a disposition for having episodes of *total* attention that fully engage one's representational resources. They suggest that the type of attention involved in the absorption experience is centered, amplifies the experience of one part of reality, involves a full commitment of available perceptual, motoric, imaginative and ideational resources to a unified representation of the attentional object (Tellegen & Atkinson, 1974). In our view, this dispositional account of absorption seems closely related to Dietrich's (2004) hypothesis of hypofrontality, on which we rely to elaborate on the attentional processes in action in the core process of flow.

Because the person experiencing flow is focused, she or he has neither time nor cognitive resources to invest in auto-reflexion. The activity becomes spontaneous, and the self becomes absent from the consciousness. This means that while flowing, an individual temporarily pauses thoughts that refer to oneself – how do I look, am I hungry, does my body hurt, etc. In flow, “one acts with a deep but effortless involvement that removes from awareness the worries and frustrations of everyday life” (Csikszentmihalyi, 2008, p. 49). This is true for most of the domains except perhaps for some autoreflexive activities such as certain forms of meditation or prayer. Due to the lack of research on flow in these kinds of activities, where reflection upon the self is at the heart of the task itself, we cannot make further assumptions.

Narrow, task-related hyperfocus characterizes the flowing experience. The person gets so intensely immersed in the activity that awareness and action merge in the present moment: here and now. During performance, the pianist is so immersed in playing that not much can get her out her element: a cell phone ringing in the audience, the sound of rain outside, the memory of her grandmother who passed away two days ago, etc. The opposite of hyper-focus is psychic entropy, a disorganization of the self that impairs its effectiveness. Absorption corresponds to hypofrontality (Dietrich, 2004) where the explicit system is unburdened or inhibited.

Early research into the psychological aspects of time have demonstrated that human temporal perception is not a simple chronometric record of reality (Hancock & Weaver, 2005). While flowing, a person is deeply attentive. Consequently, her or his perception of time can be significantly altered. When flowing, people usually report that time seems to pass very quickly (Nakamura & Csikszentmihalyi, 2002). However, this might not be completely generalizable to all domains of activities. The flow in strictly time-dependent activities such as competitive running might be an exception because awareness of the passage of time constitutes the structure of the task itself.

In conclusion, we gather in this first output of flow process the subjective experience of absorption, the lack of self-awareness, hyper focus and distortion of temporal experience. This series of phenomena is directly related to the attentional mechanism of hypofrontality highlighted in flow core processes.

Positive Affects

Research investigating the nature of autotelic experiences by consulting rock climbers, chess players, dancers and other professions has shown that the enjoyment was the primary reason for individuals to pursue the activity (Csikszentmihalyi, 1975-2000, as cited in Nakamura & Csikszentmihalyi, 2002). The genuine enjoyment that surgeons, rock climbers, and other professionals routinely find in their activities depict how an organized set of challenges and a corresponding set of skills result in optimal experience (Nakamura & Csikszentmihalyi, 2002).

Research using ESM to test flow has confirmed that subjects report the best subjective experiences when both perceived challenges and skills are high and well balanced. When flowing, they report feeling more active, alert, concentrated, higher levels of happiness, satisfaction, and creativity— although not necessarily more cheerful or sociable (Carli, 1986; Massimini et al., 1987; Nakamura, 1988; Wells, 1988).

Seligman and Csikszentmihalyi (2014) make a clear distinction between positive experiences that are pleasurable and those that are enjoyable. “Pleasure is the good feeling that comes from satisfying homeostatic needs such as hunger, sex, and bodily comfort. Enjoyment, on the other hand, refers to the positive feelings people experience when they break through the limits of homeostasis – when they do something that stretches them beyond what they were – in an athletic event, an artistic performance, a good deed, a stimulating conversation“ (Seligman & Csikszentmihalyi, 2014, p. 8).

Task Achievements

Task achievements include feeling of control and performance (e.g., productivity and creativity). Merged into one output, they represent objective (productivity) and subjective (feeling of control) performance in a given task.

Adaptive goal-directed behaviour includes monitoring of ongoing actions and performance outcomes, and resulting adjustments of learning and behaviour (Ridderinkhof et al., 2004). Due to the balance between perceived skills and perceived challenges and attentional involvement, the person experiencing flow has the impression of being in control of the situation. The sense of control is one of the main indices of flow (Csikszentmihalyi, 2000). The idea that the control of consciousness improves quality of experience can be found in almost every Eastern spiritual tradition (Csikszentmihalyi, 2008).

This control of the consciousness is often reminiscent of mindfulness meditation, “the awareness that emerges through paying attention, on purpose, and nonjudgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003, p. 145, as cited in Luken &

Sammons, 2016). Research has demonstrated the significant relationship between flow experiences and mindfulness (e.g., Wright et al., 2006). Kee and Wang (2008) found that higher levels of mindfulness in university athletes related to higher levels of flow components, such as: the balance between skills and challenges, merging of action and awareness, concentration, clear proximal goals and loss of self-consciousness (Kaufman et al., 2009). In an interview with an art and design student, Allen and Loughnane (2016) offer a vivid illustration of a mindful involvement:

Speaking from an artist's point of view, you can get so involved in being present with the creative process that involvement with an art activity can be hugely stress relieving; you are so focused on the present moment that nothing else permeates the process. It's an effective tool for mindfulness, I personally find (Allen and Loughnane, 2016, p. 684).

However, the experience of flow considerably diverges from mindfulness. According to Dane's (2011) classification in terms of attentional scope (large versus narrow) and focus on the present moment (high versus low), there are four types of attentional states: (1) mindfulness (large attentional scope and high focus on the present moment), (2) absorption/flow (narrow attentional scope and high focus on the present moment), (3) distraction/mind-wandering (large attentional scope and low focus on the present moment), and (4) prospective thinking/counterfactual thinking (narrow attentional scope and low focus on the present moment). In line with this categorization, flow and mindfulness both correspond to high levels of focus in the present moment, but they contrast in terms of attentional scope. While mindfulness refers to a maximum openness to all stimuli (internal and external), flow covers a very narrow field of focus, often leading to a lack of self-consciousness. This relative lack of reflective self-consciousness makes these two phenomena incompatible in a given moment (Sheldon et al., 2015). Therefore, mindfulness cannot be an output of the flow process.

Some literature suggests there is a positive relationship between flow and performance, especially in learning settings (e.g., Engeser et al., 2005; Schüler, 2007; Schiefele & Rheinberg, 1997, as cited in Schüler & Brunner, 2009), artistically and scientifically creative activities (e.g., Perry, 1999; Sawyer, 1992, as cited in Schüler & Brunner, 2009). Engeser and Rheinberg (2008) found that flow predicted academic performance in two out of their three studies (learning for an obligatory course in statistics and learning in a voluntary French class). According to Engeser and Rheinberg (2008), there are at least two good reasons for flow to be related to performance. First, flow is a phenomenon of high functioning that should, in itself, encourage good performance. Furthermore, individuals experiencing flow feel more motivation "to carry out further activities, and in order to experience flow again, they will set themselves more challenging tasks" (Bakker et al., 2011, p. 444). Likewise, Schüler and Brunner's (2009) similarly suggested that flow experience during a marathon is associated with the motivation for future running but not with the present race performance. "Flow functions as a reward of the running activity, which leads to the desire to perform the activity again" (Schüler & Brunner, 2009, p.

173). This body of results is in line with the argument that the links between flow and performance may be both direct (with performance resulting from the flow process) and indirect (with feedback loops fueling either the skill-challenge balance or the intrinsic motivation core process). However, we may also mention that these potential interrelations between flow and performance are not always supported empirically: divergent and inconsistent results have been reported in the domains of sports (Bakker et al., 2011; Jackson et al., 2001), music (Iusca, 2015), and work setting (Demerouti, 2006). These inconsistencies might be attributed to various factors: the significant disparity between the nature of tasks measured, heterogeneity of flow assessment methods and plurality of performance measurements.

Finally, there is some empirical evidence that flow is related positively to creativity. MacDonald and colleagues (2006) used the ESM to measure flow in tasks of musical group composition. Their results clearly show higher levels of flow are associated to higher levels of creativity (MacDonald et al., 2006). Similar findings appear in the domain of work psychology. Namely, Zubair and Kamal (2015) gathered data from 532 workers in software companies discovering that work related flow was a strong predictor of employee creativity (Zubair & Kamal, 2015). On the other hand, research in visual arts is somewhat less clear. Flowing participants performing creative mental synthesis to simulate the creative process of drawing exhibited an affect improvement in visual creativity (Cseh et al., 2015). In their experiment (Cseh et al., 2015) using creative mental synthesis task (Finke & Slayton, 1988), researchers found that the changes in affect were related to productivity and self-rated creativity. However, it was not linked to other objective or subjective performance measures evaluated by judges. Even though flow, measured by pre-task and post-task questionnaires was not related to all performance measures, it was notably correlated with self-related creativity. This study aiming to understand flow in visual creativity concluded that flow motivates perseverance towards eventual excellence rather than providing straight cognitive improvement (Cseh et al., 2015).

The subject of flow has in many ways escaped the attention of cognitive psychology and neurosciences. Mostly studied in the context of correlational studies with quite limited data collected in controlled experiments, flow seems to be implicitly considered to be an applied concept from positive psychology or as an esoteric discipline. Our main aim in this section was to try to integrate it into the framework of mainstream cognitive psychology and relate it to major cognitive functions of the human psyche.

The flow engine framework explains the relationship between flow characteristics using the metaphor of an engine. Skill challenge balance, clear proximal goals and immediate feedback fuel the process and represent necessary logical requirements for flow. Skill-challenge balance allows attention to be used in an optimal way. Immediate feedback and clear proximal goals fuel the attention, which in turn updates the actor about the new relationship between skills and challenges. These combustibles are then ignited by strokes in the cylinders – the core processes. Like interdependent sparks, attentional involvement, composed of automaticity and executive attention, and intrinsic motivation start the

dynamism of this flow machine. Adequate attentional involvement results in outcomes linked to absorption. The overall process corresponds to moderated mediation between inputs and outputs, with attention (automaticity and executive attention) as mediator and intrinsic motivation as moderator. As a result of a well-done task, task achievements occur often (but not always) as an outcome of flow process. When this happens, task-achievement results in an immediate update of skill-challenge balance, modifies proximal goals, multiplies positive affect and therefore reinforces motivation for future engagement in the task. Unlike Landhäusser and Keller (2012), we focus on putative dynamic and causal relations between flow components involving generic attentional and motivational processes.

One important implications of this model is that flow is regarded as a processing mechanism rather than a mere mental state or performance state (e.g. Jackson et al., 2001). This implies that existing indicators of flow might not be optimally adapted to the nature of the phenomenon and that actual flow-scales and tools capture flow components retrospectively or quasi-retrospectively, as if they were of the same essence. Our model does involve these flow dimensions and logically sorts their structural order in a dynamic and interdependent framework. It holds that flow represents a macro-process embracing two core cognitive processes: (1) attention (automaticity with sparks of executive attention) and (2) intrinsic motivation. From this perspective, it appears necessary to step back and review how these two processes function in the context of optimal experience and how their variation modulates the episodes of flow.

Finally, since its formalization, there has been rich and vast research concerning flow in individual settings. Nevertheless, the majority of human activity is social and happens in a group setting. There has been extremely little research about flow in group-like, team-based, collective or interdependent activities (e.g., Salanova et al., 2006; Sawyer, 2003, 2012; Walker, 2010). Therefore, it would be highly valuable to explore the phenomenon of flow in groups. Effort has been made to study flow in certain group tasks (e.g., school activities and team sports), but most have treated the individual as the focus of analysis (Nakamura & Csikszentmihalyi, 2002). Thus, the question is whether there something similar to flow in groups and how it works? In Csikszentmihalyi's studies on the quality of daily experience (2008) it has been demonstrated again and again that people report the most positive moods overall when they are with friends. A key characteristic that the flow model shares with other contemporary theories is interactionism (Nakamura & Csikszentmihalyi, 2002). Rather than focusing on the individual, taken out of context (e.g., traits, personality types, stable dispositions), flow research has emphasized dynamic systems composed of person and environment, as well as the phenomenology of person-environment interactions (Nakamura & Csikszentmihalyi, 2002). In the case of group flow, social psychology theories might be explored in order to understand the group processes that lead to optimal collaboration. Accordingly, the following chapters of this dissertation will pursue the study of collective flow by drawing on social psychology research.

Group/social/collective flow

With little or no pre-existing scientific literature, few of the researchers who have attempted studying social flow have emphasized the importance of this research topic and the need for this sub-field to grow. Noticing that basic research on the conditions and forms of social flow is limited, Salanova and colleagues (2014) recommend further research on the concept of collective flow that needs to be studied from a broader perspective by considering it to be greater than the mere sum of individuals' flow experiences, adding that more antecedents/preconditions may influence this collective experience. Salanova and colleagues (2014) also suggest that more research is needed to explore and understand the components and mechanism of this intriguing sociopsychological phenomenon. Finally, in his dissertation, van den Hout (2016) points out that the noted potential for optimal experience (flow), which can enhance effectiveness, productivity, performance, capabilities and well-being, is underexploited: there has been too little research on how teams can harness the benefits of flow, especially in work settings.

Although research on social flow has been limited, the number of contributions has begun to grow in recent years (Peifer et al., forthcoming). Across domains, these new studies range from research on individual flow in the context of group activities to research on collective flow in a genuine interdependent group activities. A pioneering researcher in this area is Keith Sawyer, who first defined group flow as “a collective state that occurs when a group is performing at the peak of its abilities” (Sawyer, 2003, p.167).

In his famous book about group creativity in jazz ensembles and improvisational theater, Sawyer (2003) was the first to mention the concept of the group flow. Both researcher in psychology of artistic creativity and a jazz pianist for over twenty years – having spent several years playing piano in Chicago - Sawyer (2003) provides a qualitative account of interactional synchrony in performances that *work well*.

These performances seem to work because the performers are closely attuned to each other; monitoring the other performer's actions at the same time that they continue their own performance, they are able to quickly hear or see what the other performers are doing, and then to respond by altering their own unfolding, on-going activity (Sawyer, 2003, p. 37).

Sawyer (2003) defines group flow as a group performing at its peak, arguing that the concept is related to the notion of the individual flow (Csikszentmihalyi, 1975-2000) but with a major difference: “Csikszentmihalyi intended flow to represent a state of consciousness within the individual performer, whereas group flow is a property of the entire group as a collective unit” (Sawyer, 2003, p. 43). While observing musical groups, Sawyer (2003) noticed that group flow requires a particular type of parallel processing. As the musicians are playing simultaneously, they are obliged to listen to other band members and to immediately respond to what is heard.

You have to be able to divide your senses... so you still have that one thought running through your head of saying something, playing something, at the same time you've got to be listening to what the drummer is doing (Sawyer interview, an introspective account, December 2, 1990; in Sawyer, 2003, p. 44).

Described as an emergent property of the group, group flow has the potential to inspire musicians to “play things that they would not have been able to play alone, or that they would not have thought of without the inspiration of the group; the highest points of improvisation occur when group members strike a groove together“ (Berliner, 2009, p. 388). According to Sawyer (2003, p. 46), group flow depends on interaction between performers, and is emergent by its essence.

Some interpersonal flow studies at the individual level

In an exploratory study Magyaródi and Oláh (2015) found that the most frequent social activities inducing flow are work and sports. The study concludes that for *interpersonal* flow experiences the level of perceived challenges should be high. Furthermore, the authors of the study (Magyaródi & Oláh, 2015) found that other interpersonal flow enablers are the level of cooperation, the immediateness/clarity of feedback, and the perceived level of skills.

MacDonald and colleagues (2006) found that the quality of the output of groups reporting higher levels of individual flow during a group music composition tasks is rated significantly higher by postgraduate student teachers. This suggests that incorporating flow predictors (clear goals, immediate feedback, challenge-skill match and no fear of failure) can be utilized to enhance group composition tasks (Peifer et al., forthcoming).

Van Schaik and colleagues (2011) studied individual flow within an immersive virtual environment for collaborative learning in which participants (Japanese and British students) were asked to work on a collective task. The task took place in the Second Life Interactive 3D Internet environment. They found that flow conditions (challenge-skill balance, clarity of goals and feedback) mediated between task constraints (the complexity inherent to a problem that is to be solved) and learning experience. Their findings support the idea that flow conditions could be used to create collective learning activities. This work provides a measurement and tests of the effects of learning activities on flow – mediated by its preconditions – in an immersive virtual environment.

One study also found that authentic leadership is associated with employees' flow experiences in the working context (Smith et al., 2012).

Authentic leadership. Avolio and colleagues (2004) define authentic leaders as those who are deeply aware of how they think and behave and are perceived by others as being aware of their own and others' values/moral perspectives, knowledge, and strengths; aware of the context in which they operate; and who are confident, hopeful, optimistic, resilient, and of high moral character (as cited in Avolio et al., 2004). Those are the leaders that help people in their search for meaning and connection by fostering a new self-awareness, while genuinely relating to all stakeholders (associates, customers, suppliers, owners, and communities)

(Avolio & Gardner, 2005). Authentic leadership has been shown to have an impact on followers' Organizational Citizenship Behaviors (OCBs), followers' commitment, followers' satisfaction with the leader, and followers' performance (Clapp-Smith et al., 2009; Walumbwa et al., 2008). Described as a process in which leaders are deeply aware of how they think and behave, of the context in which they operate, authentic leaders are perceived by others as being aware of their own and other's knowledge, values, moral perspectives and strengths (Luthans & Avolio, 2003; Gardner et al., 2005; Avolio & Luthans, 2006; Avolio et al., 2004; Clapp-Smith et al., 2009). Authentic leaders are not only concerned with their personal authenticity, but also how that authenticity can be dispatched to other collaborators. They therefore work toward influencing their followers to work toward common goal and shared objectives (Clapp-Smith et al., 2009). Authentic leadership is a higher-order, multidimensional construct, comprising elements touching a very wide range of self-aspects: proprioceptive-affective (self-awareness), cognitive (balanced processing), interindividual (relational transparency) and civilizational (moral/ethical perspective) (Walumbwa et al., 2008). Usually, authentic leadership is measured as followers' perceptions of their leaders (Clapp-Smith et al., 2009). Related to both performance and trust, authentic leadership can result in higher motivations to perform well as an individual. Shared perceptions of authentic leadership can have a beneficial effect at the group level (Clapp-Smith et al., 2009; Meindl, 1995) such as an increase in group performance (Clapp-Smith et al., 2009). Kernis (2003) as well as Ilies and colleagues (2005) identify four core elements of authenticity: self-awareness, unbiased processing, relational authenticity, and authentic behavior/action (Avolio & Gardner, 2005). These dimensions characterizing authentic leadership can be roughly mapped onto the six aspects of human wellness proposed by Ryff and Keyes (1995) to reflect human actualization (self-acceptance, environmental mastery, purpose in life, positive relationships, personal growth, and self-determination). Emergence and development of authentic leadership is, according to Michie & Gooty (2005) anchored in self-transcendent values (honesty, loyalty, equality), positive other-directed emotions such as gratitude and appreciation. Motivated by personal convictions, rather than to attain status or benefits (Shamir & Eilam, 2005), authentic leaders are grounded in their personal values and convictions (Avolio & Gardner, 2005). Authenticity has a substantial influence not only to leader's well-being, but it also influences their followers' well-being and self-concept (Ilies, et al., 2005).

Interpersonal flow studies at the collective level

Walker (2010) differentiates solitary flow experiences from social flow experiences – the latter varying on the degree of interdependence (ranging from co-active to highly interdependent). Doing one survey and two experiments with the aim to explore the conditions and qualities of social flow, Walker (2010) found support that doing activities together is better than doing it alone. The first study explored the reported examples of social flow and contrasted them with solitary flow. Participants reported examples of interactive social flow in the following activities: playing soccer on a great team, joining a jam session at their neighborhood jazz club, eating, drinking and talking with friends, exchanging and

laughing with friends, having sex with their lover, playing a game of pickup basketball, acting in a play on a night when everyone is on, having a heart-to-heart with a close friend, singing in a choir, ballroom dancing. In the second and third study, Walker (2010) experimentally investigated conditions that might make social flow more pleasant and joyful than flow experienced in solitary setting. The second study involved a tympanic paddleball game played either in an alone condition (bouncing the ball of a wall) or dyad condition (volleying a ball between participants). Analysis revealed that the strongest contributor to the experience of reported joy was playing in pairs and that the required skill level accounted for a smaller, but significant, portion of variance. The third study manipulated forms of team play: highly interdependent play (doubles passing the ball between themselves before volleying the ball across the net to the opposite team) versus less interdependent team play (volleying the ball between two people across the net). Highly interdependent play was rated more joyful and more challenging. Moreover, the study results indicate a link between the level of joy and that of the challenge.

According to the author's (Walker, 2010) concluding remarks and implications, which aren't explicitly tested in these studies, there are eleven social flow conditions. In order for social flow to occur, there has to be a team (1), the collective skills of this team need to be sufficient to match the challenges of the situation (2), and these skills must be uniformly high for all group members (3). Moreover, team members ought to have relevant knowledge and skills – task related and group related (4), emergent challenges must be relevant in the eyes of all group members (5) and the nature of the task must demand interdependence, coordination and subsequent cooperation (6). Furthermore, these team tasks must be conjunctive and require complementary participation (7), team members should be focused on intergroup relations as well as on the task to receive constant feedback (8) which itself is clear and immediate (9) as well as primarily cognitive and secondarily affective (10), while the social process feedback is primarily affective and secondarily cognitive (11) (Walker, 2010). Later, Walker (2010) states eleven social flow indicators:

- (1) Shared intense absorption & engagement with the task;
- (2) High attention to group members or teammates;
- (3) Loss of sense of time;
- (4) Less awareness of self;
- (5) Surrender of self to the group;
- (6) Emotional communication during group work;
- (7) Emotional contagion within the group and observers external to the group;
- (8) Joy, elation and enthusiasm felt and shared throughout group performance;
- (9) The experience builds meaning and a collective sense of purpose;
- (10) The group desires to repeat the experience;
- (11) Rituals may be established to institutionalize social flow.

In order to organize Walker's (2010) propositions concerning collective flow *indicators*, we selectively grouped some of the twenty-two elements given by this author into an I-P-O model. As such, the graphical representation is ought to provide a systematization of the information in a clear way. Collective flow *indicators* corresponding to the preconditions

are team member focus on intergroup relations and on the task as well as the emergent challenges relevant in the eyes of group members. Core processes include attention drawing directly on team members' focus on intergroup relations and on the task, surrender of the self to the group, and emotional contagion within the group and to the external observers. Among collective flow outputs, we listed the following elements: shared intense absorption and engagement; loss of sense of time; less awareness of self; emotional communication during group work; joy, elation, and enthusiasm; as well as the experience building meaning and collective sense of purpose. The I-P-O model has two feedback loops: the group's desire to repeat the experience, and rituals established to institutionalize social flow. See Figure 3.

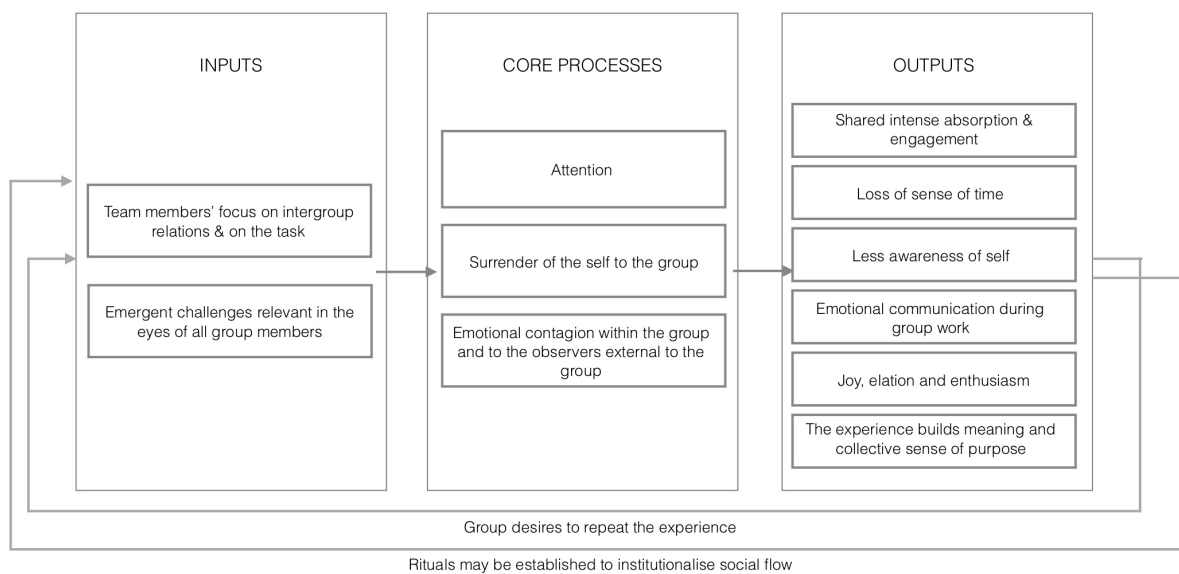


Figure 3. I-P-O selective re-arrangement of Walker's (2010) propositions for collective flow indicators.

All in all, while being quite enjoyable, solitary flow is not as enjoyable as social flow. While discussing the nature of social flow, Walker (2010) wonders if the magnitude of social flow cannot be regarded as the mere sum of the flow experiences of the team members or if there really is an emergent collective phenomenon that does exceed the sum of its constitutive parts – without giving the answer to the question raised.

Expanding the scope to include sports with more than two players, where individual measures are aggregated to the team level, Bakker and colleagues (2011) studied team member flow experience among young soccer players. Environmental resources and particularly performance feedback and support from the coach predicted team level flow during the soccer game, which in turn was positively related to self- and coach- ratings of performance. In conclusion, the results indicate that social support and performance feedback from the coach are important facilitators of flow.

Keeler and colleagues (2015) found that group singing reduces stress and fosters social flow. Zumeta and colleagues (2016) express similar thoughts about how to conceptualize and

measure collective flow. They investigated *shared flow* during collective tambours/drumming (Tamborrada) gatherings for the St. Sebastian's Feast Day in the city of San Sebastian-Donostia, in Spanish Basque Country. With their Shared Flow Scale, that measured flow in the *we* form and that was distributed before, during and after the target event, they found that positive collective gatherings stimulate shared flow experiences and in turn promoted personal well-being and social cohesion. Their results show that shared flow mediates the effect of involvement (importance, intensity, satisfaction, involvement and pride) on well-being and collective efficacy, and to a lower extent, on identity fusion (e.g., "I am one with my group", Gómez et al., 2011) and social integration (e.g., "In my relationships with my group/work colleagues, I feel supported", Richer & Vallerand, 1998).

Ryu and Parsons (2012) investigated social flow in the context of collaborative mobile learning and found that experiencing social flow is positively associated with the mobile learning experience (Peifer et al., forthcoming).

Still in the context of collaboration, Salanova et al. (2014) investigated collective flow in the context of social interactions within groups of five students – the affective experience of flow as a social construct. In their study, the flow experience was examined at the group level as a shared positive experience, occurring when a group is performing at the peak of its abilities (Sawyer, 2003). To understand the dynamics of collective flow, Salanova et al. (2014) approached the phenomenon by crossing the Flow Theory (Csikszentmihalyi, 1975-2000) and Social Cognitive Theory (Bandura, 1997; 2007). According to Bandura's theory, shared beliefs in the group's collective power to do well (collective efficacy beliefs) is susceptible to impact on the way team members apprehend challenges, according to the group skills, and this might in turn lead group members to experience the collective flow (Salanova et al., 2014). Therefore, Salanova et al. (2014) assumed that the collective flow might be a source of future efficacy beliefs. Positing that there are at least two preconditions for collective flow - the challenge-skill balance and collective efficacy beliefs - the authors (Salanova et al., 2014) decided to test this second precondition.

Collective efficacy. Collective efficacy stands for "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1997, p.447). Unlike collective intelligence, which is related to objective performance in several group tasks (Woolley et al., 2010), collective efficacy refers to a shared subjective belief of group members. It is important to know that this collective efficacy (or team efficacy) is a team's perception of its capacity to do well on one given task, and not across various tasks (which corresponds to *team potency*).

Salanova and colleagues (2014) posit that flow experience while performing a certain tasks can predict the efficacy beliefs of future group performance on that task. They attempted to extend the Channel Model of Flow (Csikszentmihalyi, 1975, 1990; Csikszentmihalyi & LeFevre, 1989) – meaning an increase in balance between challenges and skills increasing the likelihood for flow to occur - by introducing the notion of collective efficacy beliefs as antecedents to flow as well as its consequence. Data from their three-week longitudinal study supports the hypothesis that Extended Channel Model of Flow, which adds collective efficacy

beliefs as a predictor of collective flow experiences, does fit the data even better than the original channel model. During the period of three weeks, 52 student groups gathered to work on the development and promotion of a creative project about socio-cultural activities. This included three tasks: a training task to develop the official programme (T0), a task to develop a timetable for an official programme (T1), and a task to design the poster for that event (T2). In terms of measures, Salanova et al. (2014) used collective flow scale (Salanova et al., 2003) measuring absorption and enjoyment and group skill-challenge-balance. Collective efficacy beliefs were measured by averaging individuals' own perceptions of collective efficacy, using the scale developed by Salanova and colleagues (2003). According to their results, teams scoring high on collective efficacy belief measure were found to be more likely to experience flow (both synchronically and over time). Teams that share beliefs in high group efficacy appear to perceive more immediate challenges and report feeling more skilled. In turn, this has an impact on their synchronous experience of collective flow.

When discussing the possible explanations of how flow is distributed among group members, Salanova et al. (2014) take in consideration two psychological phenomena: **emotion contagion theory** and **empathic crossover**.

In the context of teaching music, Bakker (2005) found that job resources have a possible influence on the balance between teacher's challenges and skills which, in turn, contributes to the teacher's experience of flow and crossover from teachers to students through contagion (similar to emotional contagion theory). Although the contagion effect shows that this flow experience is contagious and, thus, becomes collective, the questionnaire items are still formulated at the individual level (Peifer et al., forthcoming).

Emotional contagion. According to Hatfield and colleagues (1993), emotional contagion is defined as the inclination to synchronize and mimic facial expressions, postures, vocal intonation and bodily movements with someone else in an automatic way, which ultimately leads these individuals to converge emotionally. This process is rather unconscious and takes place in an automatic manner (Bavelas et al., 1987; Hatfield et al., 1993; Salanova et al., 2014). The phenomenon of emotional contagion is characterized by: (1) mimicry of facial expressions, vocal productions, postures and movements; (2) proprioceptive feedback from own facial muscles, voice, and posture; and (3) contagion – meaning that people *catch* other people's emotions as if they were germs (Hatfield et al., 1993). Emotional contagion seems to be particularly important in interpersonal relations even when people are not explicitly processing this information. Hatfield and colleagues (1993) propose that as people pay attention to others, they continuously and automatically mimic others emotional expressions. The afferent proprioceptive feedback provoked by this mimicry results in a congruent, simultaneous affective experience (Doherty, 1997). One's susceptibility to experiencing emotional contagion is more associated to affective than to cognitive modes of empathy (Doherty, 1997). Research suggests that emotional contagion significantly influences individual-level attitudes and group processes in social settings: the positive emotional contagion group members experienced decreases conflict, improves cooperation and increases perceived task performance (Barsade, 2002). Catching someone else's good mood and

converging to a pleasant aura as a consequence, is likely to influence a variety of group processes and individual reactions. Mood contagion can be considered a mechanism of information for providing clues about how the group is doing (Frijda, 1988; Barsade, 2002). People are *walking mood inductors*, continuously influencing the moods and then the judgments and behaviors of others (Barsade, 2002). Furthermore, studies show that emotional contagion works only if the source affect is genuine (Hennig-Thurau, et al., 2006). Their findings suggest that the authenticity of a person's smile, rather than the extent of smiling, influences the customer's emotions and perceptions (Hennig-Thurau et al., 2006).

Empathic Crossover. The second phenomenon mentioned by Salanova et al. (2014) is inter-individual transmission of affective states that occurs between two or more people (Bakker et al., 2005). For example, in crossover, stress experienced in the workplace by the individual leads to stress being experienced by the individual's spouse at home (Westman, 2001). Research documents evidence that the following affective phenomena may crossover from one person to another: anxiety (Westman et al., 2004), burnout (Bakker & Schaufeli, 2000; Bakker et al., 2001; Pavett, 1986), depression (Katz et al., 1999; Vinokur et al., 1996; Westman & Vinokur, 1998), dissatisfaction (Westman et al., 2004), and physical health (Jones & Fletcher, 1993). Empathic crossover is also possible for positive emotions such as intrinsic motivation, enjoyment, absorption (Bakker, 2005), and vigor (Westman et al., 2009). Roughly, it is assumed that the emotions expressed by one life-partner elicit an *empathic reaction* in the other partner (Bakker et al., 2005). Sharing one's partner's affect – consciously or unconsciously - by placing oneself in the other partner's circumstances may contribute to the crossing over of positive affective and motivational phenomena, such as work engagement (Bakker et al., 2005). Therefore, Salanova and colleagues (2014) suggest that flow experiences could spread from one member of a group to *infect* another or other members, so that flow becomes a collective social experience.

In his dissertation, van den Hout (2016) aimed to improve the conceptualization of flow as a group phenomenon, to develop a measure of team flow and to empirically relate team flow experience to work outcomes. Defining team flow as “a shared experience of flow during the execution of interdependent personal tasks in the interest of the team, originating from an optimized team dynamic and typified by 7 prerequisites and four characteristics” (van den Hout, 2016, p. 9) team flow involves the simultaneous and collective experience of flow by team members while working for a common team purpose. Van den Hout's prerequisites and characteristics are listed in the figure below (see Figure 4.) where prerequisites are systematized as *inputs* while characteristics of the experience are labeled as *outputs*.

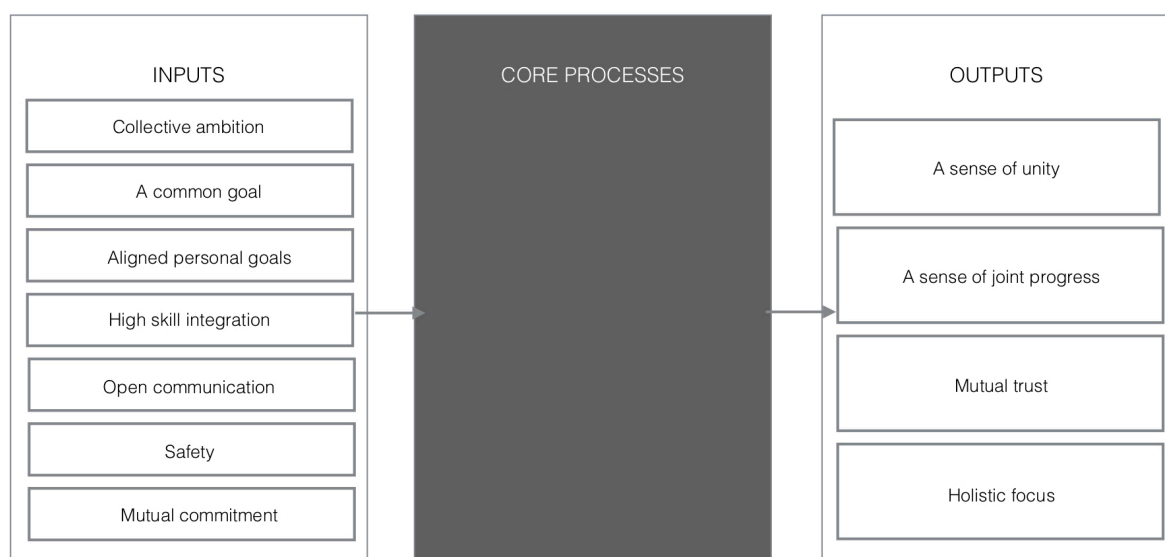


Figure 4. Van den Hout’s (2016) team flow prerequisites and characteristics represented in an I-P-O model.

In the absence of a validated measure of team flow, van den Hout developed *Team Flow Monitor (TMF)* containing 84 items (e.g., item measuring a collective ambition: “we share the same ambition”; item measuring a common goal: “we endorse the established goals”; item measuring aligned personal goals: “personal goals are derived from the common goal”, etc.) investigating the eleven elements of the team flow (see the Figure 4. above). After developing and validating a measuring instrument for team flow (the Team Flow Monitor) on various samples of student project teams of 6 to 8 people, a set of qualitative in-depth interviews was done along with a comparative analysis of 8 case study reports from business teams. The empirical findings from his quantitative studies (Team Flow Monitor survey) support the operationalization of team flow as a second-order model that consists of two factors namely the prerequisites and the characteristics of team flow. Team flow was also shown to correlate positively to measures of positive work experiences, subjective well-being, and team positivity (a type of team-level outcome measured by rating the ratio of negative statements to positive statements in a given team). Qualitative research helped to construct a descriptive model to team flow that depicts its emergence and uncovers how group dynamics conducive to team flow can also facilitate a rise in team performance, intrinsic motivation and positive work experiences. However, impact of team flow on objective team productivity remains unclear.

Based on online survey data, Snow (2010) did research on interpersonal flow, knowledge sharing and organizational commitment (“relative strength of an individual’s identification with an involvement in a particular organization”, Mowday et al., 1979, p. 226) in dyadic collaboration. According to Snow (2010), “interpersonal flow is a state in which two people are mutually engaged in a shared activity such that both individuals characterize the experience as (p. 4)”: (a) having his/her perspective broadened by the other person; (b) feeling a shared sense of identity; (c) not feeling self-conscious with each other (e.g. item, “I

am not worried that my colleague may be evaluating me while we work together”); (d) not worrying about what others think; (e) having total concentration on the shared activity; (f) feeling able to respond almost instantly to presenting situations as a pair (meaning complete and automatic complicity); (g) time passing differently than normal (h) enjoyable and intrinsically rewarding (See Figure 5. below).

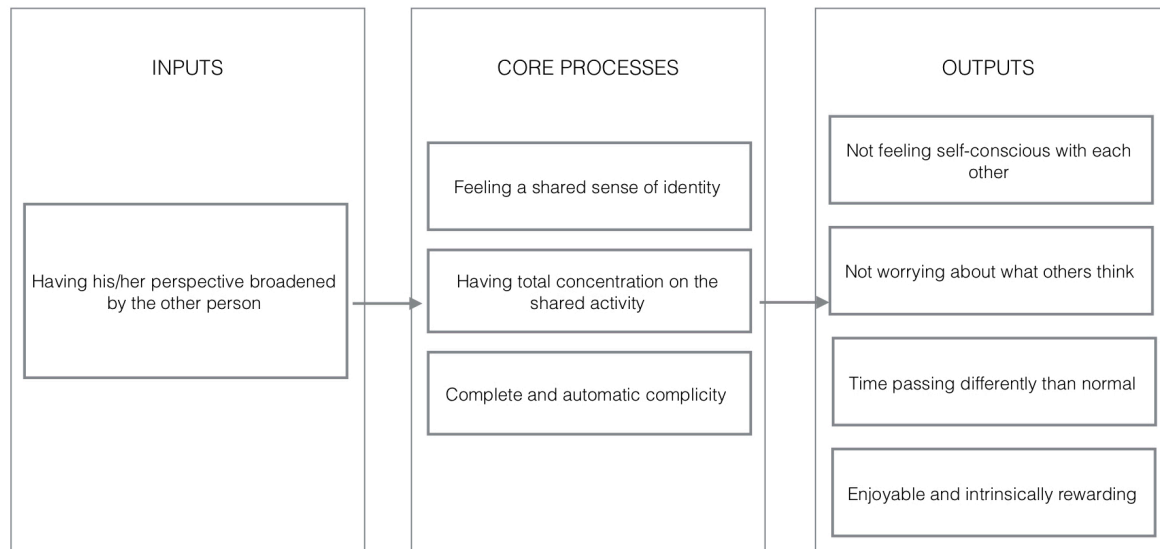


Figure 5. Snow’s (2010) interpersonal flow characteristics sorted out and systematized in an I-P-O model.

Theoretically speaking, Snow’s work is on the crossroads between two theoretical frameworks: Positive Work Relationships Framework which focuses on mutually beneficial, interactive, inclusive and situationally nested relationships between colleagues rather than behavior in and of organizations (Dutton & Ragins 2007) on the one hand, and Flow Theory (Csikszentmihalyi, 1975-2000) on the other. In her dissertation, Snow (2010) tested the conditions for interpersonal flow and characteristics of interpersonal flow in order to provide a model of the subjective experience of positive work relationships and examined the relationships between interpersonal flow experience, organizational commitment, and knowledge sharing. The analysis of her survey revealed that broadened perspective, shared identity, loss of self-consciousness outside the dyad, loss of self-consciousness within the dyad, complete concentration, action awareness, sense of control, time distortion and intrinsic award – are all characteristics of interpersonal flow. Interpersonal flow characteristics and conditions were adapted from Jackson and Ecklund’s (2004) Flow State Scale-2 (FSS-2). These items were restructured to inquire about the perceived experience of the dyad (e.g., items “Our attention is focused entirely on what we are doing”; “My colleague and I take appropriate action without thinking about trying to do so”; “We have a sense of control over what we are doing”, etc.). According to the results, each of the previously proposed interpersonal flow conditions positively predicted the interpersonal flow experience (a) cognitive trust; (b) affective trust, (c) challenge-skill balance, (d) shared goals, (e) feedback.

Moreover, it was shown that interpersonal flow positively predicts knowledge donating and knowledge collecting, organizational commitment (but not after controlling for relationship functions and personality), and finally that the proposed model of the interpersonal flow represents a theoretical conceptualization of positive work relationships and can be used as a measurement instrument for dyadic interpersonal flow. Despite being very interesting and conveying some important correlational results, it is not possible to hold those results as causal because of the survey methodology. In the end, Snow (2010) points out that future research could and should use experimental methods. The author states that future research is required to determine whether the level of challenge in the shared goal is of significant importance or if the positive work relationship impacts the interpersonal flow.

Since the literature on the topic is relatively rare, measurement of the collective flow is far from being consensual. Due to the scarcity of interest, the scholars who have studied collective flow use very different measurement instruments: aggregating individual scores of standard individual measures of flow (e.g., Keeler, 2015), aggregating individual affective proxies of flow (e.g., Walker 2015), reformulating classic measures in *we* form and then aggregating individual scores (Zumeta et al., 2016), and developing own measures of team flow experience (e.g., van den Hout, 2016). For more details about collective flow measures in previous literature, see Table 1. below:

PAPER	HOW THEY MEASURED COLLECTIVE FLOW
MacDonald and colleagues (2006)	ESF, Csikszentmihalyi and Csikszentmihalyi, 1988 – old individual measure
Van Schaik and colleagues (2011)	Guo and Poole’s (2009) measurement model of flow experience in collaborative learning within an immersive virtual environment
Walker (2010)	Rating the level of enjoyment on a 7-point Liker scale and checking what state of being was felt most often: flow, anxiety, boredom or apathy. Joy-Sadness Display Scale, derived from research on emotional expression (Ekman, 1999) was used by external observers.
Bakker (2005)	WOLF – Work Related Flow Scale (Bakker et al., 2001). Individual measure with followings dimensions: absorption, enjoyment, and intrinsic work motivation.
Keeler and colleagues (2015)	Social flow was measured using the Flow State Scale-2 (FSS-2); Jackson et al., 2010, a 36-item questionnaire that assessed individual’s perceived level of flow within a specific event.
Zumeta and colleagues (2016)	The scale measuring shared flow originally derived from the Spanish version of Jackson and Marsh’s Dispositional Flow Scale (1996) and its adaptation by Calvo et al. (2008). This scale was originally developed by Zumeta et al. (2015), was applied by Páez et al. (2015) and Zumeta et al. (2016). The scale

	comprises 27 items distributed across nine dimensions: (1) Balance between challenge and skill; (2) Clear proximal goals; (3) Unambiguous and direct feedback; (4) Action-awareness merging; (5) Focused concentration on the current activity; (6) Sense of control over one's actions; (7) Loss of self-consciousness; (8) Loss of time awareness or time acceleration; (9) Autotelic experience. Seven point Likert scale.
Ryu and Parsons (2012)	The six statements relating to flow experience, adapted from (Park et al., 2010); five-point Likert-scale. Dimensions: cognitive curiosity, intrinsic interest, and risk taking.
Salanova and colleagues (2014)	Collective flow experience was considered a latent factor with two indicators: a group task absorption scale made up of 6 items (Salanova et al., 2003) and a group task enjoyment scale (two self-constructed items adapted to the laboratory task). Also, group-challenge and group-skills were measured as a multiplicative composite with two self-constructed items (on a scale from 0 to 6).
Van den Hout (2016)	Created Team Flow Monitor (TMF-v3) with following dimensions: collective ambition, common goal, aligned personal goals, high skill integration, open communication, safety, mutual commitment, sense of unity, sense of joint progress, mutual trust, holistic focus
Snow (2010)	Items to measure some of the interpersonal flow characteristics and conditions were adapted from Jackson and Ecklund's (2004) Flow State Scale-2 (FSS-2). Because the FSS-2 was written in terms of the individual experience, the items were restructured to inquire about the perceived experience of the dyad.

Table 1. Measures and instruments used to assess collective flow

Overall, we conclude that the awareness of interaction effects among people in relation to flow experiences is increasing, and that there is a growing tendency to measure and investigate flow at the collective level. Reviewing the existing literature, we believe that the research on interpersonal flow lacks broad conceptualization and is therefore limited to individual flow experiences while being part of a collective (e.g., dyad, group). Social flow and its emotional features appear as an emergent issue in flow studies. However, finding measures for assessing interindividual flow, as a group phenomenon without passing through

the aggregation of self-reported data is a major methodological challenge for future research on this topic.

As Walker (2010) noticed, flow in social contexts may qualitatively differ from flow experienced in isolation. “Classic research in social psychology has amply demonstrated that people act, think, and feel qualitatively differently within a group than by themselves” (Allport, 1954; Asch, 1956; Latane & Darley, 1968; Lewin, 1952; Milgram, 1965; Zimbardo, 1969; in Walker 2010, p. 4). Moreover, Sawyer (2003) points out that the approach to the group flow requires attention from social psychology, “and must proceed by examining the interactional dynamics among members during performance” (p. 47) because the group can be in flow even when the members are not; or the group might not be in flow even when the members are. In line with these observations, we believe that the mechanism of the collective flow - psychosocial phenomenon - deserves to be studied from the perspective of social psychology. Therefore, in order to broaden its understanding, in the next chapter, we will offer a conceptual framework of collective flow built upon three pillars: (1) literature from social, organizational and work psychology, (2) existing literature on collective flow and (3) our insights from pilot field studies.

A qualitative synthesis of the existing collective flow literature led us to notice that certain features pointed out by researchers tend to reappear across the field, even though these features are named differently. Taking care to identify these overlapping constructs, we have categorized the salient elements into three groups: (1) features directly drawn from *solitary* flow theory, (2) socially related features that can be indirectly drawn from *solitary* flow theory, and (3) socially related features that are novel and are not mentioned in *solitary* flow theory.

Salient features directly drawn from the classic flow theory:

- Perceived challenges that should be high (Magyaròdi & Oláh, 2015); challenge-skill balance (van Schaik et al., 2011; Salanova et al., 2014)
- Immediateness/clarity of feedback (Magyaròdi and Oláh, 2015); clarity of goals (van Schaik et al., 2011); performance feedback (Bakker et al., 2011)
- Better performance (MacDonald et al., 2006), improved learning (Ryu & Parsons, 2012)
- Absorption & engagement (Walker, 2010)
- Loss of sense of time (Walker, 2010); time passing differently than normal (Snow, 2010)
- Less awareness of the self (Walker, 2010)
- Joy, elation enthusiasm (Walker, 2010); enjoyable & intrinsically rewarding (Snow, 2010)
- Total concentration (Snow, 2010)

Salient socially related features that can be indirectly related to flow theory:

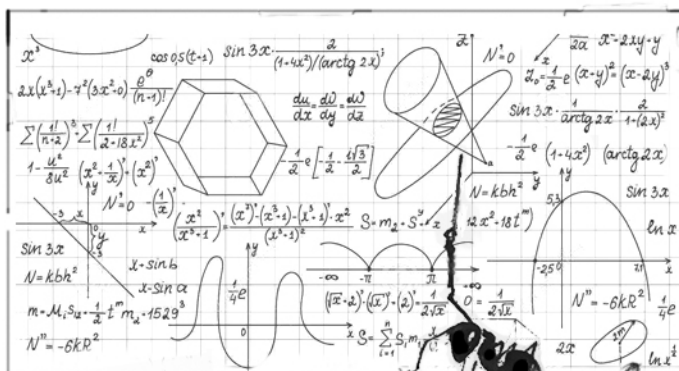
- Parallel processing, attention allocation between task and interpersonal interactions: closely attuned to each other, monitoring other people's actions (Sawyer, 2012); team members focus on intergroup relations & on the task (Walker, 2010)
- Challenges: emergent challenges relevant in the eyes of all group members (Walker, 2010); collective ambition, common goal, aligned personal goals (van den Hout, 2016; van den Hout et al., 2018)
- Feedback: support from the coach (Bakker et al., 2011); authentic leadership (Smith et al., 2012)
- Sense of control: sense of joint progress (van den Hout, 2016; van den Hout et al., 2018)
- Skill related social constructs: collective efficacy beliefs (Salanova et al., 2014); job resources (Bakker, 2005)
- Loss of self-awareness: not feeling self-conscious with each other; not worrying about what others think (Snow, 2010)

Salient socially related features that are novel and are not part of flow theory:

- Level of cooperation (Magyaròdi & Oláh, 2015)
- Shared sense of identity (Snow, 2010), surrender of self to the group (Walker, 2010), identity fusion (Zumeta et al., 2016); sense of unity (van den Hout, 2016; van den Hout, et al. 2018); blending of egos (Sawyer, 2006).
- Empathic crossover (Salanova et al., 2014), emotional contagion (Walker, 2010; Salanova et al., 2014)
- Collective sense of purpose (Walker, 2010), collective ambition (van den Hout, 2016)
- Social integration (Zumeta et al., 2016)

In our opinion, a significant number of these elements deserve to be considered and integrated in a parsimonious sociocognitive model of flow. Consequently, in the next chapter, we propose building such a model, which relies on this literature and our own insights.

CHAPTER 3: Theoretical Model, Research Question and Hypotheses



in theory, this should work...

The synthesis of existing literature has allowed us to identify salient features overlapping across the domain and to accordingly prioritize imbricating and adjacent psychosocial constructs that might be relevant for the study of collective flow. This chapter is dedicated to organizing these elements in a logically coherent system, conceiving and proposing a theoretical model of collective flow, clearly explicating the research question, confronting these to an ecological field reality and finally formalizing the research hypotheses.

Drawing on Flow Engine Framework (FEF, Šimleša et al., 2018) not only in its structure (Input-Process-Output system of representation), but also in its content (individual flow characteristics), we conceived a proposition of a temporary draft-model of collective flow process. This theoretical model has much in common with FEF model of individual flow because the elements of collective flow can possibly be, at some extent, derived from the elements of individual flow (e.g., van den Hout, 2016; van den Hout et al., 2018). However, there are also considerable differences due to its relatedness to sociocognitive group phenomena. Essentially, the draft-model of collective flow shares the same array of inputs, core processes and outputs as the FEF model. Yet, some completely new elements are added in core processes, outputs and in retroaction loops. Also, the substance and nature of the seemingly familiar flow elements, differs from FEF. These elements come from our analysis and selective sorting of salient collective flow cues from literature (see previous Chapter: salient features directly drawn from the classic flow theory, salient socially related features that can be indirectly related to flow theory, and salient socially related features that are novel and are not part of flow theory). For a preview, see the Figure 6. below:

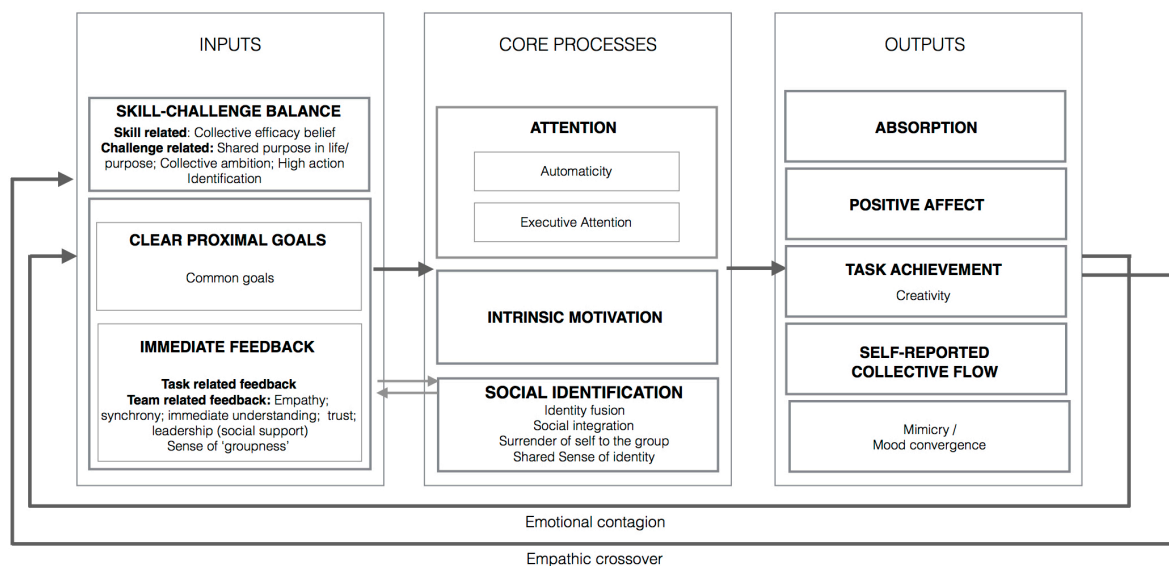


Figure 6. Our proposition of a draft-model of collective flow.

Seeking simplicity and knowing that we cannot possibly capture the whole complexity of the flow experience in social settings, we have made some strategic choices and underlined the elements that seemed as the most promising for the comprehension of this construct. With

the goal of arriving at a parsimonious model, which explains the most part of the phenomenon with the least parameters, the choice was made to focus on few elements and not all of them. These elements are deduced from the literature synthesis and logically represent preconditions and/or core processes of collective flow.

The first salient feature of collective flow that appeared and reappeared in the review of previous research is linked to adequately emitting and receiving social signals. Observing jazz bands in Chicago, Sawyer (2003) observed that there is a particular need for listening what the other does, feeling what the other feels and predicting what the other will do in the following musical measure. As they are playing together in an extremely interdependent task, musicians are obliged to carefully listen what the other band members do and to respond immediately. Complete and automatic complicity mentioned by Snow (2010) in her dissertation also suggests a necessity for cognitive, affective and behavioral synchrony, which directly depends from listening and understanding the other person. Moreover, Salanova and colleagues (2014) suggest that flow experiences could possibly spill over from one person to another thanks to the mechanism of crossover - consciously or unconsciously placing oneself in the other's person's shoes. Similar to the crossover phenomenon, we have also noticed similarities between emotional contagion (Walker, 2010; Salanova et al., 2014), high attention to teammates (Walker, 2010), emotional communication during group work (Walker, 2010) and immediateness/clarity of feedback (Magyaròdi and Oláh, 2015) – all suggesting that, when it comes to collective flow, we need social skills/dispositions linked to **empathy** in order to make it happen.

The second notable feature of collective flow that came into our sight corresponds to group members' relation towards the task at hand, the way they define it, perceive it, feel it and how important it is for them. Talking about *the experience building meaning and a collective sense of purpose*, Walker (2010) is the first to draw the attention to the ambition and meaningfulness of the task. Later, van den Hout (2016; van den Hout et al., 2018) develops on collective ambition (vision, abstract), a common goal (objective, tangible) and aligned personal goals, pointing out that the definition of the target of the group efforts is the first necessary and irreplaceable precondition for the team flow. Ambitious goal, which is challenging, motivating and playful for the whole group, but also bearer of higher purpose (the *why* of the common action) made us think of **high action identities**. Therefore, we suggest digging deeper into this second construct as well.

The third striking aspect of collective flow, which we noticed, touches the idea of *being one* with own teammates. Walker (2010) talks about surrendering of self to the group, as well as Sawyer (2006) who discusses the necessity of ego blending in collective flow. Furthermore, van den Hout (2016; van den Hout et al., 2018) develops on this one as a sense of unity, while Snow (2010) speaks of feeling a shared sense of identity in flowing pairs. All these similar or overlapping observations from the collective flow literature point at a phenomenon that might correspond to **the process of social identification**, the psychosocial glue which transforms a bunch of individuals into a full-fledged group. As a result, we estimate that this notion and its link to collective flow should be further developed and tested.

Just like for individual flow, we opted for an I-P-O (Inputs – Processes - Outputs) framework because this type of scheme seems very useful to study causal relationships in the context of empirical experimental research and is good for assessment of functional mediational and moderational mechanisms of psychological processes. Collective flow inputs are represented in the first box. Among those, we can find **empathy** and **action identification**. These variables represent the necessary collective flow preconditions. Further, the second box contains processes, which are mediator and moderator variables for the collective flow, among which we can spot **social identification**. Finally, the last box contains what we call *collective flow outputs* – the consequences and products of the whole process: absorption related phenomena, positive affect, subjective and objective task achievement, and possibly mimicry (but we will not develop on this one).

For the purpose of further exploration of the phenomenological reality of collective flow across different life domains, as well as the relevance of certain elements identified as pertinent for the functional mechanism of collective flow, we have decided to gather some qualitative and quantitative exploratory field data: online and face-to-face. Accordingly, in the following section, we will report on two preliminary exploratory studies.

Preliminary exploratory studies

In order to gain familiarity with the phenomenon of collective flow and establish further research priorities, we began to explore the concept throughout several exploratory and/or descriptive studies mixing research methodologies: online survey and case study. These studies served as a complementary material to our literature review, as they allowed us to acquire new insights helping to direct later research and improve its design. The results acquired via exploratory and descriptive studies helped us in formulating relevant hypotheses for more in-depth experimental investigation that followed. The following section which precedes the hypothesis formulation resumes two exploratory/descriptive studies: a general public online survey, and a case study from SBT Human(s) Matter's client.

EXPLORATORY STUDY N°1

Online Survey about Solitary & Collective flow

Goals of the exploratory study. In his exploratory survey about the social flow, Walker (2010) asked his respondents to report on activities where they experienced shared flow. Disclosed activities included: playing soccer on a great team, joining a jam session at their neighborhood jazz club, eating, drinking and talking with friends, exchanging and laughing with friends, having sex with their lover, playing a game of pickup basketball, acting in a play on a night when everyone is on, having a heart-to-heart with a close friend, singing in a choir, ballroom dancing (Walker, 2010). However, there was no indication about the frequency of these experiences or a comparison to that of solitary flow in similar settings.

Simultaneously as Magyaròdi & Oláh (2015) study, which was in press at that time, we have attempted to conduct a very similar exploratory study in order to investigate the phenomenological consistency of collective flow and compare it with that of individual flow. The aim of their survey was to reveal the most common activities where people experience flow in individual or social settings. The goal of the study was to gather more information concerning the domains where people experience solitary and collective flow, their frequency and to deepen our insights about flow-inducing activities by providing the possibility of open-ended questions. Finally, the last goal of this study was to compare the frequency of solitary versus collective flow across different domains.

Participants. Participants were French-speaking adults of all ages and professions. The questionnaire was run as an online *Typeform* survey with a free access. The survey link was distributed via social networks and respondents could share the link with their own network. A total of 167 participants (77 male and 90 female) with an average age of 32.95 years (SD = 9.99) answered the survey. The average completion time was three and a half minutes approximately.

Materials. After following a hyperlink shared via different social networks (LinkedIn, Facebook, Slack) participants arrived to *Typeform* online survey platform presenting an anonymous questionnaire on a minimal-design interface (see Figure 7. below). As the *Typeform* questionnaire is interface-responsive, it was possible to provide answers from PCs, laptops, smartphones, tablets or any other connected devices.

Bonjour! Merci de consacrer quelques minutes pour répondre à notre enquête.

Cette enquête est complètement anonyme et confidentielle.

start Appuyez sur ENTER

1 → Le flow est un état psychologique dans lequel on est totalement absorbé par son activité, on perd la notion du temps et on oublie tous ses soucis. On est bien, on ne veut pas s'arrêter. Avez-vous déjà vécu cet état?

2 → Le flow collectif est un état qui se manifeste lorsqu'un groupe agit comme un tout. Les membres du groupe sont absorbés dans l'activité collective, se coordonnent efficacement et se sentent bien ensemble. Avez-vous déjà vécu cet état?

3 → Lors d'une activité artistique: *
(ex: jouer dans un orchestre, chanter dans un choral, danser à plusieurs, etc.)

4 → Lors d'une activité sportive: *
(ex: football, basket, rugby, volley, etc.)

5 → Votre catégorie socioprofessionnelle: *
(Les catégories d'INSEE)

6 → Votre secteur d'activité: *

0 sur 17 questions

0 sur 17 questions

0 sur 17 questions

Figure 7. Typeform interface for this survey study.

Procedure. After reading descriptions of solitary and collective flow, participants were asked to indicate the frequency of the experience in different domains of everyday life. The close-ended survey items were followed by open-ended questions, where participants could add and report on flow-inducing activities that were not included in the close-ended part of the questionnaire.

The first part of the questionnaire concerned the experience of solitary flow. The following descriptive definition of flow was displayed to respondents in order to familiarize them with the nature of flow:

The flow is a psychological state in which the one is totally absorbed in her/his activity, losing the sense of time and forgetting her/his worries. Feeling good, no desire to stop. Have you already experienced this state? (Loose translation from French)

The items were to be answered on a 7-point Likert scale ranging from *never* (1) to *always* (7).

- During an artistic activity (e.g., playing music, singing, drawing, painting, dancing, etc.)
- During a sports activity (e.g., running, hiking, yoga, ski, gym, swimming, diving, etc.)
- During a play (e.g., playing video games, crossword puzzle, reading, listening to

- music, etc.)
- During work (e.g., manual work, data analysis, writing a report, preparing a PowerPoint, etc.)
- During daily activities (e.g., cooking, cleaning, gardening, tinkering, shopping, etc.)
- Other (please specify)

The second part of the questionnaire concerned the experience of collective flow. The following descriptive definition of collective flow was presented to respondents in order to familiarize them with the nature of it:

The collective flow is a state manifesting when a group acts as a whole. The members of the group are absorbed in the common activity, are coordinating efficiently and feel good together. Have you already experienced this state?
(Loose translation from French)

Here again, the items were to be answered on a 7-point Likert scale ranging from *never* (1) to *always* (7).

- During an artistic activity (e.g., playing in an orchestra, singing in a choir, dance in a group, etc.)
- During a sports activity (e.g., football, basketball, rugby, volleyball, etc.)
- During a play (e.g., multiplayer video game, board game, card game, etc.)
- During work (e.g., work meeting, collaborating with a colleague, etc.)
- During daily activities (e.g., take care of the children, arranging a holiday trip with a partner, shopping together, etc.)
- During convivial activities (e.g., chat with friends, family meal, etc.)
- Other (please specify)

The third, and the last part of the questionnaire concerned the demographic questions: age, sex, business segment and occupational category.

Results

Descriptive results. Survey participants originated from all major business segments established by INSEE nomenclature (French National Institute of Statistics and Economic Studies) and all industry lines. Each segment was represented by at least one respondent. However, the sample was not completely representative of French population because it was biased in favor of two sectors to which we had particular accessibility: Audit-Consulting-HR, and Education-Teaching-Research. For more detail, see Table 2. below:

BUSINESS SEGMENT	N
Audit – Consulting – Human Resources	38
Education – Teaching – Research	38
Healthcare – Social work – Well being	15
Architecture – Construction industry	13
Without activity – Retired – Student	10
Information Technologies – IT	9
Performing arts – Broadcasting – Culture – Heritage – Crafts	8
Communication – Advertising	8
Civil service	4
Telecommunication	4
Chemical industry – Platurgy – Pharmaceutical industry	3
Trade – Retail – Distribution	3
Hospitality – Restoration – Upkeep – Servicing – Maintenance – Transport – Logistics	3
Electronics – Electrotechnical industry	2
Law – Justice	1
Energies and extraction	1
Car - automotive – Shipbuilding – Railway – Aerospace	1
Wood – Furniture – Paper – Cardboard – Glass – Concrete – Ceramics	1
Environment	1
Mechanics – Machinery – Metalwork	1
Fashion and textile industry	1
Press – Publishing – Printing	1
Sports – Leisure – Tourism	1

Table 2. Sample characteristics across business segments.

Almost all occupational categories from INSEE’s PCS-1982 nomenclature (Desrosières et al., 1983) were represented in the sample except *farmers*. Evidently, the sample was not representative of French population because it was biased in favor of two occupational categories to which we had particular accessibility: Executives/Intellectual Professions, and Students. For more detail, see Table 3. below:

OCCUPATIONAL CATEGORY	N
Executive, intellectual profession	99
Student	39
Employee	9
Craftsperson, retailer or business executive	6
Other individuals without professional activity	5
Intermediate profession	5
Labourer (blue collar)	2
Retired	2
Farmer	0

Table 3. Sample characteristics across occupational categories

Quantitative data. On average, respondents reported experiencing individual flow mostly during play ($M = 5.52$, $SD = 1.47$) and work ($M = 4.97$, $SD = 1.53$). The average experience of solitary flow during artistic ($M = 4.88$, $SD = 1.95$) and sports ($M = 4.87$, $SD = 1.71$) activities was also high, while the flow in everyday activities was somewhat less frequent ($M = 4.17$, $SD = 1.74$) (see Table 4 and Figure 8.).

ACTIVITY DOMAIN	M	SD
Play	5.52	1.47
Work	4.97	1.53
Artistic activity	4.88	1.95
Sports activity	4.87	1.71
Daily activity	4.17	1.74

Table 4. The Frequencies of the Mentioned Solitary Flow in the Sample.

In social settings, flow was mostly felt in convivial context ($M = 5.26$, $SD = 1.47$). Similarly to solitary flow experience, on average, respondents report frequent experience of collective flow during play ($M = 4.74$, $SD = 1.88$) and work ($M = 4.38$, $SD = 1.69$). The reported average experience of collective flow during sports ($M = 4.19$, $SD = 2.13$) is moderate, while the collective flow in artistic ($M = 3.96$, $SD = 2.17$) and everyday ($M = 3.89$, $SD = 1.89$) activities is somewhat less frequent (see Table 5 and Figure 8.).

ACTIVITY DOMAIN	M	SD
Convivial activity	5.26	1.59
Play	4.74	1.88
Work	4.38	1.69
Sports activity	4.19	2.13
Artistic activity	3.96	2.17
Daily activity	3.89	1.89

Table 5. The Frequencies of the Mentioned Social Flow in the Sample.

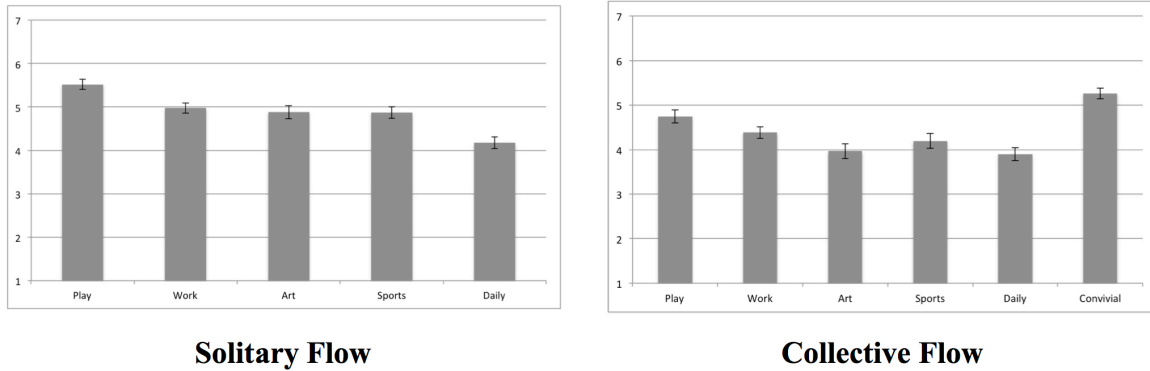


Figure 8. Average frequencies of solitary and collective flow experience across domains

In order to compare the frequency of solitary versus collective flow experience across different settings, we ran a 2 (Flow: solitary versus collective) x 5 (Activity: play, work, art, sports and daily activities) ANCOVA with sex as covariate. We examined for the main effect of the Flow (solitary versus collective), the main effect of the Activity (play, work, art, sports, daily), and interaction effects (Flow * Activity).

Results show that there is a main effect of Flow Variable $F(1, 165) = 42.24, p < 0.001, \eta^2 p = 0.219$. The Flow experience is significantly more frequent in Solitary activities ($M = 4.89, SD = 0.08$) than in Collective activities ($M = 4.24, SD = 0.10$).

Also, there is the main effect of the variable Activity $F(4, 660) = 3.71, p = 0.005, \eta^2 p = 0.022$, showing that the activity most likely to trigger Flow is Play ($M = 5.13, SD = 0.11$), then Work ($M = 4.68, SD = 0.11$), Sport ($M = 4.53, SD = 0.13$), Art ($M = 4.42, SD = 0.14$) and finally Daily activities ($M = 4.04, SD = 0.12$).

Next, we found an interaction effect between Flow and Activity ($F(4, 660) = 3.016, p = 0.018, \eta^2 p = 0.018$) showing that the influence of Activity differs between Solitary and Collective Flow (Table 6). In particular, we may mention that Solitary flow is more frequently experienced than Collective flow, except in daily activities, for which the difference is not significant.

ANCOVA (sex as covariate)					Descriptives			
Variable	df	F	p	$\eta^2 p$	Solitary Flow		Collective Flow	
					M	SD	M	SD
Art	1, 331	17.29	< 0.001	0.050	4.88	1.95	3.96	2.17
Sport	1, 331	10.413	0.001	0.031	4.87	1.71	4.19	2.13
Play	1, 331	17.730	< 0.001	0.051	5.52	1.47	4.74	1.88
Daily	1, 331	2.019	0.156	0.006	4.17	1.74	3.90	1.89
Work	1, 331	11.187	< 0.001	0.033	4.98	1.54	4.38	1.70

Table 6. ANCOVA results comparing solitary and collective flow across domains.

Qualitative data. In their answers to open-ended questions (specifying other flow-inducing activities), participants mostly reported experiencing solitary flow when travelling or moving in a vehicle (14.55%) and while praying or practicing meditation (9.09%). Other less common answers included: task planning, IT coding, playing with a cat and daydreaming. When reporting on collective flow experience, two salient topics appeared: talking, partying, and spending time with friends, family and children (30.91%), and making love – spending intimate time with their partner (16.36%). Besides these two, other more rare flow-inducing social activities included: going to theatre, house renovation, dispute, militant activism, etc.

Discussion

The results of this exploratory survey helped us gain certain amount of familiarity with the concept of collective flow experience. This survey yielded several interesting and notable results. The first result is that the collective flow seems to exist in the repertoire of the psychological phenomena, is experienced and identified among this sample. Therefore it is worth of studying, as the experience is real. However, the occurrence of collective flow seems to be significantly less frequent (not rare, just less frequent) than that of individual flow: in artistic activities, sports, play and work. The second result is that both solitary and collective flow are most frequently experienced in work and play, with the exception of convivial activities, which are the *par excellence* contexts for collective-flow experience. The slightly surprising finding that collective flow is quite often reported as being experienced in the workplace supports and strengthens our interest in furthering the research on collective flow applied to organizational settings. Also, the finding that collective flow is most common during convivial and play activities draws our attention to possibilities of turning work environment into humanly warmer, convivial places.

EXPLORATORY STUDY N°2

Case Study with SBT Human(s) Matter's Client

The context and objectifs of workshop

The present study took place during the second *Sym'Diagora* annual meeting of global leadership team of Diana and Symrise during three days in a SPA resort, Quiberon, Bretagne, France (29th September – 1st October 2015). Symrise is a major producer of flavors and fragrances (chemicals industry), while Diana Group is one of the leading manufacturers of natural flavors and the number 1 for pet food solutions (acquired by Symrise in 2014). In order to activate better synergies between the two merging entities, this conference aimed to mix and unite managers from Symrise (fewer) and managers from Diana (more numerous, Diana Food section, Diana Pet Food section and Diana Nova section).

The main objective of this annual meeting was “to engage Diana managers into new ambition (Turn people into ambassadors of the New Ambition, ready to act for the achievement of this Ambition and to lead their team in this journey)”. This new ambition of Diana was to *differentiate*, ambitiously, consumer-aware and in a successful synergy with Symrise. This objective was operationalized through series of presentations, tasks and workshops that were organized by Symrise and Diana in collaboration with SBT Human(s) Matter³ during three days.

Day one. The first day, participants attended presentations of each Diana-Symrise division, the new business ambitions, and strategies; keynote presentations, speeches and conference-like formal talk with a content presenter and the sitted audience. The audience had the opportunity to interact with the presenter via a custom made mobile app by answering some survey questions that appeared throughout the day.

Day two. On the second day, presentations were held exposing some internal differentiation examples from Diana-Symrise. Afterwards, during the first workshop (WS *Inspire*) the participants were asked to examine 11 external differentiation cases in spontaneously formed groups of 9-10, in order to prepare 1 minute presentation of the differentiation strategy of the case in question (every group had a different one). The third and the last activity was another workshop (WS *Create*) where the participants were divided in 10 preconceived groups in order to imagine and develop an inovative project that fosters Diana differentiation. This task was competitive such that the winning project gained an opportunity of funding. The project was to be written and handed in on the end of the session.

Day three. Finally, on the last day, the ten groups were to present their project in ten minutes, in front of the auditorium and evaluation board. After a brief pause for deliberation,

³ OSE Consulting at that time.

the winner was announced.

Participants. Ninety five participants took part in the workshop number two *Create* (26 women). All participants were company's employees, came from all across the world, but all spoke fluent English. Within the company, they had management or top management roles, but their specific functional roles differed: research and development, sales, business development, human resources, etc. Participants were divided into ten teams of 9-10 people (5 teams of 10 and 5 teams of 9). As the women were the minority, we ensured that each team had at least two or three female participants.

Procedure.

Tasks and material. The task of workshop 2, *Create*, consisted in: first, *brainstorming, creating, imagining, being bold*, second, *choosing, precisising, being serious* and finally *preparing a cool presentation*. The two productions of this work were: the written form and the oral form. Written product consisted in filling up a very simple written support that was provided with these guidelines. On the other hand, the oral product consisted in making the jury understand what the group proposes in their project. Each group had 10 minutes to present their work in front of the jury and other groups. Powerpoint presentations were strictly forbidden, but professional help of three illustrators (cartoon artists) was available to the groups.

Timing. The groups were given three hours to accomplish this project.

Creative productions and outcomes.

Evaluation. The evaluation was done in two times: first, the evaluation of written project report, and secondly the evaluation of the oral presentation. For the first phase, the eight-person jury consisted of Diana-Symrise top-managers. The jury members were supposed to rate the projects on 5 dimensions: (1) differentiation power, (2) activation power, (3) synergy power, (4) level of fun and originality, and (5) feasibility. This resulted in three distinct measures of performance: grade before orals, grade after orals and final rank. The two first measures were aggregated ($\alpha=0.928$), and the third was inversed in order to transform rank into points.

Questionnaire. At the end of the day, all participants of the workshop received an online link to a short self-reported questionnaire aiming to assess their subjective experience of the collaboration in the groups. Instead of using full validated measures of situational flow experience (e.g., FSS-2, Jackson et al., 2010) we opted for a three-item affective proxy. This was done in order to make the questionnaire as short as possible because the participants did not have much time to answer questions and because the context of the study was such that research intervention was not the primary goal of the event. Forty-six out of 95 participants answered and submitted their survey answers (48.42% response rate). The questionnaire was composed of:

- Social identification score : SISI – Single-item Social Identification Scale “I identified with my group” (Postmes et al., 2013), with 7-point Likert scale and another item “I feel proud to be a member of my group”. These two items were aggregated in one single score ($\alpha = 0.861$)
- One item assessing the level of task challenge “The task that we did was very easy-difficult”, with 7-point Likert scale (1 corresponding to *very easy* and 7 corresponding to *very difficult*).
- One item assessing the empathetic allocation of attention to ingroup interactions “When working together, in our group, there was a high level of attention to each other”, with 7-point Likert scale.
- A 3-item flow experience affect measure (“When working in my group, I felt : focused, alive, pleased”), with 7-point Likert scale for each affect. These 3 items were aggregated into one single score ($\alpha = 0.776$).
- One item assessing the self-evaluation of team performance (“How satisfied are you with the work your group did”), with a 7-point Likert scale.

Results

Individual Level Analysis. Individual self-reported data was analysed through multiple linear regressions in order to gain an insight about what aspects of individual experience predict flow and self-rated performance.

What does predict Flow? We performed regression analysis with individual team member scores of flow experience as a dependent variable and group identification, perceived challenge, and group empathy as independent variables. The results show that group identification ($t = 3.402$, $p = 0.002$, $\beta = 0.105$) and perceived empathy ($t = 3.810$, $p < 0.001$, $\beta = 0.101$) are significant predictors of flow experience of group members. The perceived challenge ($t = -0.092$, $p = 0.927$, $\beta = 0.120$) of the common task does not seem to predict the experience of flow in group members. The variation explained by the model is $R^2 = 0.430$ (see Table 7.).

Model		Unstandardized	Standard Error	Standardized t	p
1	intercept	1.247	1.119	1.115	0.272
	Group Identification	0.358	0.105	0.435	3.402 0.002
	Perceived Challenge	-0.011	0.120	-0.012	-0.092 0.927
	Perceived Empathy	0.385	0.101	0.470	3.810 < .001

Table 7. Multiple regression to predict flow experience.

What does predict Self-rated Performance? We performed regression analysis with individual team member scores of performance as a dependent variable and group identification, perceived challenge, perceived empathy and flow experience as independent variables. The results show that flow experience ($t = 4.947$, $p < 0.001$, $\beta = 0.186$) is a significant predictor of self-rated performance. The group identification ($t = 0.859$, $p = 0.396$,

$\beta = 0.138$), perceived challenge ($t = 0.753$, $p = 0.456$, $\beta = 0.138$) and perceived empathy ($t = 1.114$, $p = 0.272$, $\beta = 0.137$) do not predict self-rated performance. The variation explained by the model is $R^2 = 0.612$ (see Table 8.).

Model		Unstandardized	Standard Error	Standardized t	p
1	Intercept	-1.528	1.307	-1.169	0.250
	Group Identification	0.118	0.138	0.105	0.396
	Perceived Challenge	0.104	0.138	0.081	0.456
	Perceived Empathy	0.152	0.137	0.135	0.272
	Flow Experience	0.922	0.186	0.671	4.947 <.001

Table 8. Multiple regression to predict self-rated performance.

Group level analysis. After having performed the individual level analysis and having seen how the self-reported factors relate to each other, we have decided to do group level analysis as well. This was done by aggregating average individual self-reported data and combining them with team performance measures (team grade and final team rank).

What does predict Flow? We performed regression analysis with aggregated team member scores of flow experience as the dependent variable and aggregated scores of group identification, aggregated scores of perceived challenge, and aggregated scores of perceived empathy as independent variables. The results show that perceived empathy ($t = 2.477$, $p = 0.048$, $\beta = 0.171$) is a significant predictor of flow experience. The aggregated group identification ($t = 1.419$, $p = 0.206$, $\beta = 0.201$) and perceived challenge ($t = 0.068$, $p = 0.948$, $\beta = 0.298$) do not predict collective flow experience. The variation explained by the model is $R^2 = 0.618$ (see Table 9.).

Model		Unstandardized	Standard Error	Standardized t	p
1	intercept	1.226	2.197	0.558	0.597
	Group Identification	0.285	0.201	0.381	0.206
	Perceived Challenge	0.020	0.298	0.018	0.948
	Perceived Empathy	0.425	0.171	0.633	2.477 0.048

Table 9. Multiple regression to predict the aggregate team level flow experience.

What does predict performance?

Grade. We performed regression analysis with team grade (aggregate grade before orals and after orals, $\alpha = 0.928$) as the dependent variable and aggregated scores of group identification, perceived challenge, perceived empathy, and flow experience as independent variables. The results show that none of the variables predicted the team performance (group identification $t = 1.480$, $p = 0.199$, $\beta = 0.149$; perceived challenge $t = -0.779$, $p = 0.471$, $\beta = 0.191$; perceived empathy $t = 0.025$, $p = 0.981$, $\beta = 0.156$; flow experience $t = -0.227$, $p = 0.829$, $\beta = 0.261$). The variation explained by this insignificant model is $R^2 = 0.464$ (see Table 10.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	2.846	1.443		1.973	0.106
	Group Identification	0.220	0.149	0.596	1.480	0.199
	Perceived Challenge	-0.149	0.191	-0.268	-0.779	0.471
	Perceived Empathy	0.004	0.156	0.012	0.025	0.981
	Flow Experience	-0.059	0.261	-0.121	-0.227	0.829

Table 10. Multiple regression to predict the group performance (measured by the grade).

Final Score. Next, we performed regression analysis with team’s final score (group rank inversed: e.g., 1=10, 10=1) as the dependent variable and aggregated scores of group identification, perceived challenge, perceived empathy, and flow experience as independent variables. The results show that none of the variables predicted the team final score (group identification $t = 1.378$, $p = 0.227$, $\beta = 1.437$; perceived challenge $t = -0.139$, $p = 0.895$, $\beta = 1.842$; perceived empathy $t = -0.312$, $p = 0.768$, $\beta = 1.508$; flow experience $t = -0.321$, $p = 0.761$, $\beta = 2.525$). The variation explained by this model is $R^2 = 0.354$ (see Table 11.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	2.603	13.938		0.187	0.859
	Group Identification	1.980	1.437	0.609	1.378	0.227
	Perceived Challenge	-0.256	1.842	-0.053	-0.139	0.895
	Perceived Empathy	-0.470	1.508	-0.161	-0.312	0.768
	Flow Experience	-0.811	2.525	-0.187	-0.321	0.761

Table 11. Multiple regression to predict team’s performance (final score).

Discussion

This exploratory study yielded few interesting results, which fuelled our further reflexions and directed our attention towards some promising paths for ulterior studies aiming to demystify the mechanism of optimal collaboration in small groups. The results of individual level analyses showed that perceived empathy and group identification predicted flow and that flow experience, in turn, predicted self-rated performance.

Empathy proxy or attention allocation to ingroup relations (measured by the item “When working together, in our group, there was a high level of attention to each other”) revealed to be predictive of the flow experience on the aggregate team level as well. The intuition that there is some kind of parallel processing in the attention allocation between task and interpersonal interaction, suggested both by Sawyer (2003) and Walker (2010), in collective flow, seems to reappear in our quantitative field case study. Therefore, we consider that this concept of empathic attention, the close attuning to each other (Sawyer, 2003), is worth of further, more systematic and rigorous examination.

Possibly triggered by empathy (this is an assumption because our actual data do not properly measure empathy), in turn, the flow experience of individual team members exhibited a significant predictive power on self-rated performance. This finding supports our theoretical assumption that the flow in social settings (see Figure 6. *Our proposition of a draft-model of collective flow*) results in positive affect, and thus generates team’s desire to repeat the experience.

On a group level, nothing seemed to predict the performance (group grade or the final rank). Relative imperfection of our design, as well as the lack of psychometrical robustness to our measures encourages us to continue to believe that collective flow is a process conducive to increased performance as well as to continue examining the relationship between the two. The same is true for the *perceived challenge*, which did not turn out to be that important for the flow nor for performance. Measured as a *level of task difficulty*, it is possible (if not certain) that the validity of this item is disputable and does not really capture the appeal and the ambition of the common goal.

This exploratory study is of a great value to us because of its hyper-ecological character. Sample, context, task and the circumstance of the study had, undoubtedly, its methodological limitations (difficult to control and isolate variables outside the laboratory framework), but on the other hand had some priceless advantages. Carrying out a study on the sample that is actually the target of this dissertation's commercial application by SBT Human(s) Matter, is certainly a great asset and contributes much to directing the further research work in this research project.

Our theoretical model and hypotheses

Thanks to these two explorations, we may conclude that the collective flow is a real phenomenon, experienced by people in all life domains, less frequent than solitary flow, but nevertheless remarkably present in convivial activities, play and work. Group identification and perceived ingroup empathy revealed as flow predictors in the context of creativity workshop, while flow appeared as a predictor of self-rated performance. On the whole, the results of these two preliminary exploratory studies reinforced our intuition to pursue the study of collective flow.

Given the scientific and industrial (business) importance of understanding conditions under which employees happily exhibit the peak of their creativity in an utmost motivating but also sustainable way (*Chapter 1*); taking into the account the scarce but growing scientific literature about it (*Chapter 2*) and considering the promising results of our preliminary studies (see the previous section), we are brought to the following research question for this dissertation:

How to stimulate the collective flow in order to increase group productivity and group well-being at the same time?

With the goal of challenging our theoretical draft-model of collective flow, affronting it to quantitative data, our aim is to answer the question what conditions do promote and boost the experience of collective flow. This examination consists in several empirical studies designed to carefully test and verify our theoretical model (see Figure 9. below).

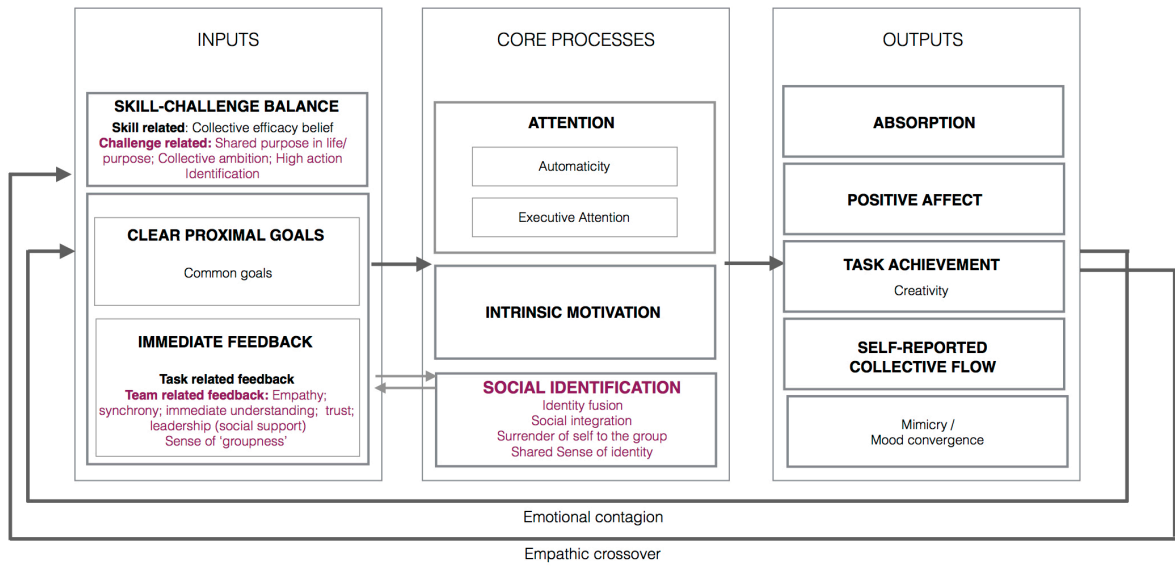


Figure 9. Our proposition of a draft-model of collective flow

As the literature indicates and the results of the field study confirm, the team related immediate feedback consisting in emitting and receiving socially relevant cognitive, emotional, motivational and behavioral stimuli is likely to play an important role in the mechanism of collective flow. This brings us to our first hypothesis concerning **Empathy**:

H1: Empathy of group members fosters the collective flow

Consequently, the first empirical chapter (*Chapter 4*) will be dedicated to examining this hypothesis. A series of three studies (a pilot experiment, a large correlational study and a field study) will be presented as our means to verifying the general H1.

Compelled and intrigued by the amount of research which is theoretically suggesting that team’s challenge, when shared and formulated in the right way, is conducive to collective flow, we definitely wanted to test this empirically. In addition to research literature inputs, one more motivation for pursuing this examination came from SBT’s consulting practice – a technique based on Simon Sinek’s (2009) *always start with a Why*. This rule of the thumb consists in always starting a group discussion, idea generation session or a project with explicitly and purposefully asking oneself *Why do I do this?* In such a way, the person or the team is obliged to carefully formulate the ambition, which represents the *big picture*. Overlapping with the literature review insights, this made us think of **Action Identification Theory** (Vallacher & Wegner, 1985, 1987) and the hierarchy of task meanings that people ascribe to what they are doing. This brings us to our second hypothesis:

H2: High Action-Identification fosters the collective flow.

Therefore, in our second empirical chapter (*Chapter 5*) we will elaborate on this theory and present two studies (a laboratory experiment and a field study) aiming to test the general H2.

Our third assumption arising from the previous research on collective flow and our second preliminary study concerns **Social Identification**, the collective feeling of *groupness* where individual egos blend and become *one* in order to perform a shared task seamlessly and effortlessly. This brings us to our third hypothesis:

H3: Social identification fosters the collective flow

Ergo, the third and the fourth empirical chapters (*Chapter 6* and *Chapter 7*) will present three experiments (two face-to-face and one online study), which attempt to test the general H3.

All the theoretical and conceptual explanations of these three notions (**Empathy**, **Action Identification**, and **Social Identification**) will be presented in their corresponding chapters.

In the following chapter, as previously noted, we aim to test our first hypothesis concerning the impact of **empathy** on the collective flow.

CHAPTER 4: Empathy, Theory of Mind and Collective Flow



I know how you feel bro

Based on our field observations and a literature review, we have a reason to believe that facilitating social skills of group members or/and creating groups composed of individuals that dispose of higher social capacities would facilitate an effective and pleasant group collaboration. So, in this chapter, we aim to examine the impact of the capacity to take someone else's perspective on the collective flow (**H1: Empathy of group members fosters the collective flow**). After clarifying the concepts and vocabulary - such as empathy, emotional intelligence and theory of mind (ToM) / mentalizing - used in the beginning of the chapter, we will present a small-scale experimental pilot study and a larger-scale study testing our hypotheses. Further in the chapter, we will also describe an applied field study (very heterogeneous sample), which attempted to challenge and further extend our results in a complex, ecological environment of a two-day hackathon. At the end, we will discuss and attempt to interpret our findings as well as propose future perspectives for research in this domain.

Empathy, TOM, emotional intelligence & collective intelligence

Experiencing the collective flow, group members' resources, just like in solitary flow, are entirely dedicated to the task. The group is self-managing itself so that interpersonal relation management does not interfere with any member's focus. In order to collaborate optimally, social interactions should be fluid, seamless and effective - meaning that when we listen to what the other one is saying, we really do understand what he/she means by that and are able to build on that in appropriate manner. So, we assume that intragroup relations are processed through automatic attentional processes (Dietrich, 2004; Šimleša, et al. 2018). Assuming that intragroup processes in collective flow are automatic, we believe that cognitive, affective and behavioral factors enabling this automation foster the collective flow. Therefore, in the model that we propose, we believe that openness to take somebody else's perspective, mediated by the process of allocation of attention to the collective task, will enable the collective flow. Moreover, being open to somebody else's perspective is known to enhance social identification. According to Gallese (2009), a common physiocognitive mechanism of embodied simulation (mirror neurons) – mediates human capacity to share meaning, thus anchoring our identification with and relatedness to others. Therefore, we hint that the impact of this form of social sensitivity on collective flow is also mediated by group identification. See Figure 10.

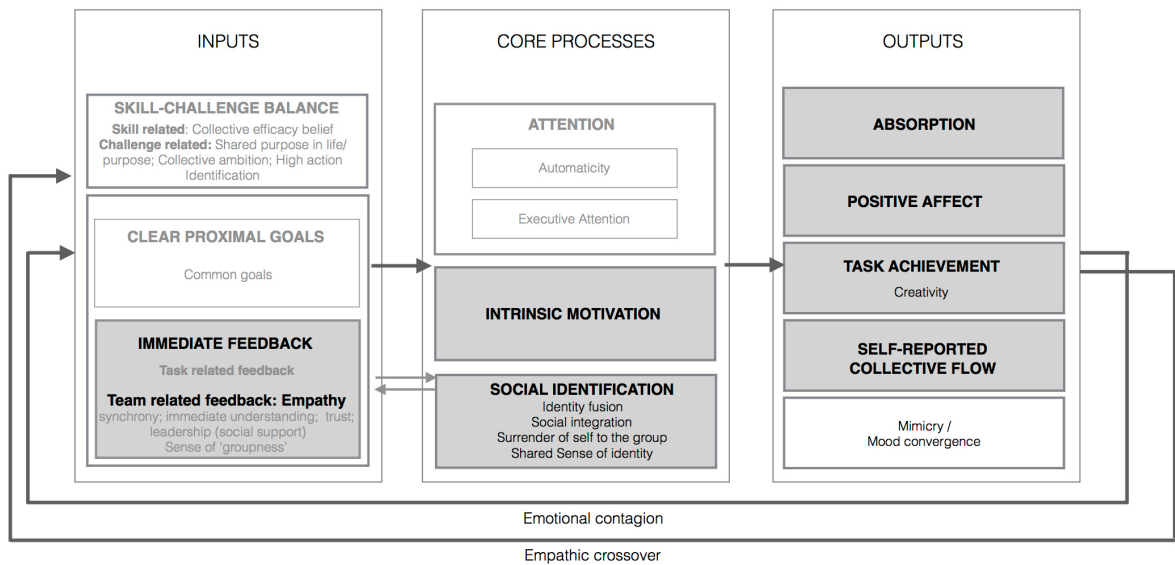


Figure 10. I-P-O diagram depicting a hypothetical relation between social sensitivity collective flow mediated by attention allocation process and group identification.

This openness to taking someone else’s point of view may relate to Empathy, Theory of Mind and Emotional Intelligence. Before presenting our studies, we will briefly present each of these concepts and explain our reasoning why we believe they are important for the collective flow.

Empathy. Originally used in German aesthetics to describe that someone comes to know a piece of art, the word *empathy* comes from German *empathie* (Watson, 2001). In psychology, empathy has its origins in the therapeutic work of Carl Rogers (1959) who saw empathy as: “the state of perceiving the internal frame of reference of another person, with accuracy and with emotional components and meanings that pertain to it, as if one were with the other person, but without the loss of the as-if condition” (Rogers 1959, p. 210-11; Brunero et al., 2010). Broadly speaking, empathy refers to the affective and cognitive reactions of one person to the observed experiences of another person (or other living being) (Davis, 1983). In order to experience empathy, research (Stotland, 1969) suggests that two conditions are necessary: (1) perception of another person as in need and (2) adoption of that other's perspective (Batson & Moran, 1999). This ability to share other peoples’ feelings results in a better understanding of actions of the people surrounding us and promotes prosocial behavior (Singer & Lamm, 2009). Biologically speaking, the development of mechanisms to connect with its caregivers is a matter of life and death to a human infant because compared to many other animals on our planet, human beings are small, slow and weak (Zaki & Ochsner, 2012). Meltzoff (2002) argues that the development of this connecting mechanism, the empathy, is rooted in imitation. According to this theoretical view, the experience of imitating other people serves as *discovery mechanism* for social cognition. It enables interpersonal understanding and leads to empathy, perspective taking, and theory of mind (Meltzoff, 2002). In this way, human infants use the observed behavior of their parents as a mirror to gain more

knowledge about themselves and vice-versa (Gallese, 2003). Empathy may be regarded as a central characteristic of emotionally intelligent behavior (Salovey & Mayer, 1990). Accounts from neuroscience (e.g. Gallese et al., 2004) support this view indicating that the neural structures engaged when processing and controlling actions, sensations and emotions are also activated when these are just simply observed (Goubert et al., 2005). Innate, evolutionary and dispositional, this empathetic capacity seems to be also context-dependent and has been successfully manipulated in experimental settings (e.g., Lie, 2006). A study exploring whether students trained in perspective-taking writing task would demonstrate increased awareness of emotional aspects in their clinical encounters with patients shows that training in point-of-view writing can improve students' empathetic skills (develop empathy for another, accurately identify the feelings of another, demonstrate insight, etc.) on certain affective dimensions (Lie, 2006). Empathy, the ability to infer and share the emotional experiences of another (Gallese, 2003) so crucial for the success of social interaction relies on neural networks associated with making inferences about mental states of other people: temporal and frontal regions of our brains (Völlm et al., 2006). Several brain-imaging studies have investigated the neuroanatomical basis of mentalizing in healthy subjects (Fletcher et al., 1995; Goel et al., 1995; Baron-Cohen et al., 1999; Brunet et al., 2000; Castelli et al., 2000; Gallagher et al., 2000, 2002; Russell et al., 2000; Vogeley et al., 2001; McCabe et al., 2001; Ferstl & von Cramon, 2002) producing remarkably consistent results. These studies reveal a network of three main areas including medial prefrontal cortex (mPFC), the posterior superior temporal sulcus (STS) and the temporal poles (Frith & Frith, 2003).

Theory of Mind (ToM). Empathy is often linked to the Theory of Mind. The two concepts are related and share a lot in common, but are not quite the same. In their famous chimpanzee article, Premack and Woodruff (1978) define ToM as a system of inferences serving to impute mental states to oneself and others. Empathy, on the other hand, is described as something more basic: it is when we put ourselves in the place of the other in the sense that it is not a prediction of what that other person would do, but rather an inference about what we would do if we were in that person's shoes. On the contrary, theory of mind would be taking into account the knowledge, beliefs, intentions, guesses of another in order to predict his or her behavior. Therefore, according to these authors (Premack & Woodruff, 1978) empathy is basically a theory of mind restricted to its purpose (motivational), meaning that it does not offer any inference about other's knowledge. As such, empathy can be regarded as emotional-motivational subset of the ToM, which is a larger, encompassing concept. Impairments of ToM are found in following clinical populations: individuals with autism spectrum disorders, dementia, and bipolar disorder (Baron-Cohen et al. 1985; Baron-Cohen et al. 1997; Bora et al. 2005; Brüne and Brüne-Cohrs 2006; Cuerva et al. 2001; Gregory et al. 2002; Happé, 1994; Kaland et al. 2002; Senju, 2012). This *folk psychology* (Samson & Apperly, 2010), the ability to make sense of and/or predict another person's behavior is measured by numerous standard (implicit) and explicit measures that were developed for children, adolescents and adults – both typical and abnormal – Sally-and-Anne test (Baron-Cohen et al. 1985; Wimmer & Perner, 1983), cartoon diagrams (Sarfati et al., 1997), and explaining the reason a character in a story behaved in a certain manner (Gregory et al. 2002; Happé, 1994), etc. One of the most famous measures of ToM is *Reading the Mind*

in the Eyes Test (RMET - Baron-Cohen et al., 2001) used to assess adult mentalizing abilities – more precisely to test its affective component with an advanced difficulty. Subtle and sensitive, the scores on this test are generally inversely correlated to Autism Spectrum Quotient (the AQ). It consists of matching eye-region expressions in 36 pictures to verbal descriptions of mental states. Brain-wise, mentalizing (ToM) activity engages a system of midline and superior temporal structures broadly involved in ‘self-projection’: the ability to represent states outside of a perceiver’s ‘here and now’ (Zaki & Ochsner, 2012). Neuropsychological studies examining patients with brain injuries consistently find ToM deficits associated with unilateral right hemisphere damage, which results in functionally specific deficit in attributing intentional states to others, especially those involving second-order attributions (Griffin et al., 2006). Cognitively, mentalizing process seems to rely on executive functions, the set of cognitive processes that regulate, control and manage other cognitive processes, including inhibition, working memory, cognitive flexibility, and planning (Miyake et al., 2000; Miyake & Friedman, 2012; Carlson & Moses, 2001). Executive functions and ToM appear to be tightly associated (Aboulafia-Brakha et al., 2011). In their study, Schneider and colleagues (2012) find that, under cognitive load the implicit processing of theory of mind is disrupted. This finding implies that the cognitive system responsible for implicitly tracking beliefs draws somewhat on executive processing resources. Depending on whether the attribution of beliefs is about us or about other people, it will require different amount of cognitive effort. Bradford and colleagues (2015) reveal significantly longer reaction times when attributing beliefs to other people as opposed to recognizing and attributing beliefs to oneself. So crucial in any cooperative task and in cultural learning, ToM can be slightly enhanced by training. Research has shown that one year of acting classes resulted in significant gains in empathy scores in elementary school aged children and significant gains on a naturalistic measure of theory of mind in adolescents (Goldstein & Winner, 2012). This makes sense because actors must carefully analyze the beliefs, desires, and motivations of their characters (Hull, 1985; Stanislavski, 1950) – activities that psychologists would classify as complex and fine theory of mind tasks. More precisely, it is found that adolescent and adult actors are particularly skilled in reading others’ mental states (ToM), but do not report above average levels of empathy (Goldstein et al., 2009). Apart from acting, another activity that seems to enhance ToM is reading literary fiction (Kidd & Castano, 2013). Readerly or literary texts, those that engage their readers actively and creatively, as the readers were writers themselves, lead to an improvement of scores on tests of affective ToM. However, this finding does not seem to be replicable in the short term (Panero et al., 2016). Reading segments of literary fiction immediately before measuring ToM does not seem to always enhance the score on this test. Inversely, the capability to recognize authors of the presented segments remains robustly linked to Reading the Mind in the Eyes Test (RMET) score, concluding that either individuals with high theory of mind are drawn to reading or lifetime reading strengthens this capacity (Panero et al., 2016). From school, work, peer and intimate relationships, mentalizing activities are paramount. These cognitive operations need to be conducted spontaneously in order to succeed in teamwork. For example, in the work place, an individual needs to be able to listen to what other group members say and understand why they are taking on a specific perspective, especially if it differs from one’s own perspective (Ahmed & Miller, 2011). In line with that, studying healthy human

subjects in collaborative settings, Woolley and colleagues (2010) tested the hypothesis that groups have characteristic levels of intelligence – the collective intelligence (‘c’) defined as the general ability of the group to perform on a wide variety of tasks. This property of group was found to be positively correlated with the average social sensitivity of group members assessed using Reading the Mind in the Eyes Test. The finding was replicated in natural and online groups (Engel et al., 2014). The measure of ToM was found to be equally predictive of collective intelligence in both face-to-face and online groups.

Emotional Intelligence (EI). ToM can be regarded as a subset of a broader array of skills and abilities associated with emotional intelligence (Engel et al., 2014). The origins of EI can be traced back to E. L. Thorndike’s (1920) social intelligence and Gardener’s (1983) multiple intelligences model. This larger construct, encompassing social awareness (closely linked with theory of mind) is defined as “an ability to perceive accurately, appraise, and express emotion; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth” (Mayer & Salovey, 1997, p.10). EI is related to both emotion and intelligence, but it is also distinct from them (Mayer et al., 2008). In their classical theoretical model of Emotional Intelligence, Mayer & Salovey (1997) decompose this construct into four branches (see figure 11.).

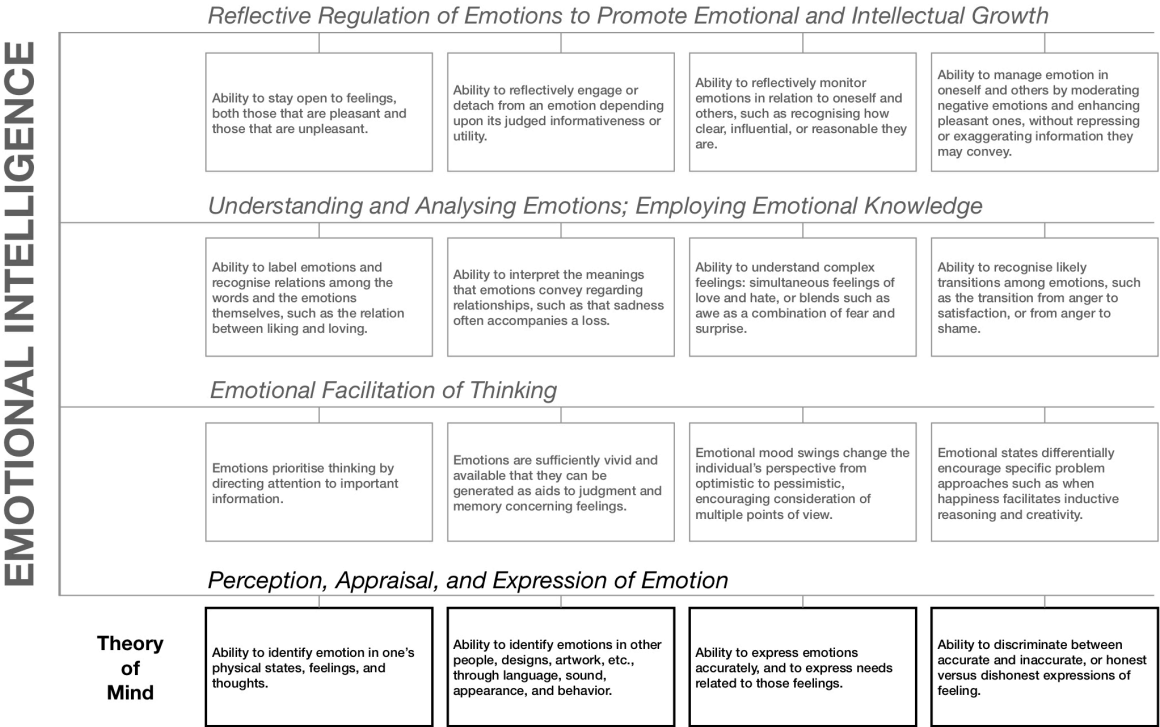


Figure 11. A model of Emotional Intelligence. Figure adapted from Mayer & Salovey (1997, p.11).

The lowest branch concerns the accuracy with which individuals can identify emotions and emotional content, which very much corresponds to ToM. Salovey and Mayer’s classical

model was followed by a plethora of alternative conceptualizations of EI (e.g., Bar-On, 1997; Cooper & Sawaf, 1997; Goleman, 1995; Petrides & Furnham, 2000), which resulted in virulent controversies (Mikolajezak, 2009), which we will not address in detail in this thesis. Meeting the three classical criteria of a standard intelligence construct, EI is capable of being operationalized as a set of abilities, meets certain psychometrical criteria and relates to preexisting intelligences, and develops with age (Mayer et al., 1999). Numerous intellectual problems contain emotional information that must be processed and therefore EI could be labeled also as *emotional competence* (Mayer & Salovey, 1993). EI can be approached as a *trait* and as an *ability* depending on how we measure it: measurement through self-report questionnaires leads to the operationalization of the construct as a personality trait. In contrast, the measurement of EI through maximum performance tests, if possible, would lead to the operationalization of the construct as a cognitive ability (Petrides et al., 2004). EI appears to be modestly related to performance outcomes in a variety of applied settings. There seems to be an increasing confidence in the discipline of organizational psychology, which tests of EI can predict job performance to an extent that is useful (Daus & Ashkanasy, 2005; in Zeidner et al., 2008). An experimental study of the impact of EI on collaboration shows that EI of followers affects job performance and job satisfaction, while EI of leaders affects their own satisfaction and extra-role behavior (Wong & Law, 2002). Zhou & George (2003) propose that leaders with high emotional intelligence play a critical role in enabling and supporting the creativity in the workplace through following five factors: (1) identification, (2) information gathering, (3) idea generation, (4) idea evaluation and modification, and (5) implementation. Only one study examined the relationship between flow and emotional intelligence. Marin & Bhattacharya (2013) investigated flow in relation to trait emotional intelligence in piano performance students. Their results suggest that flow was predicted by the amount of daily practice and trait emotional intelligence. However, a positive link between flow and high achievement was not supported.

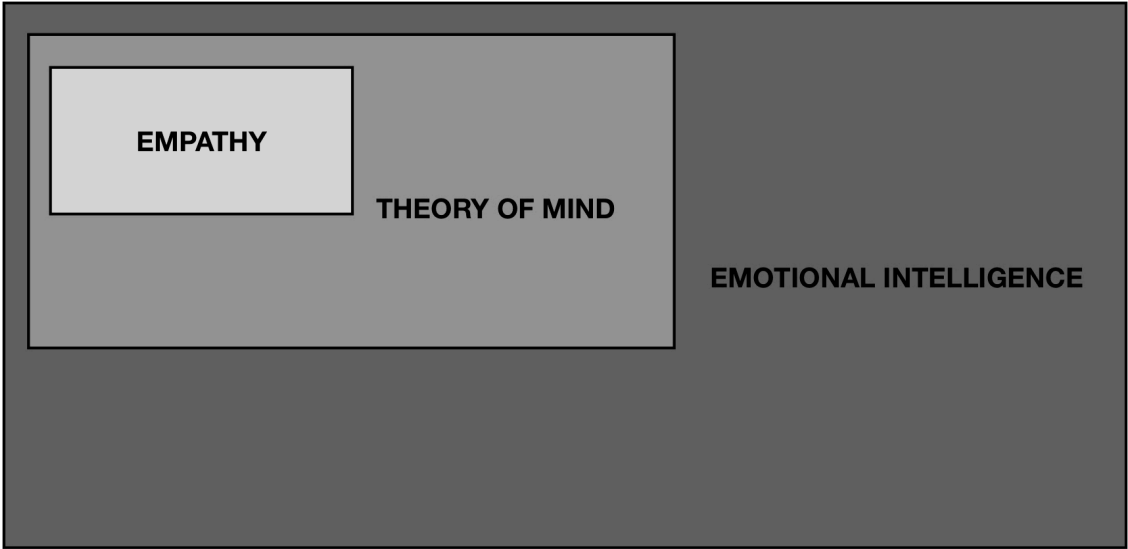


Figure 12. A graphical representation of social sensitivity notions into sets and subsets.

Empathy, theory of mind and emotional intelligence appear very much alike and remain theoretically consonant. Still, these three psychological constructs differ between them in the scope of their definition and in the empirical approach that was given to each of these. Simply put, all three refer to a disposition or a skill allowing to relate to others and to facilitate interpersonal interactions. As such, empathy, theory of mind and emotional intelligence seem to be particularly useful factors for human socialization and collaboration. Research supports this assumption, finding that all three are particularly useful in interactive settings (Lie, 2006; Woolley, et al., 2010; Engel, et al., 2014). In order to coordinate these three constructs in a structured but yet simplified way, we decided to represent them graphically (see Figure 12.). Empathy, the narrowest of the three, referring to the affective and cognitive reactions of one person to the observed experiences of another (Davis, 1983) is represented as the smallest set. Theory of mind, a broader term, includes empathy as its subset but adds into the account the knowledge, beliefs, intentions, guesses of another in order to predict his or her behavior (Premack & Woodruff, 1978). Finally, emotional intelligence, the most extensive of the three, embraces the two previous. Ability not only to perceive and predict other's intentions, emotions and behavior, emotional intelligence also means understanding emotional knowledge and regulating one's own emotions accordingly to promote one's and other's personal growth (Mayer & Salovey, 1997). Knowing that social sensitivity such in empathy, ToM or EI is favourable and advantageous for human interaction, we assume that it also plays a role in the collective flow. Hence we hypothesise that openness to other's perspective (such as in empathy) increases the chances that the work group reaches the state of collective flow by facilitating attentional and identification processes. As a result, we decided to test these assumptions through an experimental study where we will induce an empathic openness to some groups and no empathy to other, compare them and verify the accuracy of our predictions.

PILOT EXPERIMENT

Collective Flow and Induced Empathy

Goals of the study. In the present study, we attempt to experimentally induce empathy in student workgroups and to measure the subsequent impact on collective flow – in terms of psychosocial parameters and objective performance parameters. In order to experimentally induce empathy, we have used the procedure by Batson and colleagues (1997). There were two conditions: empathic condition and self-centered-control condition. Inducing empathy in the “empathic condition” consisted in asking participants to do a “warm-up” exercise, which resides in imagining and writing how the other group members feel at that moment. On the other hand, the “self-centered-control condition” consisted in asking participants to do a similar exercise, which consists in writing how they feel at that moment (introspection).

Hypotheses. We hypothesize that groups allocated to other-perspective-taking induction before the group task will experience higher levels of flow (H1) and show improved creative performance (idea fluency and the originality of concepts, H2). The effect of the

experimental manipulation on creative performance should be mediated by the flow (H3). We believe that adopting other group member's perspective is beneficial to the positive experience of collaboration and therefore to the creative performance of the group.

Participants. 27 French engineering students (19 male and 8 female, age $M = 27.67$, $SD = 6.15$) participated in the study. Individual participants were assigned to 10 working groups of 3 persons (7 groups) or 2 persons (3 groups). Due to the relatively low number of girls in general, 7 groups had one female participant, while the other 3 groups were exclusively composed of male participants.

Materials. In terms of material, all groups were equipped with two flipchart A0 sheets, a big quantity of post-its of all colors and permanent markers.

Procedure. In the beginning of the experiment, we operated empathy induction task to half of the groups while the other half of the groups (control condition) did the self-centered task. The procedure was inspired by Batson and colleagues' (1997) experiment. This *empathy condition* or *imagining-how-other-feels condition* was presented as a *warm up exercise* that was supposed to cognitively prepare the groups for upcoming creativity workshop. During ten minutes time, participants were instructed to write down approximately ten lines about how the other group members feel at this moment. Imagining how someone else feels evokes relatively pure empathic emotion, which has been found to evoke altruistic motivation (Batson et al., 1997). The control condition was also presented as a *warm-up* but here, the participants were asked to write down ten lines about how they feel themselves. Detailed instructions that subjects received can be found in the Table 12. below:

In order to prepare yourself for creativity workshop, your mental agility has to be awakened. This task will warm you up intellectually for the upcoming effort. Things that you will be writing will be kept strictly confidential and anonymous: nobody will have the access to your paper. Nevertheless, it will be kept until the end of the day – it will be useful for your last activity.

Aim: Imagine how other group members of your team feel (versus how you feel, in the *control condition*) at this moment. Write down 10 lines and give in your paper to the experimenter when you finish. You have 10 minutes for this.

Table 12. Experimental instructions transcript.

After this ten-minute induction task, the experimenters collected all papers and put them on the side. The following creativity workshop included a face-to-face brainstorming session (Osborn, 1963).

The creativity workshop consisted in three distinct phases: (1) idea generation, (2) idea selection, and (3) idea elaboration.

Groups were presented with the following imaginary business case: Hyperpark (see Figure 13.) is a French amusement park that has opened its doors five years ago. Seventy per cent of its visitors are French and 30% are foreign. After having experienced a continuous growth during 4 years, the revenue is stagnating, as well as the number of visitors. In addition, because of the crisis, the average amount of money spent by visitor tends to decrease, which results in a continuous decline of park results.

The goal of the brainstorming was to find ideas to revitalize the Hyperpark activity, and more precisely to make the park more appealing for parents and grandparents who accompany children.



Figure 13. An illustration of Hyperpark appearing in participant instruction material.

Before starting a 30-minute idea generation phase, participants received the following brainstorming instructions (Osborn, 1963; see Table 13. and Figure 14.):

Rules of brainstorming

- (1) You have to produce a maximum of ideas on this subject (the quantity brings the quality);
- (2) It is prohibited to criticize ideas, including your own ideas (via self-censure);
- (3) Crazy, unusual and imaginative ideas are welcome;
- (4) Combine and improve ideas of others (variants, combinations, diversion, inversion, etc.)

Table 13. Experimental instructions transcript.



Figure 14. Teams generating ideas during the first phase of brainstorming.

After 30 min of brainstorming, groups proceeded to a selection phase, which consisted in selecting three best ideas out of the pile of ideas produced during the idea generation step. Groups had 10min to discuss and select the 3 best ideas in order to develop them further in the third phase (see Table 14.):

The choice of the best ideas: once you have finished the brainstorming, you will proceed to idea evaluation and sorting. Until now, the goal was to produce a large quantity of ideas. From now on, it is allowed to judge, evaluate, sort ideas, etc. in order to choose the best amongst them. Be concentrated and efficient.

The goal: choose together the top 3 ideas that you will elaborate later. You have 10 minutes to make your choice.

Table 14. Experimental instructions transcript.

Once the selection was finished, participants were asked to write down their top three ideas on a standard idea-template (one-page A4 document) helping them to express the idea clearly in a way that a “potential investor” could understand it. The groups were given 20 minutes to get the idea-templates done (see Table 15.):

The idea elaboration. Once you have chosen your top 3 ideas, you can begin to fill in the idea templates. You will find an idea template for your project that aims to help a potential investor to understand what it is about and how you wish to carry out the project. The goal: develop and deepen your top 3 ideas in order to communicate it to someone else. Write down your concepts by filling out the template. You have 20 minutes to do this.

Table 15. Experimental instructions transcript.

Idea templates consisted in seven boxes: title, detailed description, illustration, differentiating elements (characteristics that allow users to perceive the offer as unique), advantages, disadvantages, and time horizon (short term, middle term, long term).

All idea templates, as well as flipchart sheets and post its from the diverging phase were collected by the experimenter. Self-report questionnaires were distributed in order to be completed by each individual. Participants were then debriefed and dismissed.

The whole experimental procedure lasted approximately three and a half hours, which corresponds to a half of the academic day.

Manipulation checks.

- Three items related to empathy (BES-A, Carré et al, 2013) (“I was paying attention to other group members’ feelings”; “Other group members’ emotions affected me very much”, “I could often understand how other members are feeling even before they tell me”) ($\alpha=0.153$). Due to the low reliability of the aggregated score, we ran the analysis with individual scale items.
- Two items related to self-consciousness – manipulation check for control group (“My feelings affected me a lot, I was very attentive to my feelings”) ($\alpha=0.296$).

Data collection. The questionnaire was composed of:

- **FSS – 13-item The Flow Short Scale** (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters: absorption ($\alpha=0.621$; e.g., “I felt just the right amount of challenge, I didn’t notice time passing”), fluency ($\alpha=0.833$, e.g., “My thoughts run fluidly and smoothly, I had no difficulty concentrating”) and importance ($\alpha=0.556$, e.g., “Something important to me was at stake here, I was worried about failing”). We decided not to keep the importance sub-scale because of its moderate reliability. Aggregated clusters composed of absorption (4 items) and fluency (6 items) offered a reliable measure of total flow ($\alpha=0.776$).
- **Social Identification Score**, composed of: SISI – Single-item Social Identification Scale “I identified with my group” (Postmes et al., 2013), with 7-point Likert scale and 4 other items taken from Henry et al. (1999) (“I enjoyed interacting with the

members of this group”; “All members need to contribute to achieve the group’s goals”; “This group accomplishes things that no single member could achieve”; “The members of this group were connected”) ($\alpha=0.620$).

- **SIMS – The 16 items Situational Motivation Scale** (Guay et al., 2000), with 7 –point Likert Scale. Composed of 4 clusters: intrinsic motivation ($\alpha=0.898$, e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant”), identified motivation ($\alpha=0.848$, e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me”), external regulation ($\alpha=0.818$, e.g., “I was engaged in this activity: Because I was supposed to do it, Because it was something I had to do”), and amotivation ($\alpha=0.735$, e.g., “I was engaged in this activity: I did this activity but I was not sure if it was worth it, There might be good reasons to do this activity, but personally, I didn’t see any”).
- **16-item Brief Mood Introspection Scale - BMIS** (Niedenthal & Dalle, 2001) with 4-point scale. Composed of 3 clusters: positive moods (lively, happy, caring, content, peppy, loving, active; $\alpha=0.862$), negative moods (sad, tired, gloomy, jittery, drowsy, grouchy, nervous, fed up; $\alpha=0.725$), and calm (mood unrelated to all other moods).
- **Self-perceived creativity** items (4 items: “I had many ideas”; “I had ideas of great quality”; “The team had many ideas”; “The team had ideas of great quality”) with 7 –point Likert Scale ($\alpha=0.857$).

Creative performance

Five hundred fifty-five ideas from the divergent thinking phase were collected and examined. The fluency was measured in terms of number of non-redundant ideas produced by group and by each individual in each group.

The idea-templates were evaluated by 3 SBT management and strategy consultants, blind to the conditions, employing a widely used consensual assessment approach (Amabile, 1982; Yong et al., 2014). Nine rating criteria were determined previously by the associate partners and executive directors of the company (SBT Human(s) Matter). Each consultant had to rate each idea-template on nine different criteria. See Table 16. which summarizes the reliability of each of nine criteria used by judges to evaluate the quality of idea templates produced by groups:

CRITERION	RELIABILITY (Cronbach's Alpha)
1. This idea allows increasing visitors' expenditures.	$\alpha=0.708$
2. The implementation will be rather quick.	$\alpha=0.770$
3. This idea allows an opening to international market.	$\alpha=0.695$
4. This idea is differentiating and original	$\alpha=0.665$
5. This idea can attract the "non-children"	$\alpha=0.544$
6. This idea can satisfy the "non-children"	$\alpha=0.361$
7. This idea can bring customer loyalty for "non-children"	$\alpha=0.281$
8. This idea is actionable (I can trace an action plan)	$\alpha=0.684$
9. Globally, this is a good idea.	$\alpha=0.318$

Table 16. The nine criteria used by judges. Items in bold correspond to criteria that had a satisfactory interjudge reliability. Other items correspond to criteria that had a poor interjudge reliability.

Criteria 5, 6, 7, and 9 were removed because of a poor interjudge agreement (see alphas above). So, we have calculated the mean score of idea-template evaluations for these criteria between the 3 judges. The reliability analysis between the 5 criteria was ($\alpha=0.745$).

Results

Manipulation check. In order to perform a manipulation check, participant's reports of empathy were submitted to a simple (*empathic condition* versus *self-centered-control condition*) between subjects ANCOVA with the sex as a covariate. The analysis of variance revealed no main effect of condition for the first empathy item ($F(1, 24) = 1.535, p = 0.227, \eta^2p = 0.060$, self-centered condition $M = 3.89, SD = 2.14$, empathy condition $M = 5.00, SD = 2.00$). Next, we did not observe a significant main effect of the condition for the second item ($F(1, 24) = 0.941, p = 0.342, \eta^2p = 0.038$, self-centered condition $M = 4.22, SD = 2.02$, empathy condition $M = 5.00, SD = 1.50$). We observed a significant effect of empathy induction for the third empathy item. However this effect goes in the opposite direction from our predictions ($F(1, 24) = 21.946, p < 0.001, \eta^2p = 0.478$, self-centered condition $M = 5.50, SD = 1.38$, empathy condition $M = 2.56, SD = 1.99$). The main effect of condition was not observed for self-consciousness items (first self-consciousness item - $F(1, 24) = 0.889, p = 0.355, \eta^2p = 0.036$, self centered condition $M = 3.33, SD = 2.09$, empathy condition $M = 4.11, SD = 2.26$; second self-consciousness item - $F(1, 24) = 0.485, p = 0.493, \eta^2p = 0.020$, self-centered condition $M = 3.44, SD = 2.06$, empathy condition $M = 4.11, SD = 2.26$).

Individual Level Analysis. Group identification, flow, motivation, mood and self-evaluations of creativity were analyzed at the individual level with a simple (empathy versus self-centeredness) ANCOVA with sex as a covariate. There were no significant main effects of the condition, in particular on flow variables, which invalidates H1. We noticed one insignificant but marginal main effect on Social Identification Score. Participants in the self-centered condition reported being less identified to their group ($F(1, 24) = 3.638, p = 0.069, \eta^2p = 0.132$) ($M = 5.64, SD = 0.94$), than in empathy condition ($M = 6.25, SD = 0.64$) (see Table 17. for more detail).

ANCOVA (sex as covariate)					Descriptives			
Variable	df	F	p	η^2p	Self-centered		Empathy	
					M	SD	M	SD
Flow (absorption)	1, 24	0.705	0.409	0.029	5.39	0.93	5.08	0.98
Flow (fluency)	1, 24	0.374	0.546	0.015	4.96	1.03	5.24	1.26
Flow (total)	1, 24	0.014	0.907	0.001	5.14	0.89	5.18	0.90
Social Identification Score	1, 24	3.638	0.069	0.132	5.64	0.94	6.25	0.64
Intrinsic Motivation	1, 24	0.607	0.444	0.025	5.52	1.28	5.85	0.81
Identified motivation	1, 24	1.805e-32	1.000	0.000	4.61	1.41	4.64	1.47
External Regulation	1, 24	0.833	0.370	0.034	3.98	1.52	4.50	1.35
Amotivation	1, 24	0.090	0.766	0.004	1.95	1.05	1.83	0.98
Positive Moods Score	1, 23	0.676	0.420	0.029	2.93	0.75	3.15	0.42
Neutral: Calm	1, 24	3.369e-4	0.986	0.000	3.00	1.18	3.00	1.00
Negative Moods Score	1, 24	1.254	0.274	0.050	1.75	0.89	1.47	0.21
Self-rated creativity	1, 24	0.232	0.634	0.010	5.55	0.93	5.74	1.08

Table 17. Results of ANCOVA analysis with sex as covariate for all independent variables. Tendencies in bold.

Creative performance of groups. Contrary to our predictions, the number of ideas did not differ between the self-centered condition and the empathy condition ($F(1, 8) = 3.114, p = 0.116, \eta^2p = 0.280$, self-centred condition $M = 65.20, SD = 20.27$, empathy condition $45.80, SD = 13.92$), which invalidates H2.

Originality idea templates. Analysis of the variance (ANOVA) for the quality of idea templates showed that there was no significant difference between the two conditions (self-centered condition and empathy condition) ($F(1, 16) = 0.299, p = 0.592, \eta^2p = 0.0.18$, self-centered condition $M = 3.78, SD = 0.46$, empathy condition, $M = 3.62, SD = 0.77$).

Analysis of Mediation. The mediation hypothesis H3 was not performed because previous two hypotheses were not supported.

Discussion

The aim of this study was to examine the impact of induced empathy on the collaboration and creative performance of student working teams. Unfortunately, we did not succeed in experimentally inducing the empathy. In contrast to Batson and colleagues (1997) whose sample consisted of psychology students, our sample consisted of engineering students. Attempting to account for this inconsistency, we propose two alternative explanations. First, there is a possibility that their sample was more susceptible to switch to an *empathy mode*, either due to their higher dispositional empathy or due to their training to take an empathetic attitude as an occupational requirement (becoming psychologist). The second element that differs between Batson and colleagues (1997) study and our study, and therefore could account for unsuccessful empathy induction procedure, is the task that was used to induce empathy. In Batson and colleagues (1997) experimenters induced empathy by asking participants to take the perspective of an imaginary character, Katie Banks whose parents and a sister had recently been killed in a car accident. Katie explains her tragic situation and tries to take care of her surviving younger siblings while she finishes the last year of college. Obviously, the object of empathy in their case was more distant and exaggerated as unfortunate victim with noble human intentions. In contrast, as the object of empathy, our subjects had their living, here-present teammates: complex personalities with probably less spectacular life stories than Katie Banks. Therefore, practically no difference was observed between the two conditions in terms of: flow, group identification, motivation, affects, self-evaluation of creativity, objective creative performance nor the quality of final innovation projects. It might be possible that the empathy comes to be a factor difficult to experimentally manipulate with our population (engineering students) because it might be more of a dispositional than a situational phenomenon. In the following study, we decided to approach this issue differently. Instead of trying to induce the empathy to our experimental subjects, we chose rather to screen them for their dispositional social sensitivity and then see how the groups composed of individuals with differing levels of this characteristic collaborate and flow.

CORRELATIONAL STUDY

Collective Flow and Dispositional Theory of Mind

Goals of the study. Having failed to successfully manipulate empathy by perspective-taking writing procedure, we have decided to approach the problem of social sensitivity in a different way. Supposing that the ability of perspective-taking should be treated as a trait rather than a state, we have decided to make another study procedure which will, instead of trying to manipulate the empathic state, rather take into account participant's existing individual dispositions in terms of Theory of Mind (ToM). Previous research on collaboration (Woolley et al. 2010, Engel et al. 2014) found that teams of people scoring high on ToM had significantly higher *collective intelligence*, the measure of general group effectiveness. Their results indicate that average ToM scores were the only significant predictor of collective intelligence. However, to our knowledge, there are no ToM studies that take into account the aspect of subjective well-being in an effective collaboration setting. Therefore, taking into account these findings, we aimed to explore to what extent the ToM dispositions predict the collective flow, the measure of group effectiveness and well-being. The aim of this study was to test the relationship between Theory of Mind, the collective flow and creative performance.

Hypotheses. We hypothesize that group members having higher Reading the Mind in the Eyes Test (RMET) score will be more likely to experience flow (the higher the RMET, the higher the absorption) – H1. We hypothesize that groups having higher average RMET score will be more likely to experience collective flow – H2. Also, we hypothesize that groups having higher average RMET score will perform better in the creativity task, in terms of fluency and originality of ideas – H3.

Participants. 375 French engineering students (332 male and 43 female, age $M = 23.29$, $SD = 1.58$) from across the country (Nanterre, Nice and Saint-Nazaire) and two different curricula (general engineering and construction engineering) participated in the study. 88,53% of our participants were male, which represents well the gender composition of this engineering school itself. Individual participants were assigned to 69 working groups of 5 to 6 people. Due to the relatively low number of girls in general, 38 groups had one female participant, while the other 31 groups were exclusively composed of male participants.

Materials. In this study, we used Reading the Mind in the Eyes Test - RMET (Baron-Cohen et al., 2001) consisting of 36 photographs of the eye-region of the face of different people (Figure 15.). The participant is ought to choose which of the four words best describes the mental state of the person in the photograph (Baron-Cohen et al., 2001). Following completion of RMET questionnaires, a face-to-face brainstorming method was used with exactly the same materials like in our Pilot study (see above).

Procedure. After completing Reading the Mind in the Eyes Test participants were organized in 69 teams of 5 people on average and took part in a half-day long creativity

workshop consisting in group brainstorming on the Hyperpark case, idea selection and project elaboration. The procedure was identical to that of the Pilot Experiment (see above).

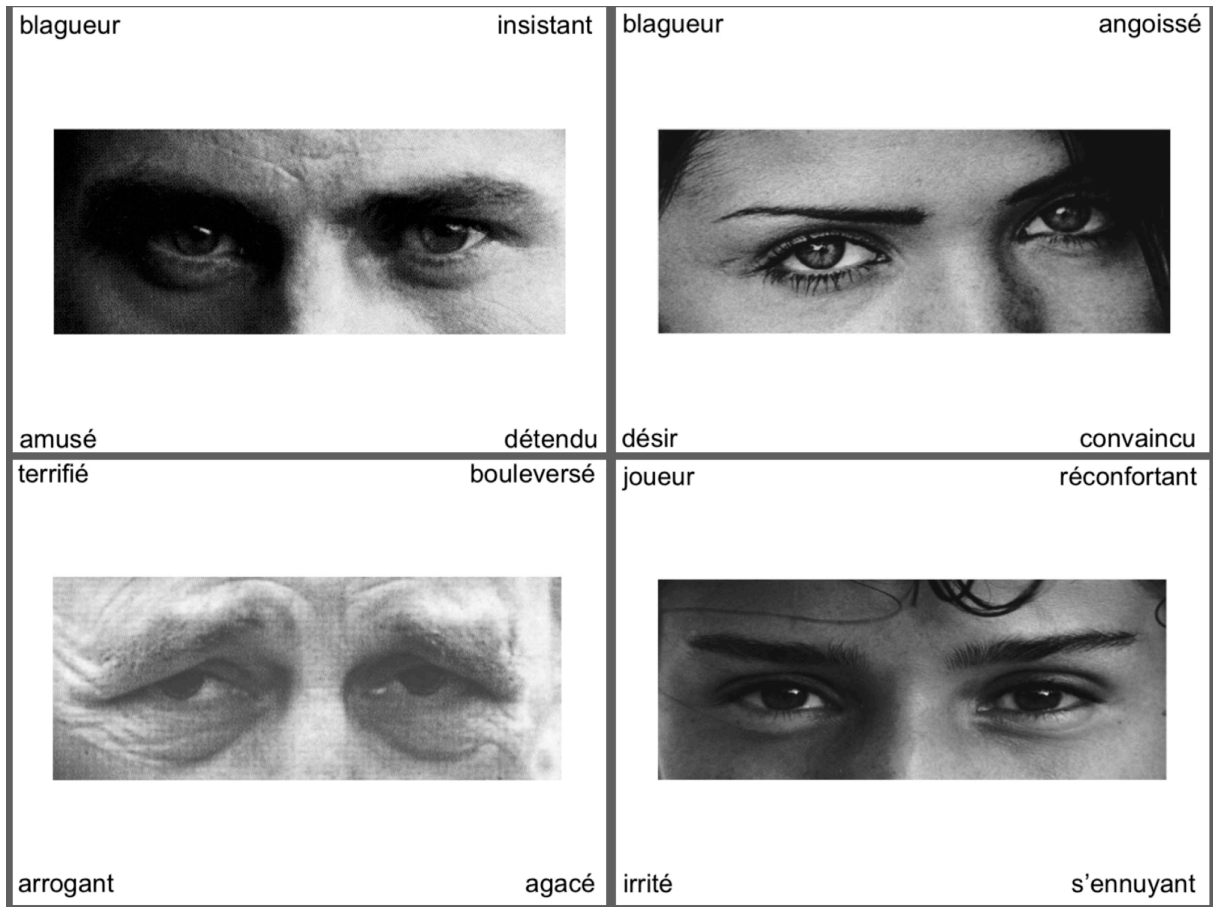


Figure 15. Reading the Mind in The Eyes Test item examples.

Data collection. Self-reported questionnaire composed of flow scale, collective flow items, social identification measure, motivation scale, and self-reported creativity items were administrated to all participants.

The questionnaire was composed of:

- **Absorption scale extracted from FSS – The Flow Short Scale** (Rheinberg et al., 2002) with 7-point Likert scale: 4 items, $\alpha=0.518$ (e.g., “I felt just the right amount of challenge”, “I didn’t notice time passing”) – we decided to remove one item (“I am completely lost in thought”) because of its poor correlation to the rest of items and kept 3 items ($\alpha=0.693$).
- **SIMS – The Situational Motivation Scale** (Guay et al., 2000) was used, with 7 –point Likert Scale. We collected 3 out of 4 clusters because amotivation was not of an interest for this study. We measured intrinsic motivation ($\alpha=0.919$, e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this

activity is pleasant”), identified motivation ($\alpha=0.863$, e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me”), and external regulation ($\alpha=0.705$, e.g., “I was engaged in this activity: Because I was supposed to do it, Because it was something I had to do”).

- **SISI – Single-item Social Identification Scale** “I identified with my group” (Postmes et al., 2013), with 7-point Likert scale
- **Collective Flow** measured by two homemade items (“Our team acted as a whole. The team members were absorbed in the collective activity, coordinating effectively and feeling good together”; “I feel that our team wants this activity to continue”) ($\alpha=0.662$).

Creative performance. The effectiveness was measured in terms of creative fluency (number of single ideas generated during the brainstorming phase) and originality of innovation projects (assessed by an expert judge). To test the reliability of the expert’s ratings, a second expert judge double-blind-rated 40% of the corpus of idea templates. The interjudge agreement for this sample was moderate, but acceptable: $\alpha=0.633$. Therefore, we pursued the analysis based on the evaluations of the first judge.

Results

Individual Level Analysis. Individual self-reported data was analysed through multiple linear regressions in order to gain an insight about what aspects of individual experience predict flow.

What does predict Flow? We performed regression analysis with absorption flow as dependent variable and the three motivation dimensions, social identification and RMET as the independent variables (See Table 18.). The results show that only two variables predict the absorption flow score: intrinsic motivation ($t = 9.682$, $p < 0.001$, $\beta = 0.042$) and social identification ($t = 4.443$, $p < 0.001$, $\beta = 0.029$). The RMET score appeared to be insignificant ($t = -0.130$, $p = 0.897$, $\beta = 0.010$), hence H1 is not validated. The variance explained by this model corresponds to $R^2 = 0.416$. In other words, the individual scores on intrinsic motivation and social identification were strong predictors of the individual flow experience (absorption) of group members in their teams (see Table 18.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	2.326	0.334		6.955	< .001
	Intrinsic Motivation	0.409	0.042	0.530	9.682	< .001
	Identified Motivation	0.021	0.037	0.031	0.574	0.566
	External Regulation	-0.050	0.032	-0.067	-1.569	0.118
	Social Identification	0.130	0.029	0.198	4.443	< .001
	RMET Score	-0.001	0.010	-0.005	-0.130	0.897

Table 18. Multiple linear regression to predict flow absorption.

For the following analysis, we decided to remove Identified Motivation and External Regulation scales because they seem to have no impact on flow whatsoever.

Group level analysis. After having performed the individual level analysis and having seen how the self-reported factors relate to each other, we have decided to do group level analysis as well. This was done by aggregating average individual self-reported data and combining them with team performance measures (team grade and final team rank).

What does predict Collective Flow? We performed regression analysis with aggregated team member scores of collective flow as the dependent variable and aggregated scores of absorption flow, aggregated scores of intrinsic motivation, aggregated scores of social identification and aggregated scores of RMET as independent variables. The results show that social identification ($t = 6.033$, $p < 0.001$, $\beta = 0.104$) and intrinsic motivation ($t = 2.224$, $p = 0.030$, $\beta = 0.139$) are significant predictors of collective flow. The aggregated RMET score does not predict collective flow at all ($t = -0.302$, $p = 0.764$, $\beta = 0.031$). Interestingly, aggregated scores of individual flow absorption do not predict collective flow either ($t = 1.595$, $p = 0.116$, $\beta = 0.152$). H2 is not verified. The variation explained by the model is $R^2=0.686$ (see Table 19.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	-1.044	0.834		-1.252	0.215
	Mean Flow Absorption	0.243	0.152	0.190	1.595	0.116
	Mean Intrinsic Motivation	0.310	0.139	0.255	2.224	0.030
	Mean Social Identification	0.628	0.104	0.517	6.033	< .001
	Mean RMET Score	-0.009	0.031	-0.022	-0.302	0.764

Table 19. Multiple linear regression to predict collective flow.

What does predict task achievement (creativity in terms of post-it fluency)? The regression model with fluency as the dependent variable included aggregated flow-absorption scores, aggregated intrinsic motivation scores, aggregated social identification score, aggregated collective flow score, and aggregated RMET scores. The results show that only flow absorption ($t = 2.172$, $p = 0.034$, $\beta = 7.731$) is significant predictor of fluency. Aggregated RMET scores do not predict idea fluency ($t = -0.918$, $p = 0.362$, $\beta = 1.534$). It is interesting to note that scores of collective flow do not predict idea fluency ($t = -0.372$, $p = 0.711$, $\beta = 6.227$). The model explains $R^2 = 0.101$ of variance of idea fluency (see Table 20.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	45.600	42.035		1.085	0.282
	Mean Flow Absorption	16.788	7.731	0.450	2.172	0.034
	Mean Intrinsic Motivation	-5.558	7.197	-0.157	-0.772	0.443
	Mean Social Identification	1.104	6.494	0.031	0.170	0.866
	Mean Collective Flow Score	-2.319	6.227	-0.079	-0.372	0.711
	Mean RMET Score	-1.408	1.534	-0.112	-0.918	0.362

Table 20. Multiple linear regression to predict post-it fluency.

What does predict task achievement (creativity in terms of idea-template originality)? We performed a regression analysis with idea template originality score as the dependent variable and with mean flow absorption, mean intrinsic motivation, mean social identification, mean collective flow, RMET score and post-it fluency as independent variables. The results show that none of the independent variables predict the idea template originality. RMET score was not a significant predictor of idea-template originality ($t = -1.398$, $p = 0.164$, $\beta = 0.063$). The variation explained by this model is $R^2 = 0.020$ (see Table 21.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	6.699	1.612		4.155	<.001
	Mean Flow Absorption	0.173	0.317	0.084	0.546	0.586
	Mean Intrinsic Motivation	-0.037	0.277	-0.019	-0.133	0.895
	Mean Social Identification	-0.191	0.258	-0.094	-0.742	0.459
	Mean Collective Flow Score	-0.015	0.261	-0.009	-0.058	0.954
	Mean RMET Score	-0.088	0.063	-0.129	-1.398	0.164
	Post-it Fluency	-0.001	0.007	-0.015	-0.164	0.870

Table 21. Multiple linear regression to predict originality of idea-templates.

Discussion

This investigation aimed to explore the impact of social sensitivity on group collaboration both in terms of its productivity and well-being. The results do not provide support that Theory of Mind skills, measured by *Reading the Mind in the Eyes Test*, predict the experience of flow in team members. In contrast to our hypotheses (H1) that ToM score will predict the optimal experience of collaboration in group members, we found no evidence for that in our data. Therefore, we cannot conclude that individual ToM scores have any link to individual flow in the context of collaboration. On the group level (aggregate team member scores), our results demonstrated that average group ToM score does not predict the collective optimal experience (the aggregate collective flow score of the group). Furthermore, no link was found either between average group ToM score and creative performance in terms of idea fluency or idea-template originality. These results are in contradiction with findings of Woolley et al. (2010) who found that average ToM group score predicts the team performance. There are several explanations why we failed to replicate their results. First, Woolley et al. (2010) used a broad battery of different tasks among which only one was group idea generation task. In contrast, we had only one group task, which was a creativity task – because we were particularly interested in group-creativity. The other issue that might contribute to this inconsistency is the (supposed) sample difference. We do not clearly know who were the participants of Woolley et al. (2010) study, but we suppose these are some ad-hoc groups of adult subjects that met in the laboratory for that occasion. In contrast, we had some real intraclass groups of engineering students who knew each other before the study and who were used to working together often. Maybe, the ToM skills are discriminatory only when strangers have to work together without having the opportunity to get to know each other before.

In terms of creative performance, we found that the idea fluency was predicted by individual flow absorption. This implies that the total focus on the task in terms of individual absorbing experience may be conducive to increased group performance in a divergent creativity task.

Individual flow in group and Collective flow seem to be powered by the same processes: intrinsic motivation and social identification. However, they do not have the same effects.

Our study has several limitations. First, the sample of fourth-year engineering students might be not generalizable to our target population: SBT Human(s) Matter clients. The participation in the study was compulsory and part of students' academic curriculum. As such, it might be the case that the participants were not optimally engaged in delivering the best possible innovation projects because it was more about *learning how to collaborate on a project* (student motivation) rather than *saving the company with an innovative solution* (client motivation). However this interpretation can be dismissed because the reported scores of intrinsic motivation were quite high ($M = 5.05$, $SD = 1.30$ on a 7-point Likert scale).

Having tested our hypotheses in the controlled laboratory settings gave us valuable insights about the link between social sensitivity and creative group collaboration. However, in order to explore further this link, we decided to seize a partnership opportunity between SBT Human(s) Matter and a nongovernmental association, *Flow* (organizing innovation events such as hackathons) and explore this idea in an ecological setting: a two-day hackathon. This time, we attempted to test the importance of theory of mind dispositions in ad-hoc teams that do not know each other before starting the collaboration on the innovation project. It might be the case that theory of mind disposition is more important in the groups of strangers and who are not used to interacting with each other. Also, we attempted to manipulate the average ToM dispositions in groups by creating relatively homogeneous teams in terms of RMET scores.

FIELD STUDY

Mind Fhack Hackathon Competition

Goals of the study. The opportunity for this field study emerged out of the collaboration of SBT Human(s) Matter and *Flow*⁴ association – a nonprofit student organization specialized in event organization. Conceived as a two-day hackathon (design sprint-like event in which pluridisciplinary teams collaborate intensively on innovation projects), Mind Fhack represented a new experience of ambitious and innovative project creation around the topic *Human Spirit Tomorrow*. Exploring fields of cognitive science, artificial intelligence and neurotechnology, but also philosophy and art – competing teams accepted the challenge of imagining the future of new technologies in human life. As a sponsor of this happening, SBT Human(s) Matter had a privileged access to the event and could benefit from data-collection. Consequently we used this opportunity to study the impact of dispositional ToM competences on team performance, and collective flow as well as other psychosocial parameters. The methodological novelty of this study consisted in attempting to form relatively homogeneous teams in terms of ToM competence (with three clusters - low, average and high) and following their progression during two days.

Hypotheses.

H1: The mean ToM score of the team members predicts the experience of collective flow.

H2: The mean ToM score of the team members predicts the team performance at the end of the competition.

Participants. Fifty-four French adults (36 male and 18 female, age $M = 30.65$, $SD = 11.89$) from various occupational backgrounds (IT, education, engineering, entrepreneurs, neuroscience, cognitive science, architecture, event planning, coaching, art, human resources, innovation, bioinformatics, research, consulting, and mathematics) from across the country participated in the study. Individual participants were self-organized into 9 project groups.

Team formation. On the evening before the actual hackathon launch, participants were given Reading the Mind in the Eyes Test - RMET (Baron-Cohen et al., 2001). The answers to RMET questionnaire were analyzed during the night and participants were divided into 3 groups according to their RMET score (high-ToM, moderate-ToM, and low-ToM). The three ToM segments were not presented as such, but rather as *psychosocial profiles* and renamed with names of Marvel Superheroes: Ironman (high-ToM), Hulk (moderate-ToM), and Superman (low-ToM), see Figure 16. below. In the morning of the first day of the hackathon all participants were informed what is their *superhero profile* and advised to form homogeneous groups because *superheroes of the same kind tend to collaborate better together*. Next, participants were free to self-organize into 9 project groups depending on their

⁴ Latter became a startup *ExoFlow*

topic preference, but also trying to respect diversity of gender, professions, and to respect the homogeneity of the ToM/superhero profiles.

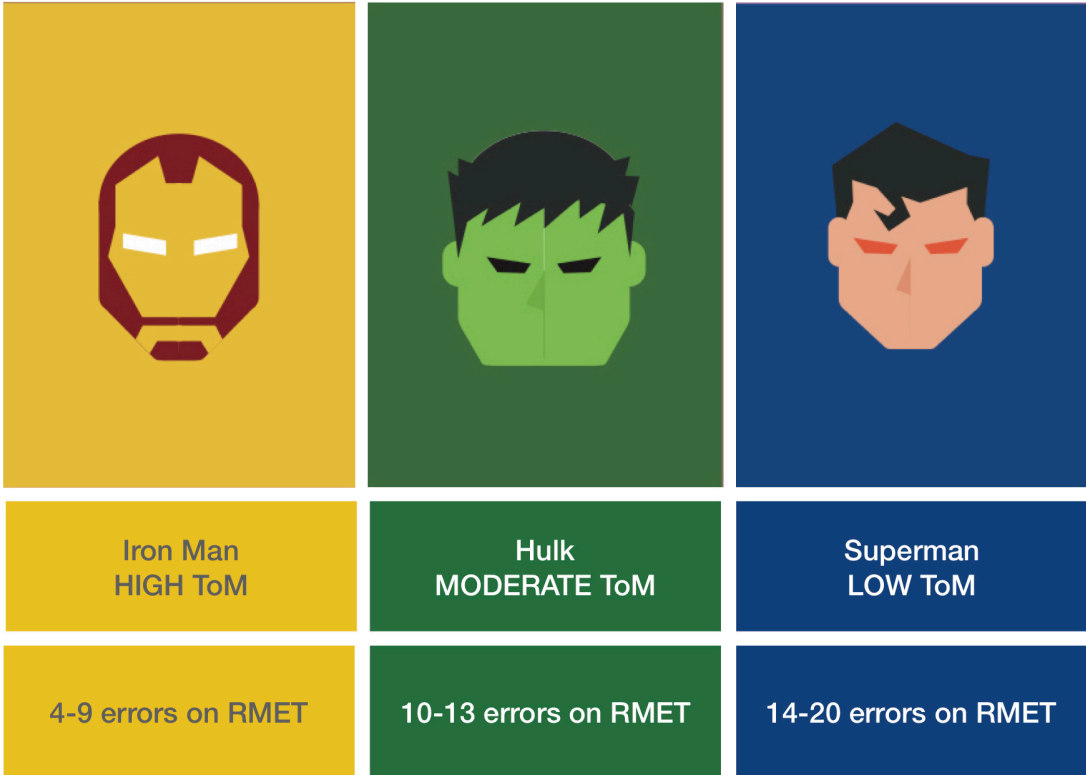


Figure 16. Cover story for ToM segmentation of hackathon participants.

Given the plurality of group-formation parameters, it was impossible to have completely homogenous teams in terms of ToM profiles. Consequently the average team RMET scores ranged from 20 to nearly 29, see Table 22. below:

TEAM	RMET SCORE	
	M	SD
N°6 Pocahontas	20.00	0.00
N°2 Lion King	25.40	1.14
N°4 Nemo	26.00	3.51
N°1 Mulan	27.67	0.58
N°9 Adibou	27.83	2.83
N°3 Aladdin	28.00	0.00
N°5 Dory	28.16	2.14
N°8 The Jungle Book	28.50	2.12
N°7 Frozen	28.75	5.86

Table 22. Team RMET scores.

Procedure. With the help of animators and coaches, nine pluridisciplinary teams of Mind Fhack have been working on the campus Bel Air in Villeurbanne, France on nine different innovation projects (see Figure 17.). The first day of the hackathon consisted in two work-sessions where teams worked on their projects, interrupted by a lunch-break during which participants filled-out an individual self-reported questionnaire (D1 questionnaire). Immediately before the dinner break, all groups had to present their progression in a 2-minute elevator pitch. The second day also consisted of a morning and afternoon work session and in-between lunch-break with questionnaire filling (D2 questionnaire). At the end of the second day, all groups exposed their projects in front of the jury who evaluated the projects, announced the winners and distributed the prizes. Participants were debriefed about the study details during the evening cocktail that followed the jury deliberation.



Figure 17. Teams working on their innovation projects during the Mind Fhack hackathon event.

Data Collection. Self-reported questionnaire composed of flow scale, collective flow items, social identification measure, motivation scale, and self-reported creativity items were administrated to all participants. The questionnaire was composed of:

- **Absorption scale from FSS –The Flow Short Scale** (Rheinberg et al., 2002) with 7-point Likert scale: 4 items, $\alpha=0.745$ for D1, $\alpha=0.682$ for D2 (e.g., “I felt just the right amount of challenge, I didn’t notice time passing”). D1 and D2 data could not be aggregated because of very poor reliability scores, hence we decided to analyze separately the experience of groups on the first and second day.
- **Intrinsic motivation scale from SIMS** – The Situational Motivation Scale (Guay et al., 2000), with 7 –point Likert Scale: $\alpha=0.864$ for D1, $\alpha=0.939$ for D2 (e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant”).
- **SISI – Single-item Social Identification Scale** “I identified with my group” (Postmes et al., 2013), with 7-point Likert scale.
- **Collective Flow** measured by two homemade items (“Our team acted as a whole. The team members were absorbed in the collective activity, coordinating effectively and feeling good together”; “I feel that our team wants this activity to continue”) ($\alpha=0.695$ for D1, $\alpha=0.646$ for D2).

Performance measure. In order to measure the team performance, we used the final jury evaluations. All four jury members used template grid with five dimensions to assess the quality of the projects. The five evaluation criteria were the following: (1) project vision, (2) user experience, (3) prototype quality, (4) business model, and (5) the quality of the oral presentation. Each evaluation criterion could bring a maximum of 5 points, so the maximum possible number of points was 25.

The organizing committee of the event determined the five rating criteria previously. Each jury member had to rate each project presentation on five different criteria. See Table 23. which summarizes the reliability of each of five criteria used by four jury members to evaluate the quality of innovation projects presented by teams.

CRITERION	RELIABILITY Cronbach’s Alpha
1. Project Vision	$\alpha = 0.689$
2. User Experience	$\alpha = 0.760$
3. Prototype quality	$\alpha = 0.685$
4. Business Model	$\alpha = 0.714$
5. Oral Presentation	$\alpha = 0.635$

Table 23. The five criteria used by four jury members.

Results. Forty-six participants filled-out the RMET questionnaire on the evening before hackathon. On the first day, 43 hackathon participants answered the survey. On the second day, 31 hackathon participants answered the survey.

What does predict collective flow on the first day? We have run a linear regression with collective flow as a dependent variable and four independent variables: mean RMET score, flow absorption score from the first day, intrinsic motivation score from the first day, and social identification score from the first day (see Table 24. below). The results show that none of the independent variables predicts the collective flow (RMET $t = -0.498$, $p = 0.652$, $\beta = -0.262$; flow absorption $t = 0.100$, $p = 0.927$, $\beta = 0.075$; intrinsic motivation $t = 0.346$, $p = 0.752$, $\beta = 0.188$; social identification $t = 0.773$, $p = 0.496$, $\beta = 0.492$).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	0.150	11.213		0.013	0.990
	Mean RMET Score	-0.061	0.122	-0.262	-0.498	0.652
	J1 Flow Absorption	0.101	1.008	0.075	0.100	0.927
	J1 Intrinsic Motivation	0.773	2.237	0.188	0.346	0.752
	J1 Social Identification	0.381	0.492	0.463	0.773	0.496

Table 24. Multiple linear regression to predict collective flow

What does predict collective flow on the second day? The same analysis was done with the second day average team collective flow as a dependent variable, with the exception of RMET scores, which were removed. Our hypothesis indeed assumed that RMET scores would be important for getting to know each other on the first day only. Therefore the three independent variables of the model for the second day included: aggregate flow absorption, aggregate intrinsic motivation, and aggregate social identification. Results demonstrate that none of these variables predict collective flow on the second day (flow absorption $t = 0.507$; $p = 0.639$, $\beta = 0.461$; intrinsic motivation $t = 0.591$; $p = 0.586$, $\beta = 0.531$). However, the aggregate scores of social identification are marginally significant ($t = 2.378$; $p = 0.076$, $\beta = 0.436$). The variance explained by this model corresponds to $R^2 = 0.840$ (see table 25.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	-3.601	2.310		-1.559	0.194
	D2 Flow Absorption	0.234	0.461	0.151	0.507	0.639
	D2 Intrinsic Motivation	0.314	0.531	0.227	0.591	0.586
	D2 Social Identification	1.037	0.436	0.683	2.378	0.076

Table 25. Regression to predict the collective flow.

Does RMET predict the performance? We have run a linear regression with team performance as a dependent variable and RMET score as independent variable. The results indicate that RMET is a negative and insignificant predictor of team performance ($t = -0.981$, $p = 0.365$, $\beta = 0.350$). The variance explained by this model corresponds to $R^2 = 0.138$ (see table 26).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	19.232	9.333		2.061	0.085
	RMET Score	-0.343	0.350	-0.372	-0.981	0.365

Table 26. Regression to predict performance

What does predict the performance? We have also run a linear regression with team performance as a dependent variable and three independent variables as predictors: flow absorption on the second day, social identification on the second day and collective flow score on the second day. The results indicate that none of the variables is a significant predictor of team performance. However, we have observed that social identification on the second day has a marginal significance to predicting team performance ($t = 2.458$, $p = 0.091$, $\beta = 4.574$). The variance explained by this model corresponds to $R^2 = 0.682$ (see table 27.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	Intercept	-32.847	17.423		-1.885	0.156
	D2 Flow Absorption	1.646	1.788	0.360	0.921	0.425
	D2 Social Identification	11.243	4.574	2.221	2.458	0.091
	D2 Collective Flow Score	-6.055	2.819	-2.074	-2.148	0.121

Table 27. Regression to predict performance

Discussion

Having an opportunity to test the relationship between the Theory of Mind, collective flow and creativity in an ecological setting of a hackathon, we engaged in a study of ad-hoc teams. Obviously, our research intervention was not the primary reason of this happening and therefore we had to make some real-time methodological compromises. Ideally, our wish was to constitute homogeneous teams in terms of their member's ToM dispositions and thus to compare three distinct conditions: *low ToM*, *average ToM* and *high ToM* condition. Due to other parameters, the team formation was not successful enough and we have not accomplished forming perfectly homogeneous teams in terms of ToM scores. In consequence, we have analyzed the data in a correlational fashion.

Just as in the previous study at CESI Engineering School, we found no evidence that ToM dispositions predict collective flow. RMET scores were not predictive of collective flow. An insignificant, but marginal result was found for social identification on the second day indicating that there is a certain possibility for the social identification to play a role in the experience of collective flow on the second day of the event, but not on the first one.

The results from this study reinforce our findings from the previous one: group members' ToM dispositions do not seem to be that important for the small-group innovation teamwork. Having numerous methodological limitations, the results of this study should be taken with caution. Even though imperfect, we decided to report on this study as an exciting example of a possible methodology and a hint for further research. Subjectively speaking, putting the scientific rigor aside: this hackathon, from an observer's perspective, corresponded exactly to what collective flow *feels like* to outside witness. Furthermore, the unofficial oral testimonies of the hackathon participants made us think that this sprint-like innovation setting is really beneficial for experiencing the collective flow. Despite the complexity of a rich ecological context, we encourage future research to use the opportunity of real hackathons as the field for studying optimal collaboration and peak performance phenomena.

Discussion

Consisting in three studies, this chapter aimed to answer our first theoretical hypothesis **H1**: Empathy of group members fosters the collective flow. The experimental pilot study, which unsuccessfully attempted to manipulate situational empathy yielded results that suggest no difference between the two experimental conditions except the social identification, which was marginally but insignificantly higher for the *empathy* condition. There was no significant difference for creativity either. In the next study, where we examined the relationship between dispositional theory of mind and collective flow, we have not found any support for our hypothesis either: RMET scores did not predict anything at all. However, we observed that intrinsic motivation and social identification do predict individual and collective flow, while the task achievement was marginally but insignificantly predicted by the flow experience. Lastly, a field experiment in the context of a hackathon, examining the relationship between the dispositional theory of mind and collective flow attempted to test our hypothesis in an ecological setting with ad-hoc groups of genuine strangers. Findings indicate that RMET scores did not predict collective flow or performance. Nevertheless, we observed a marginal link between social identification measured on the second day of the event and the experience of collective flow, as well as performance. Overall, we can conclude that our first theoretical hypothesis is not supported by our data.

In line with our results, we are led to modify our theoretical model by removing Empathy/ToM/Social Sensitivity from inputs. Therefore, the corrected model is the following (See Figure 18.)

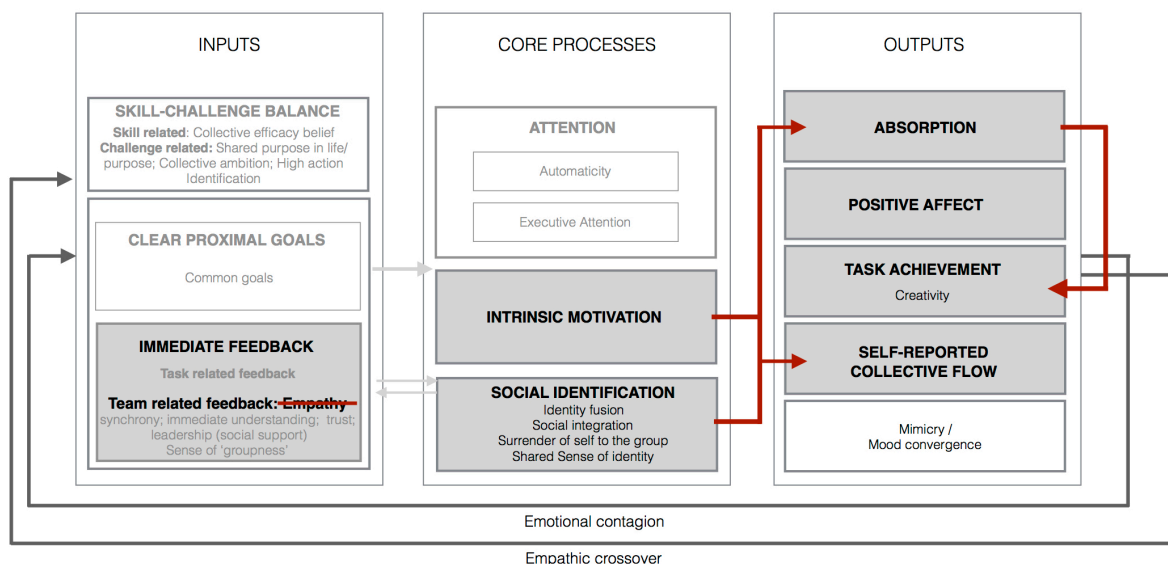


Figure 18. The corrected I-P-O model of Collective Flow.

Even though none of our hypotheses was confirmed, our study yielded some very interesting and significant results concerning flow in group-context. It should be noted that, on an individual basis, absorption flow was predicted by intrinsic motivation (which is consistent with previous research on flow, and particularly with our FEF model) and by social identification (which, on the contrary, is something completely new and surprising). We argue that these results demonstrate the paramount importance of social relationships for the eudemonic well-being. Individually determined, the social identification refers to the individual member's relationship to being part of some entity (Postmes et al., 2013). This concept, which is capital in determining what is a group and what is not a group (Sherif, 1966) is one of the key concepts in social psychology. Bridging this topic addressed within social identity theory (Tajfel, 1978; Tajfel & Turner, 1979) and self-categorization theory (Turner, 1985, Turner et al., 1987) with positive psychology perspectives leads us to take into consideration Seligman's (2011) PERMA theory of flourishing. PERMA is a theory of human well-being, a multi-dimensional approach offered to define what it means to flourish in life. It includes the five following factors: **P**ositive emotion, **E**ngagement (being in the flow), **R**elationships, **M**eaning (purpose in life), and **A**ccomplishment (PERMA). Positive relationships, one of Seligman's conditions for flourishing, are also present in other theoretical conceptualizations of well-being (e.g., Keyes et al., 2002; Keyes, 2005; Huppert & So, 2013; Diener et al., 2010). Therefore, noticing that the research in positive psychology is unanimous about the importance of positive relationships for human thriving, our findings seem to acquire more sense. Described by Seligman (2011, p. 15) as "feeling socially integrated, cared about and supported by others, and satisfied with one's social connections", the concept of positive social relationships may be linked to social identification while still being quite different.

Individual flow in a group setting seems to function differently than individual flow in solitary settings. As we have seen, the individual optimal experience in group setting depends on intrinsic motivation, but also depends on social identification. This psychosocial attitude of belonging to something bigger than self appears to be important in collective situation.

Regarding the results on the group level, we found that collective flow, just like individual flow, was predicted by intrinsic motivation and social identification. Interestingly, the individual absorption did not predict the collective flow. This is an important and surprising finding. Psychometric robustness of our collective flow measure does not permit us to jump into fast conclusions, but nevertheless we can notice that individual flow is not simply the phenomenological subset of collective flow and that collective flow may not be the aggregation of group members' individual flow experience. Having common grounds, these two phenomena remain very much distinct.

In the following chapter, we will present experimental studies aiming to examine the hypothesized relationship between the high action identification, collective flow and creative performance.

CHAPTER 5: Action Identification and Collective Flow



In this chapter, we are going to examine the second notable feature of collective flow, which arose from the literature - corresponding to defining, perceiving and relating to the challenge of the task at hand. The importance of doing something far-reaching, meaningful and challenging seems to be one of the preconditions of the interpersonal flow (van den Hout, 2016; van den Hout et al., 2018; Walker, 2010). This ambitious goal that the group determines, a bearer of a higher purpose is thus the second element of our collective flow framework and will be explained, examined and discussed in this chapter. This next element of our Collective Flow Theoretical Framework (see Figure 19.) constituting the preconditions block is, thus, the notion of **action identification**. Therefore, in this chapter, we will test our second theoretical hypothesis, **H2: High Action-Identification fosters the collective flow**. Major part of this chapter is submitted as an empirical paper in *Small Group Research*⁵ and currently under review.

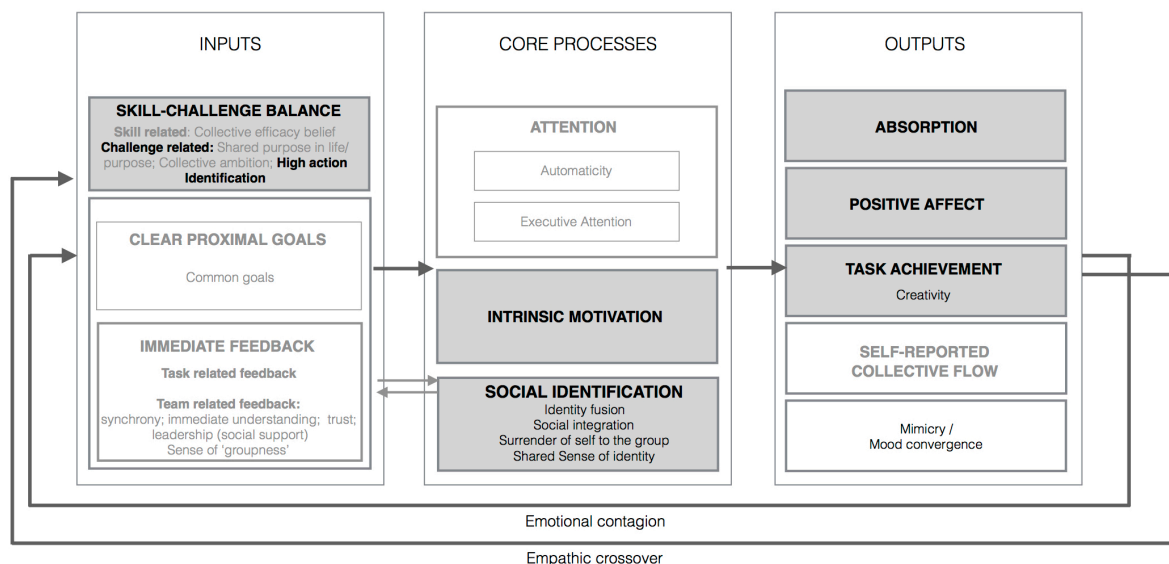


Figure 19. I-P-O diagram depicting a hypothetical relation between high action identification and collective flow.

Here, in this chapter we examine how important is the way the action is labeled in the context of creative teamwork through one laboratory experiment and one field study. Experimental manipulation of action identification allowed us to vary the action identities in controlled context and assess its causal effects on output elements of the model (positive affect, absorption and creativity) in the context of an innovation project. On the other hand, a quasi-experimental test of varying action identities in a field study was an occasion to explore the robustness of the phenomenon in the real-world setting.

⁵ Šimleša, M., Buisine, S., Blanchard, E., & Guegan, J. (submitted manuscript). Shoot for the moon: The role of action identification in collective flow. *Small Group Research*

Action identification theory

What are you doing right now: *looking at words*, *reading a chapter* or *getting updated about novelties* in the field of group-flow research? The way we cognitively represent action and label it is called the act identities. According to the theory of action identification (Vallacher & Wegner, 1985; 1987), we tend to identify our actions at particular level in a cognitive hierarchy of meanings. A low level of action identification involves its technical or mechanical details, such as *looking at words*, while high level of action identification will relate to its purpose, such as *getting updated about novelties in the field of group-flow research*. The theory consists of three principles (Vallacher & Wegner, 1987): (1) people do their action in reference to the existing identity on their mind, (2) when more than one identity is available, the higher one rules-out, and (3) when an identity makes the action too difficult to maintain, people tend to go for a lower one. This means that when a certain action is performed poorly, there is general tendency to adopt a lower-level identity of that act (Vallacher & Wegner, 1989).

The identities are represented in a cognitive hierarchy of action identities. *Looking at words* and *reading the chapter*, have a hierarchical relation to each other in that looking at words indicates *how* reading the chapter is done. Often, lower level action identities correspond to the *how* of the action, while higher action identities represent the *why* of the action. Empirically, depending on how the action is identified, the behavioural, affective and cognitive outcomes can significantly differ.

For example, in their experiment, Dar & Katz (2005) find that patients suffering from obsessive-compulsive disorder tend to agree more with high-level identities for their compulsive actions. Performing the same act habitually with the high-level identity in mind therefore makes them less likely to attempt to modify or regulate the habit.

Furthermore, as high level act identities indicate that a person understands causal effects and conventional interpretations, Kozak et al. (2006) examined the relationship between action identification and mind attribution – a process whereby the perceiver infers the existence of mental states, internal events, and other features of another person from external cues (Ames, 2004; Carruthers & Smith, 1996). Interestingly, their results show the attribution of an intention and cognition to a target person is associated with being able to identify the target's behaviour in terms of high-level effects.

Libby and colleagues (2009) investigated how the visual perspective (1st person versus 3rd person) in action imagery relates to action identification level. It appears that there is a bidirectional causal relationship linking 3rd person images and abstract (high) action identities.

A neuroscience study (Marsh et al., 2010) shows that brain regions corresponding to action identification and mind attribution overlap (the middle temporal gyrus near the extrastriate body area, the ventral premotor cortex and the inferior parietal lobule). According to their results, action identification is performed by regions that are involved in the

interpretation of actions and the inference of their attendant goals. Also, Marsh et al. (2010) find correlation between action identification and Autism Quotient scores. Precisely, greater autism quotient scores were linked with a failure to attribute high-level identifications to the actions of likable human targets – hence, a failure to infer that intentions and goals underlie their actions.

The level of one's action identification (also called *the level of personal agency*, Vallacher & Wegner, 1989) can impact action effectiveness, action planning, self-conception. Simply put, high-level action identification (i.e., understanding one's own action in terms of its implications and purpose) leads to better effectiveness, more planful behaviour and the degree to which the actions are organised by and reflected in the self-concept (Vallacher & Wegner, 1989).

The level of action identification is also related to the level of expertise in the target activity. Experts do smaller sub-activities implicitly such that they get chunked into meaningful, more abstract super-actions. Low action identification levels are associated to the need to conduct a behaviour with conscious attention to detail and a greater tendency to commit action errors, which is observed when the agent has a low level of expertise in the target activity (Vallacher & Wegner, 1989). Difficult actions will be identified at a low level, and will not enable the individual to integrate her acts in a big picture (Fointiat & Pelt, 2015). Conversely, expertise in a domain is associated to maintaining one's actions with more abstract identities in mind (e.g., Ewell et al., 2018).

When it comes to action planning, low level action identification is reported to be linked to greater impulsiveness and less temporal stability in the behaviour, and a lower self-motivation suggests less persistence (Vallacher & Wegner, 1989). Somehow, high-level identification shields people against the emergence of alternative identities that could change the course of the action. Lacking the big picture, low-level action identification might lead the person to engage in impulsive behaviour, responding to stimuli and pressures of the context rather than showing stability across contextual variations. Sticking to the action plan in certain way ensures the direction and consistence of a set of actions and simultaneously allows for certain degree of flexibility in the execution of intermediary sub-actions.

Also, high-level identities may be linked to more internal locus of control (a belief that one has control over the outcome of events in life). Hence the tendency to identify what is being done in high-level terms is associated with the perception that the larger effects of one's behaviour are within one's personal control (Vallacher & Wegner, 1989).

When identified in low-level terms, the person's conscious concern with action details leads to relative ineffectiveness, is related to lesser levels of self-motivation, is more impulsive, less consistent over time and more external in locus of control. According to Vallacher and Wegner, (1989), the level of action identification and self-motivation are significantly and positively correlated suggesting that conceptualizing own actions in more meaningful and purposeful terms seems to be related to the intrinsic interest in the activity

and possibly the autotelic experience of that activity. This finding makes us question the relationship between action identification, intrinsic motivation, capacity to stick to the action plan on the long term and flow experience.

In the case of higher-level action identities corresponding to the *why* of the action (distal consequences and implications), the conscious concern with the significance of an action, enabled by the relative effectiveness of that action shields the action against the emergence of new identities and, as such, maintains a stable course (Vallacher & Wegner, 1989).

To our knowledge, there are only two studies examining the importance of action identification in teams (Woolley 2009a, 2009b), demonstrating that the focus on the outcome is positively related to performance on open-ended tasks and that team-members' action identification levels mediate this relationship (Woolley, 2009a), and that outcome-focused teams tend to exhibit significantly higher level of action identification than teams that are focused on processes (Woolley, 2009b). It was shown that groups interpreting their task with a high level of action identification focus more on the outcome while groups with a low level of action identification focus more on the process and achieve lower performance on complex tasks (Woolley, 2009a).

All these studies measured the action identification after a participant or a group performed the activity. To our knowledge, no study dealt with prescribed action identities. However, in everyday life, in organizations, vast majority of employees and work teams receives a brief from their manager for a given task, or defines it through a collective process (Durham et al., 1997). Therefore, the activity is described and identified from the beginning. Thus, we aim at exploring the impact of varying action-identities on the group members' subjective experience as well as on the quality of their work.

EXPERIMENTAL STUDY

Action Identification Persona Experiment

Goals of the study

In the present study, we attempt to make two contributions to the literature. First, we attempt to manipulate the level of action identification by inducing low-level versus high-level act identities in a group setting. To our knowledge, this is the first study aiming to induce varying levels of action identification in a collaborative group setting. Second, we intend to measure the impact of these different levels of action identification on sociocognitive processes involved in collective flow (group identification, motivation, and absorption), as well as on the creative performance. The creativity task in this study involves an ideation protocol using Persona method - largely used by designers and ergonomists (Barré et al., 2017). This method consists in creating fictional user profiles on the basis of data collected about real users regarding their needs, customs, and expectations (Barré et al., 2017; Blomquist & Arvola, 2002; Bornet & Brangier, 2016). Furthermore, Persona method seemed particularly well adapted for an operationalization, manipulating differing levels of action identification, because of its user-centered approach. By focusing the ideation on serving end-users, the aim of the task can be easily formulated in different ways, varying the impact of the solution on the ultimate beneficiary.

Hypotheses

Specifically, in this study, we were interested in how differing levels of contextual action identification impact the collaboration and productivity on a creative task. We posit that the relationship between action identification and collective flow is positive.

Identifying the task in high-level identities focuses the efforts towards a bigger goal and thus might shift the attention from irrelevant details such as comparison within the ingroup. Such attention focus is favourable for social categorization (Tajfel & Turner, 1986) of group members in terms of the group and the group's *raison d'être*. Moreover, as the brain regions corresponding to action identification and mind attribution of likable targets overlap (Marsh et al., 2010), it is likely that high-level action identification enhances social categorisation of group members (identification in terms of group belonging – amidst likeable, similar others).

Furthermore, action identification and self-motivation seem to be positively and significantly correlated one to another (Vallacher & Wegner, 1989). Therefore, inducing high action identities may result in increased levels of intrinsic motivation. When individuals are intrinsically motivated, they engage in their work for the challenge and enjoyment of that work (Amabile, 1983). Focusing on high-level goals of the task by the means of action

identification is likely to generate autotelic experience, and therefore flow, in group members. Thus, we proposed the following hypothesis:

H1: High level of action identification should increase social identification, motivation, and flow.

H2: High level of action identification should increase the creative performance of the group, and this relation should be mediated by social identification, motivation, and flow.

Method

Participants

The participants were French undergraduate engineering students. The experiment was run in a form of innovation workshop (see Figure 20.), which was a part of students' final year curriculum. A total of 72 students participated in the study (11 female and 61 male) with an average age of 23.67 years ($SD = 1.69$). The 72 participants were distributed into 24 work groups. Eleven groups had one female participant, while the other 13 groups were exclusively composed of male participants.



Figure 20. Students in work teams doing the task.

Materials

For this study we used Persona method. The conception of User Persona profiles, hypothetical character sketches (or prototypes) of people who are supposed to engage with the product, consisted in blending quantitative demographic data with qualitative psychographic data in order to achieve a plausible support material for representing end-user market segments. Quantitative elements of persona creation conveyed the research information based on facts and data representing *mean* characteristics of two target groups: the most common names in France chosen from national registry sorted by the year of birth, last names, occupation, and most common activities according to national benchmark. On the other hand, qualitative elements were added to make the profiles personal enough, the story relatable and believable, depicting the real life of a person: specific details about daily concerns, family details, and personal affinities. These attributes were added for enhancing memorability, maintaining the focus of participants on the end users throughout the workshop session. Two Personae were created to represent two target segments, namely children and disabled persons (see Figure 21.). Each persona sheet contained a photograph of the person, first name, last name, age, occupation, approximately 150-word long biography, life motto, digital habits profile, personality traits, and life goals.



Figure 21. The two Persona profiles.

Procedure

The groups received instructions to propose creative solutions for future application of a connected object that can do *almost anything* (Figure 22.). The gadget is portable, connected, and can communicate with users and objects of all sorts. All groups were provided with the two Personae and instructed to imagine applications of the connected object for a child (Marie) and a person with disability (Philippe).



Figure 22. The connected object *MegaTech*.

Groups were randomly assigned to 2 conditions (between-group factor) differing in the level of action identification. The higher-level identity condition groups were instructed to imagine applications that will *change the life of the Personae*, while the lower-level condition groups were instructed to imagine applications that will *improve the daily life of Personae*. Everything else remained identical for the two conditions.

The creativity workshop was divided into 3 phases: divergent thinking phase, convergent thinking phase (Guilford, 1967), and elaboration phase. In the first phase of the session (30min, i.e. 15min for each Persona), groups carried out idea generation using post-its. In the second phase of the session (20 minutes) the teams were to choose the four best ideas (two for each Persona) and develop them in the third phase (40 minutes) by filling-in a pre-defined one-page idea-template (title of idea, detailed description, illustration, differentiating elements, advantages, disadvantages, and feasibility – short-term, middle-term, long-term). Each group was supposed to hand in four idea-templates containing creative application projects (two for each Persona). The whole experimental procedure lasted around 3.5 hours.

Data collection

After the session, participants filled out a questionnaire individually, were debriefed and dismissed. The questionnaire was composed of:

- **SISI – Single-item Social Identification Scale** “I identified with my group” (Postmes et al., 2013), with 7-point Likert scale, measuring the group identification.
- **FSS – 13-item The Flow Short Scale** (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters: absorption ($\alpha=0.740$; e.g., “I felt just the right amount of challenge, I didn’t notice time passing”), fluency ($\alpha=0.829$, e.g., “My thoughts run fluidly and smoothly”, “I had no difficulty concentrating”) and importance ($\alpha=0.560$, e.g., “Something important to me was at stake here”, “I was worried about failing”). We decided not to keep the importance sub-scale because of its moderate reliability.
- **SIMS – The 16 items Situational Motivation Scale** (Guay et al., 2000), with 7 – point Likert Scale. Composed of 4 clusters: intrinsic motivation ($\alpha=0.922$, e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant”), identified motivation ($\alpha=0.861$, e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me”), external regulation ($\alpha=0.613$, e.g., “I was engaged in this activity: Because I was supposed to do it, Because it was something I had to do”), and amotivation ($\alpha=0.762$, e.g., “I was engaged in this activity: I did this activity but I was not sure if it was worth it, There might be good reasons to do this activity, but personally, I didn’t see any”). We decided not to keep the external regulation sub-scale because of its moderate reliability.

Creative performance

Five hundred eighty five ideas from the divergent thinking phase were collected and examined. The fluency was measured in terms of number of non-redundant ideas produced by group and by each individual in each group.

The 95 idea-templates were evaluated by 4 innovation experts, blind to the conditions, employing a widely used consensual assessment approach (Amabile, 1982, 1996; Yong et al., 2014). Each expert had to rate each idea-template on a 7-point Likert scale from 1 (not creative at all) to 7 (extremely creative). Interjudge agreement on the whole sample of idea-templates appeared insufficient to conduct a reliable analysis. Therefore we decided to exclude the idea-templates that had a standard deviation superior to 1.00 in creativity ratings. The final sample included 53 idea-templates for which the four raters had the best Inter-rater agreement (Cronbach’s $\alpha = 0.806$).

Test of H1 – Collective flow processes. Group identification, flow and motivation were analysed at the individual level with a simple (high level action identification vs. low level action identification) ANCOVA with sex as a covariate.

We observed a significant main effect of the action identification ($F(1, 69) = 11.07, p = 0.001, \eta^2p = 0.138$), showing that group identification was higher in the high action identification condition ($M = 5.71, SD = 1.25$) than in the low action identification setting ($M = 4.36, SD = 2.06$).

We observed a significant main effect of the action identification ($F(1, 69) = 4.342, p = 0.041, \eta^2p = 0.059$), showing that intrinsic motivation was higher in the high action identification condition ($M = 4.72, SD = 1.21$) than in the low action identification setting ($M = 3.96, SD = 1.89$).

The same pattern was observed for identified motivation ($F(1, 69) = 5.71, p = 0.020, \eta^2p = 0.076$) where the scores were significantly higher in the low action identification condition ($M = 3.22, SD = 1.77$) comparing to high action identification condition ($M = 4.07, SD = 1.28$).

There were no significant differences for amotivation ($F(1, 69) = 1.616, p = 0.208, \eta^2p = 0.023$) ($M = 3.569, SD = 1.863$ for low action identification condition vs. $M = 3.11, SD = 1.19$ for high action identification condition).

We observed a significant main effect of the action identification ($F(1, 69) = 4.17, p = 0.045, \eta^2p = 0.057$), showing that absorption factor of flow score was higher in the high action identification condition ($M = 4.35, SD = 0.75$) than in the low action identification setting ($M = 3.69, SD = 1.27$).

On the other hand, no significant difference was found for flow fluency subscale ($F(1, 69) = 1.145, p = 0.288, \eta^2p = 0.016$) ($M = 4.58, SD = 1.49$ low action identification condition vs. $M = 4.90, SD = 0.99$ high action identification condition).

Overall, our results suggest that high action identification in groups positively impacts identification of group members to their team, intrinsic motivation of group members and absorbing experience of flow.

Test of H2 - Creative performance and mediation. Contrary to our predictions, the number of ideas did not differ between the low action identification condition and the high action identification condition ($F(1, 69) = 2.12, p = 0.15, \eta^2p = 0.03$, high identification condition $M = 7.44, SD = 3.76$ vs. low identification condition $M = 9.72, SD = 8.29$), which invalidates H2.

The quality of idea-templates ($N = 53$) was slightly superior in the high identification condition ($M = 4.138, SD = 0.805$) than in the low identification condition ($M = 3.69, SD = 0.88$). However, this difference was only marginal ($t(51) = -1.893, p = 0.064$).

The absence of significant effects of Action identification on creative performance also invalidates the mediation hypothesis. We nonetheless performed a mediation analysis to better inform the effects of Action identification on Sociocognitive processes involved in collective flow, namely Group identification, Motivation and Absorption. In line with our

theoretical model of collective flow, we tested a mediation model including Action identification as Independent factor, Motivation and Group identification as Mediators and Absorption as Dependent variable. In this model, the Motivation factor was computed from the aggregation of intrinsic motivation and Identified motivation ($r = 0.751$, $p < 0.001$ controlling for Action identification). Sex was included as a covariate.

The results (Figure. 23.) show that a high level of Action identification increased group identification ($\beta = 1.34$, $p = 0.001$), which in turn increased Flow absorption ($\beta = 0.24$, $p = 0.001$). Sobel test confirms that the indirect effect of Action identification on Flow absorption through Social identification is positive and significant ($z = 2.31$, $p = 0.02$). High levels of Action identification also increased Motivation ($\beta = 0.82$, $p = 0.019$), which increased Flow absorption ($\beta = 0.49$, $p < 0.001$). The indirect effect of Action identification on Flow absorption through Motivation is positive and significant as well ($z = 2.18$, $p = 0.028$). Partial correlation between group identification and Motivation is low and non-significant ($r = 0.175$, $p = 0.148$). This mediation analysis accounts for much of Flow absorption variance ($R^2 = 0.483$).

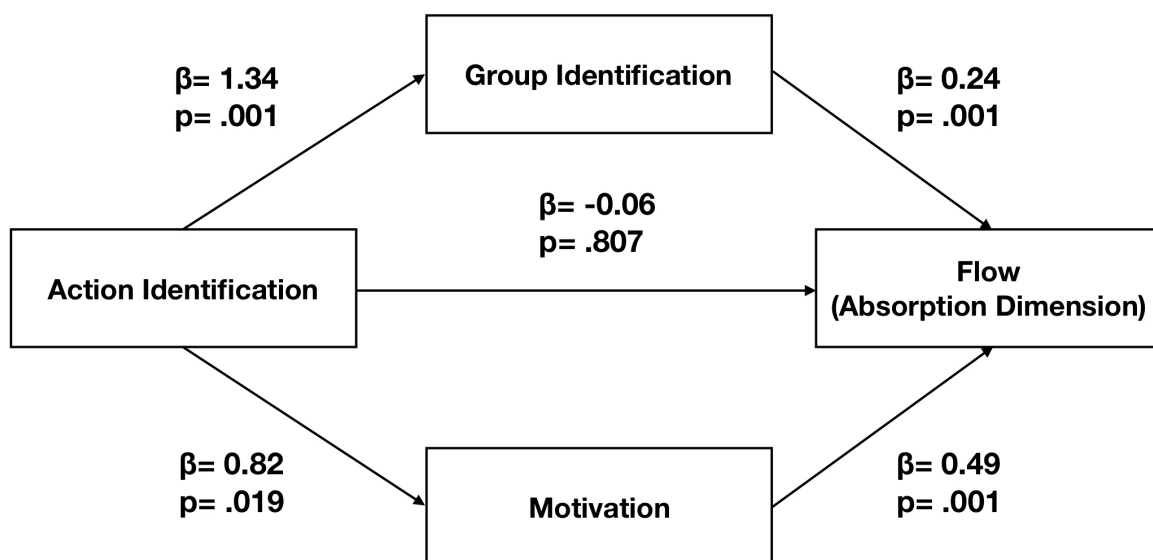


Figure 23. Mediation diagram.

Discussion

The aim of this study was to examine the impact of differing action identification levels on the collaboration and creative performance of small groups working on an innovation project. Although scarce, existing research on action identification and teamwork reports findings from studies that measure action identification a posteriori. In contrast, this study offers a distinctive approach and perspective. A sample of twenty-four nominal, face-to-face groups, each composed of three persons, worked on innovation projects for an extended period of time of three hours and a half (which represents one half of a regular school-day).

As predicted, the findings of this study clearly demonstrate that high-level action identification of a collective task fosters group identification, intrinsic motivation, and flow. One achievement of the present study was demonstrating that a subtle experimental manipulation of team instructions that barely differs in few words has a significant impact on these processes. Therefore, these findings provide an original and important empirical support for saying that high level action identification in collaborative projects is particularly beneficial.

However, the relationship between action identification and creative performance (fluency of ideas and originality of innovation projects) remains unclear. This result concerning the creative performance, which remains inconclusive due to its insignificance, surprisingly but undoubtedly raises several questions.

One achievement of the present study was demonstrating a double, parallel mediation between action identification and flow. Showing that collective flow can be successfully manipulated by varying different levels of action identification, and that this is interceded by intrinsic motivation and group identification - is a hitherto unseen result. With regards to our theoretical model, we can thus say that high action identification is indeed one of the challenge-related inputs of collective flow. Hence, we can say that this element does belong to the model and that we have validated our second theoretical hypothesis.

The analysis of mediation between action identification and flow was partially mediated by group identification. It is possible that an ambitious task focus has a potential to draw group members' attention from unnecessary and harmful processes such as intergroup comparison. Doing together something big, important and purposeful seems to be perfectly suitable for social categorization (Tajfel & Turner, 1986) with ingroup members.

Concomitantly, the link between action identification and flow is mediated by the motivation. Having labelled the joint action in terms of high action identities increases the self-determined motivational processes, meaning the work becomes more motivating by itself. So, our results indicate that the higher the action is identified, the more autotelic the experience of collaborative act execution. Unsurprisingly, autotelic motivation fosters flow. According to the Flow Engine Framework (Šimleša et al., 2018) being involved in an activity providing flow requires a certain kind and certain level of motivation that moves the doer's

will to continue being invested in the activity. Therefore, in this theoretical model, motivation appears as a very important variable in the flow process mechanism.

According to the common belief and popular science, the power of longing to do big things, that are purposeful, meaningful and having a significance is considered to have a potency for motivating and uplifting people on their way to success, innovation and/or happy life. Famous heuristic *shoot for the moon* might be translated as follows *label your act identities in the highest possible manner and hope for the best*. Our findings are in line with Dyer and colleagues' (2011) hypothesis that innovators tend to believe that they can change the world. According to their descriptive model, innovators, unlike a typical executive, question, observe, network and experiment more, driven by the desire to change the status quo.

Consider the consistency of language that innovators use to describe their motives. Steve Jobs wants to “put a ding in the universe”. Google cofounder Larry Page has said he’s out to “change the world”. (Dyer et al., 2011, p. 25)

Studying these exceptional leaders, authors (Dyer et al., 2011) find that these persons spend almost one more day each week on discovery activities. This means that fulfilling their dream to change the world implies spending additional time trying hard to explore and discover how to operationalize this ambition. Interestingly, a salient theme within the innovative companies studied by Dyer et al. (2011) is looking for hiring individuals who have (1) already invented or discovered something, (2) are experts in certain domain of knowledge, and (3) manifest a passion to change the world.

Certainly, our study had several limitations as well, which suggest new directions for future research. First, the study was done on a sample of French engineering students, which means that the results and conclusions might not be instantly generalizable on population corresponding to other demographic characteristics and expertise levels such as present and future clients of SBT Human(s) Matter. Nevertheless, as the manipulation of action identification level is a rather simple to operationalize in any collaborative setting where the task goal is explicitly verbalised, this generalizability issue is easy to overcome.

Second, in order to maintain a controlled experimental framework, the participants were not in position to propose the task on their own, but instead were given an already prepared assignment. Thus, this exercise remains explicitly prescribed, and partially fictional. Nonetheless, it may be possible to somehow design a study where groups can define their own question and thus work on projects that correspond more to their actual concerns and issues they hold for purposeful. This might be a very interesting direction for the future research.

Having observed that the relationship between high action identification and flow experience is partially mediated by the process of social identification, we assumed that acting upon both of these (action identification and social identification) might yield interesting results. The following field study run in a hyper-ecological setting was done with a set of complex non-creativity tasks in order to explore the generalizability and universality of the effect of high action identification.

FIELD STUDY

Autrans Teambuilding Example

Context. Every year around wintertime, SBT Group organizes a two-day teambuilding seminar for all employees. This event is an important opportunity to create lasting relationships between colleagues and establish strategy for quality teamwork. One of the yearly seminars of SBT Group took place on 10th and 11th of October 2016 at Autrans (Isère department, Rhône-Alpes region, France), a mountain recreational resort located on the Vercors Plateau in the Vercors Regional Natural Park, approximately 10km west of Grenoble. The event program was carefully planned and filled with numerous group activities: treasure hunt game, questionnaire competition, collective singing animation and a party – for the day one; followed by presentations of strategic vision, and small-group workshops around the main axes of Group’s strategy on the day two. Having an access to organization of the seminar and the possibility to do research upon it, we decided to use the treasure-hunting game on the day one as a field study for assessing collective flow experience in a *real-life* setting.

Goals of the study. There were three main goals for this study. The first aim of the study was to extend the study of action identification in group work on a different population, in a different contextual setting. Secondly, we aimed to examine the effect of high action identification on collective flow and performance on a task that is not a creativity task.

Hypotheses. We hypothesize that the high action identification is generally beneficial for the teamwork and will reflect in increased collective flow as well as in increased team performance.

H1: High action identification increases flow, intrinsic motivation, positive mood and social identification.

H2: High action identification increases team performance

Participants. The participants were SBT Group employees from four Group’s subsidiaries: SBT Lyon, SBT Grenoble, SBT Toulouse and SBT Paris. The study was done in the treasure-hunting-game setting. A total of 74 employees participated in the study (44 female and 30 male) with an average age of 34.43 years ($SD = 8.57$). The 74 participants were distributed into 12 teams of 6 or 7 participants. The groups were not built randomly, but intentionally to ensure for the heterogeneity: sex, seniority, subsidiary location (Lyon, Grenoble, Toulouse or Paris) and function (managers, consultants, accountants, researchers, designers, hotline operators, sales persons, etc.). Each group had a name of Marvel Comics super-hero: (1) Jean Grey, (2) Wonder Woman, (3) Iron Man, (4) Superman, (5) Green Arrow, (6) Flash, (7) Hulk, (8) Batman, (9) Elektra, (10) Invisible Girl, (11) Storm, and (12) Magneto (see Figure 24. below).



Figure 24. Superhero logos for each group.

Materials. The 12 teams were equipped with group membership insignia. Each player wore a kerchief in the color of their group and a badge with the logo of the group. After the collective instruction briefing, each group was given one physical topographic terrain map with the checkpoints marked on it. The experimental induction was done by printing a motivational header in big letters on the upper section of the map: *Your goal is to check on the check-points* (Fr. *S'enregistrer sur les check-points* - low action identification condition) or *Your goal is to surpass yourselves together* (Fr. *Se dépasser ensemble* - high action identification condition).

Procedure. The groups received instructions about the rules of the game and began the trail. The time limit was set to 2 hours and 30 minutes for everyone with a penalty of subtracting - 20 points from the final score for the overdue. Each checkpoint brought 10-25 points (depending on the difficulty) for a group. Checkpoint error meant subtracting -5 points. Six check points were equipped with a task or a challenge (for more detail, see the table 28. below), which brought 30 additional points. Failing to do the challenge-task subtracted -50 points from the score. At the end of the game, all points were counted and a ranking list of groups was established. A self-reported questionnaire, in an online form, was administered one week later.

TASK	CHALLENGE
Intuition / Capacity to find the hidden	Find the hidden item with an avalanche beacon.
Puzzle	Team or team leader has a puzzle to solve.
Analysis / Mystery	Problem-solving with a use of logical deduction for the entire team.
Precision	Archery in the woods.
Creativity	Aqueduct construction in order to bring water from point A to the point B. Every team needs to contribute to the overall construction. All sectors will be linked into one big aqueduct in the end (see Figure 25.)
Agility	You will dispose of a stretcher and transport an injured person as fast as you can through a trail in the woods

Table 28. List of challenges.



Figure 25. Wonder Woman team working on the aqueduct construction task at one of the check-points.

Data collection.

The questionnaire was administrated online (Typeform) one week after the teambuilding seminar. We had 47 answers to this online questionnaire. This questionnaire was made of:

- **BMIS** - 16-item Brief Mood Introspection Scale (Niedenthal & Dalle, 2001) with 4-point scale. Composed of 3 clusters: positive moods (lively, happy, caring, content, peppy, loving, active; $\alpha = 0.850$), negative moods (sad, tired, gloomy, jittery, drowsy, grouchy, nervous, fed up $\alpha = 0.504$), and calm (mood unrelated to all other moods); because of the poor reliability, we decided not to aggregate negative moods.
- **Social Identification Score** – composed of SISI, Single-item Social Identification Scale (Postmes et al., 2013), with 7-point Likert scale.
- **FSS** – 13-item The Flow Short Scale (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters: absorption (e.g., “I felt just the right amount of challenge”, “I didn’t notice time passing” $\alpha = 0.662$), fluency (e.g., “My thoughts run fluidly and smoothly”, “I had no difficulty concentrating” $\alpha = 0.881$) and importance (e.g., “Something important to me was at stake here”, “I was worried about failing” $\alpha = 0.642$). Aggregating absorption and fluency subscale resulted in a total flow score with good reliability ($\alpha = 0.882$).
- **SIMS** – The 16 items Situational Motivation Scale (Guay et al., 2000), with 7 –point Likert Scale. Composed of 4 clusters: intrinsic motivation (e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant” $\alpha = 0.946$), identified motivation (e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me” $\alpha = 0.883$), external regulation (e.g., “I was engaged in this activity: Because I was supposed to do it, Because it was something I had to do” $\alpha = 0.796$), and amotivation (e.g., “I was engaged in this activity: I did this activity but I was not sure if it was worth it, There might be good reasons to do this activity, but personally, I didn’t see any” $\alpha = 0.661$).

Results.

Here, we analyzed the participants’ answers from the second questionnaire that was filled-out one week after the Autrans event.

Individual results.

ANCOVA (sex as covariate)					Descriptives			
					High AI		Low AI	
Variable	df	F	p	η^2p	M	SD	M	SD
Flow Absorption	1, 44	2.773	0.103	0.059	6.052	0.766	5.652	0.838
Total Flow	1, 44	2.086	0.156	0.045	5.412	0.851	4.943	0.924
Intrinsic Motivation	1, 44	0.530	0.471	0.012	5.844	1.224	5.630	0.935
Positive Mood	1, 44	2.733	0.105	0.058	4.474	0.642	4.098	0.823
Social Identification (SISI)	1, 44	0.617	0.436	0.014	5.292	1.601	4.826	1.230

Table 29. ANCOVA with sex as covariate results.

Test of H1. In order to test our first hypothesis and see whether there is a significant difference between the two conditions, we have used a simple ANCOVA with the sex as covariate for following variables: flow absorption, flow total, intrinsic motivation, positive mood and social identification (see Table 29). The results suggest that there is no significant difference for any of the variables between the two conditions (flow absorption $F(1, 44) = 2.773$, $p = 0.103$, $\eta^2p = 0.059$; total flow $F(1, 44) = 2.086$, $p = 0.156$, $\eta^2p = 0.045$; intrinsic motivation $F(1, 44) = 0.530$, $p = 0.471$, $\eta^2p = 0.012$; positive mood $F(1, 44) = 2.733$, $p = 0.105$, $\eta^2p = 0.058$; social identification - SISI $F(1, 44) = 0.617$, $p = 0.436$, $\eta^2p = 0.014$). This invalidates our first hypothesis.

Regressions. Unable to observe significant differences in sociocognitive and affective variables of individual experience, we decided to pursue our analysis without the comparison of the two conditions, by exploring the structure between the observed variables. Therefore, we have run a multiple regression analysis to see what does predict individual flow experience of group members.

What does predict flow on individual level? A regression analysis was run, with total flow score as a dependent variable. The three independent variables of the model included: positive mood, social identification, and intrinsic motivation. Results demonstrate that positive mood and intrinsic motivation were positive and significant predictors of flow experience (positive mood $t = 1.972$; $p = 0.055$, $\beta = 0.168$; intrinsic motivation $t = 2.540$; $p = 0.015$, $\beta = 0.115$). Social identification score was marginally significant positive predictor of flow ($t = 1.782$; $p = 0.082$, $\beta = 0.088$). The variance explained by this model corresponds to $R^2 = 0.439$ (see Table 30.).

Model	Unstandardized	Standard Error	Standardized	t	p
1 intercept	1.261	0.688		1.834	0.074
Positive Mood	0.332	0.168	0.274	1.972	0.055
Social Identification Score	0.156	0.088	0.220	1.782	0.082
Intrinsic Motivation	0.292	0.115	0.349	2.540	0.015

Table 30. Multiple linear regression to predict flow on the individual level.

Group results. Next, we have aggregated individual answers into group scores and analyzed data on the group level in order to explore what predicts flow on a group level and what predicts team performance.

What does predict flow on a group level? A regression analysis was run, with aggregate flow score as a dependent variable. The three independent variables of the model included: aggregate social identification, aggregate intrinsic motivation, and aggregate positive mood. Results demonstrate none of these variables were significant predictors of flow experience on the group level (intrinsic motivation $t = 1.188$; $p = 0.269$, $\beta = 0.302$; positive mood $t = -0.018$; $p = 0.953$, $\beta = 0.322$). Social identification score was marginally significant positive predictor of group-level flow ($t = 2.102$; $p = 0.069$, $\beta = 0.151$). The variance explained by this model corresponds to $R^2 = 0.608$ (see Table 31.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	1.541	1.316		1.171	0.275
	Social Identification Score	0.317	0.151	0.551	2.102	0.069
	Intrinsic Motivation	0.359	0.302	0.357	1.188	0.269
	Positive Mood	-0.019	0.322	-0.018	-0.060	0.953

Table 31. Multiple liner regression to predict flow on the group level.

What does predict performance? Finally, we ran a regression analysis to see what could be the significant predictors of team performance. A simple regression with aggregate team flow score as the independent variable and team performance scores as the dependent variable was run. Results indicate that the aggregate total flow score is a significant predictor of team performance ($t = 2.789$; $p = 0.019$, $\beta = 52.172$). The variance explained by this model corresponds to $R^2 = 0.438$ (see Table 32.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	-496.268	271.676		-1.827	0.098
	Total Flow	145.502	52.172	0.661	2.789	0.019

Table 32. Simple linear regression to predict team performance.

Discussion

The aim of this study was to examine the impact of high action identification on positive sociocognitive processes in groups as well as the team performance. Study was done in the context of a two-day teambuilding seminar for all SBT Human(s) Matter employees. Action identification levels were manipulated as two versions of explicit treasure hunting game with *low action identification condition* and *high action identification condition*. We hypothesized that high action identification wording will increase both flow and team performance, but there were absolutely no significant differences between the two

experimental conditions. Regression analyses allowed us to explore the phenomenon of flow in teams without taking into account the unsuccessful experimental induction. The results show that, on an individual level, flow experience is predicted by intrinsic motivation, while on a group level, it is predicted by social identification. This reinforces our theoretical model and is consistent with our conceptualization of collective flow. We have also found that aggregate team flow predicts performance scores of the teams participating in the competition, which is consistent with the results of the previous chapter (see study *Collective Flow and Dispositional Theory of Mind*). One of the limits of this study is linked to our operationalization of the level of action identification. While the induction of the high-level action identification *Your goal is to surpass yourself* was more team-oriented than task-oriented, the induction of the low-level action identification *Your goal is to check on the check-points* was more task-oriented.

Discussion

Aiming to test whether high action identification fosters collective flow (theoretical **H2**), we performed one experimental laboratory study and one experimental field study. The results of the first (laboratory study) validate our hypothesis showing that high action identification enables the absorbing experience of flow in social settings. This effect is simultaneously mediated by intrinsic motivation and social identification. Next, the results of the field study demonstrate that intrinsic motivation and social identification predict flow experience, while the flow experience predicts the team performance. These results reinforce our theoretical model represented below (see Figure 26. below):

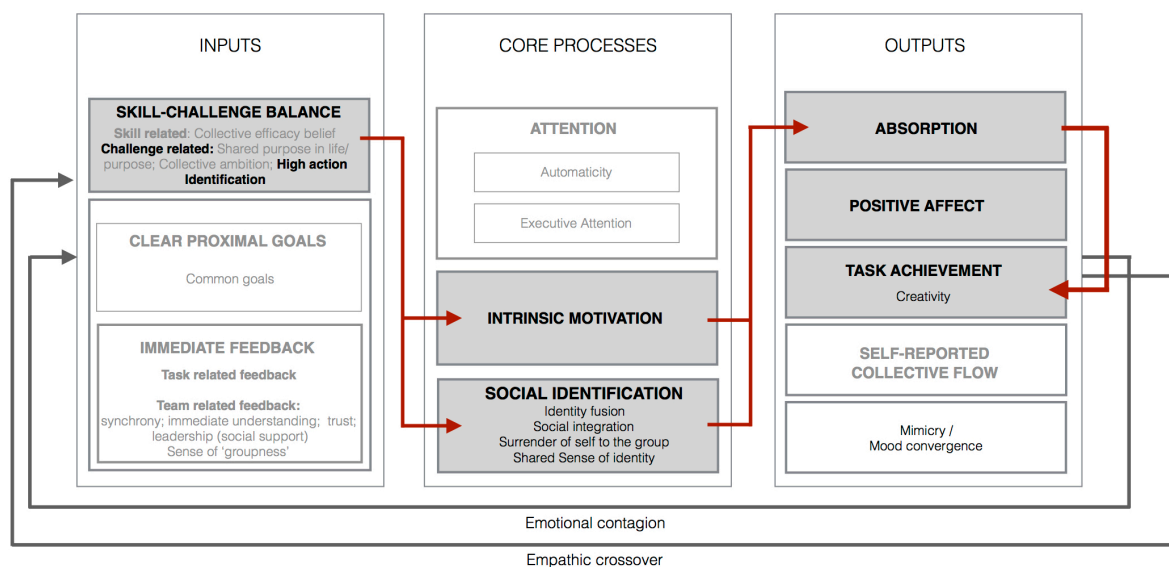


Figure 26. Updated I-O-P model of Collective Flow.

Throughout the studies in this chapter, as well as the previous one, we have observed a link between social identification and flow experience in group settings. In the following chapter, we will attempt to deepen the understanding of this mechanism by designing two experimental studies, which try to foster social identification by the means of social categorization.

CHAPTER 6: Social Identification and Collective Flow



One of the salient cues to understanding the mechanism of collective flow that arose from the literature review as well as from the field studies was the group member's feeling of belonging to the team, the feeling of *we-ness*. In order to build a group tissue out of the single group member cells, a sociocognitive intertissue is needed. The unavoidable concept in social psychology that determines what is a group and what it is not is called *social identification*. According to Tajfel (1972), social identity is "the individual's knowledge that he belongs to certain social groups together with some emotional and value significance to him of this group membership" (p. 292). In cognitive terms, a group exists as soon as two or more individuals perceive themselves as members of the same social category (Turner, 1982). Individually determined, the social identification refers to individual member's relationship to being part of some bigger entity: a private acceptance of group membership, and is a necessary and sufficient condition to group formation (Postmes et al., 2013; Turner, 1982). Largely addressed within social identity theory (SIT - Tajfel, 1978; Tajfel & Turner, 1979) and self-categorization theory (Turner et al., 1987) social identification is proven to be leading to group productivity (Worchel et al., 1998) and therefore seemed to us to be worth of taking into account when examining the process of optimal collaboration. Hence, in this chapter, we will be testing our third theoretical hypothesis **H3**: Social identification fosters the collective flow. Consequently, we were led to experimentally examine its link to the creative performance of small groups, their well-being, together with other sociocognitive processes that appear relevant (affective state, motivation, flow). In this chapter, after breaking down the terminology from the theoretical point of view, we present two studies testing the impact of social identity on collective flow.

Social Identity Perspective

Social identity theory. Based on the findings of the minimal group paradigm (Tajfel et al., 1971), Tajfel and Turner (1979) founded a theory of group and intergroup behaviour which posits that identity varies along a continuum referring to interpersonal behavior on one side (*I* versus *you*; personal identity) and intergroup behavior on the other (*us* vs. *them*; social identity). Members of a social group seem often to share no more than a collective perception of their own social unity and this seems sufficient for them to feel and behave as a group (Turner, 1982). The minimal group paradigm implies that assigning individuals to groups that are *purely cognitive* (Tajfel & Turner, 1979) may be contributive to ingroup favouritism. In other words, mere categorization of people according to a trivial criterion (preference for abstract painters such as Klee or Kandinsky), appeared to be sufficient to encourage them "to allocate more monetary resources to fellow in-group members than to out-group members – even though they did not know who these ingroup and outgroup members were and despite the fact that they, themselves, could not benefit from this strategy" (Turner, 1982, p. 22).

Social identity relies on common features that are shared by the group members and distinguish them from other relevant groups even though the distinction criteria might be completely trivial or yet completely imaginary – even for the groups with no prior history nor expected future. For instance, a minimal group categorization could consist of wearing either a red or blue T-shirt. Based solely on the colour of the T-shirt, and without any other real

experiences with ingroup or outgroup, group members are shown to favour the ingroup and allocate more resources to individuals with same-coloured T-shirts (Trepte & Loy, 2017).

While in some situations people think of themselves as independent individuals who interact with others based on their personal characteristics and convictions, there are many more social situations where they think of themselves and others in terms of group membership (e.g., gender, age, nationality, professional role, etc.) (Ellemers et al., 2004). Consequently, in these situations where the self is defined in terms of group belonging/membership, this self-identification will impact the ingroup and outgroup behaviour. This will particularly be reflected in intergroup comparison and group evaluation such that a positive social identity will be rewarded with positive self-esteem, whereas a negative social identity, on contrary, is followed by social mobility behaviours, competition, or cognitive strategies to improve the image for the in-group (Tajfel & Turner, 1979). The first to theorize a distinct form of identity at the group level, social identity theory was also the first to accord ontological and explanatory significance to group identities (Spears, 2011).

Self-categorisation theory. Similar to Self Identity Theory and closely linked to it – Self-Categorization Theory has its distinctive specificities. Self-Categorization is a more general theory of the self, offering a more hierarchical structure: horizontal and vertical. This theory is more explicit than Social Identity Theory in proposing that instead of one self-concept, there are many of them and each is adapted to a different comparative context (Turner et al., 1987). According to this theory, personal and group identities exist as different levels, and thus is more inclusive (with different nested levels differing in abstraction: personal self, group self, national self, human self, etc.). This allows for the coexistence of wide repertoire of group identities available: psychology student, lab member, employee, female, family member, etc. However, not all categories will be used at once: the process of self comparison will be central to determining which identities become salient in which contexts. According to Turner (1982), social categorization defines a person by systematically including them within some, and excluding them from other related categories – what a person is and is not. This corresponds to the *functional antagonism*: as one level of self-definition becomes more salient, the other levels become less so (Hornsey, 2008). Depending on the situation, an individual will feel more or less part of a given social category.

Self-categorisation theory (Turner et al., 1987) makes a distinction between personal and social identity. The self-identity, according the SCT, is something variable, multi-faceted (i.e., different social groups organized in a system of inclusion levels) fluid, and largely context-dependent: the self is socially defined in interaction and varies with the social roles that one plays and the expectations, judgements, and reactions to others (Turner et al., 1994). According to this theory, **social identity** refers to shared social categorical self. In order for a group to experience high levels of cohesion, it is important that members of the group define themselves in terms of the group. This means that if we want to have a very strong group, the members of the group should, in the context of group work/time, switch their identities so that they temporarily identify as *we*. For that to happen, it is necessary for social categories to be

salient enough. Category salience depends upon three general principles: relative accessibility, comparative fit and normative fit (Turner et al., 1987).

Accessibility refers to the relative readiness of a certain category to be activated. It corresponds to past individual experience, her/his expectations, motivations, needs and objectives. Depending on personal dispositions of an individual, accessibility is thus relative and differing from one person to another. For example, if you are pro-European, there is a greater chance that you will activate category *European* than someone who is Eurosceptic, because this category, due to the motivation, interest and ambition, which you accord to it, is more accessible.

Comparative fit refers to in-group and intergroup similarities and differences (outgroup differences outweigh the ingroup differences), a *metacontrast*, maximized by within-group similarity and between-group difference. For instance, in a group of acquaintances composed of British and French, national identities are likely to be activated as a result of the contrast between the two subgroups (see Figure 27.).

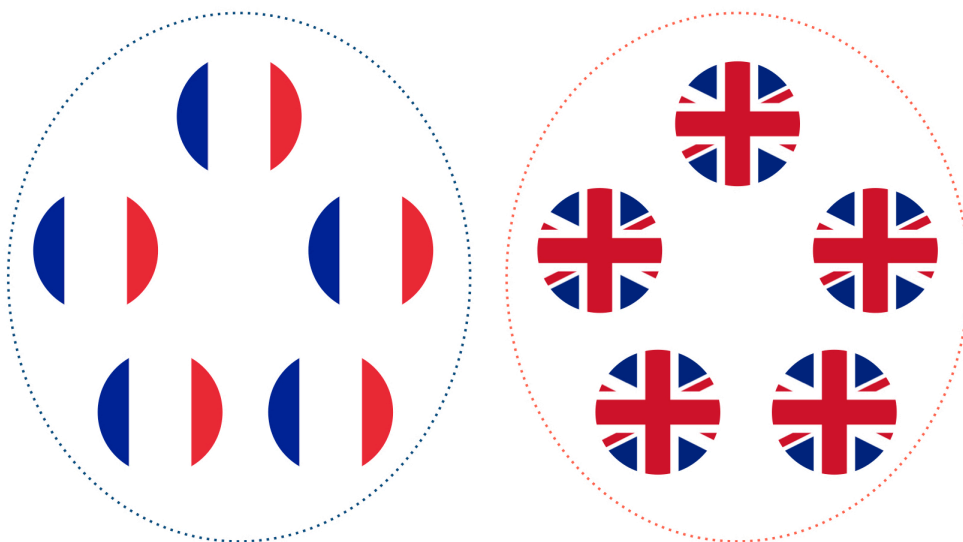


Figure 27. Comparative fit (metacontrast on a country level).

However, if another bunch of Chinese colleagues joins the company, similarities between British and French will certainly outweigh perceived differences due to a novel object of comparison – Chinese. In this case, it is likely that British and French activate the category *European* (see Figure 28.).

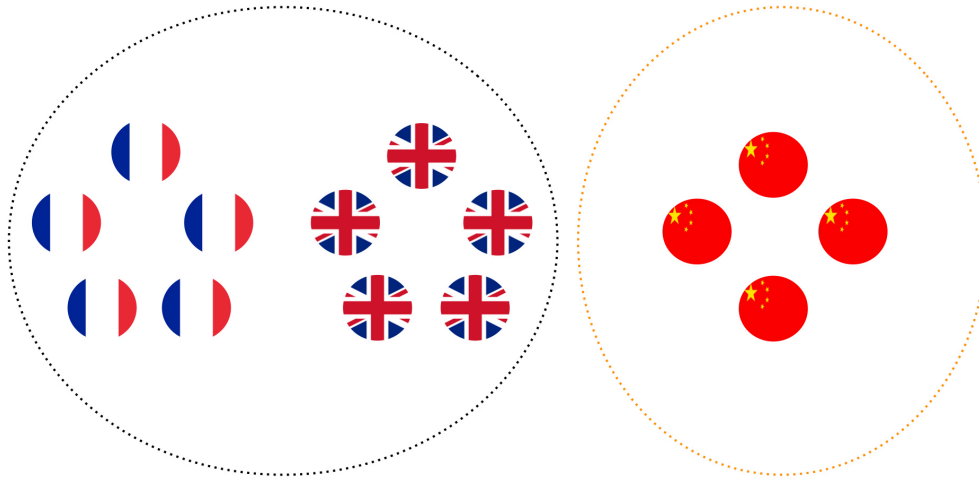


Figure 28. Comparative fit (metacontrast on a continental level).

Normative fit corresponds to the social meaning, the cognitive representation of substantive attitudinal, behavioural and normative content of the social identity (Oakes et al., 1991). It includes expectations about the direction and meaning of these comparative differences - stereotypically, we might expect that British are more Eurosceptic or that Chinese are less likely to engage in political discussion.

Let's take another example, but this time of a single individual in various settings, experiencing multiple social identities at different times of day, fitting the contextual reality. For example, at home, with her children, a woman will probably perceive herself as a mother (social category) more than a doctor, even though she works in a hospital. At work, in contrast, with her patients, she will probably perceive herself as a doctor more than a mother, even though she has kids. When at home, the social category of *mother* will be more accessible as well as the readiness to use this category. As someone with few years of motherhood experience, and due to the presence of her children, this person is likely to have the category *mother* accessible to her (**accessibility**). In the context of home, the doctoral categories are kind of shifted, that aspect of her identity gets depersonalized in order to incorporate the other category that is more adapted and more useful to the context: that of a mother. On contrary, when in hospital, engaging with her patients and subordinate co-workers, the category of *doctor* will be more accessible. As the comparative difference between care-needing patient and care-giving doctor exceeds the shared similarity of parenthood (because the patient is likely to be someone's a parent as well), the resulting contrast will make that category of *doctor* pops out, rather than the category of a *mother*, in this case (**comparative fit**). Normatively, stereotypical expectations and the direction of these comparative differences imply that the social category of a *doctor* does not share the same mission and content as the social category of *mom* does (**normative fit**). Similar analysis is applicable to all other social categories for this person when they fit the social reality: she will categorise as *a liberal* when exposed to political issues and engaging in a discussion with

more conservative counterparts; *a technophile* when confronting less gadget-friendly interlocutors in a debate about new technologies, etc.

The role of the fit in the salience of social categorisation appears to be crucial. “Social categorisations are activated where they provide veridical, adaptive representations of social relationships – they provide veridical perception because they are activated only when they ‘fit’ the reality” (Oakes et al., 1991, p. 142). Social categories are internalized to define the self by combining individual components with elements of a salient category in a given context. As a function of the context (*accessibility* and *fit*; Turner et al., 1987; Turner et al., 1994), social categories may be salient and individuals see themselves and the others not on the basis of personal characteristics but as representatives of salient groups (*depersonalization process*; Turner et al., 1987).

Depersonalization. Self-categorizing on a group level is likely to trigger the process of depersonalization. This process corresponds to a prompt, punctual and contextual modification of one’s identity going in the direction of a subjective convergence of the subject and her/his social group. In other words, this means a shift along the continuum of social identity from the pole of personal identity to the pole of social identity. This phenomenon is characterized by self-stereotyping, which leads an individual to perceive her/himself as a member of ingroup and to adopt prototypical behavior of this group. Distinct from deindividuation (Festinger et al., 1952) which is defined as a mindless loss of personal identity when in crowd or mob, depersonalization is a *normal* and adaptive phenomenon allowing for group behavior, mutual attraction and successful collaboration (Oakes et al., 1994).

Group productivity. According to our assumptions, collective flow is a state that results in high group productivity and elevated levels of creativity. In their study of group productivity, Worchel et al. (1998) asked participants to make paper chains with a stack of construction paper, a pair of scissors, a stapler and instructions on how to make a paper link chain – under the cover that the aim of the experiment was to study the manual dexterity and was similar to that confronted by workers in many industrial settings. Basically, in this experiment, each participant was to cut a slice of paper, curl it and staple it in a continuous chain. The most astonishing result was that individual productivity increased when they were working for a group-based incentive than when working for an individual incentive in a social situation. However, we must notice that the task of chain making is not very ecological, at least for study of collective flow.

Worchel et al. (1998) have found that elements helping to increase the likelihood that individuals see their team as relevant to their self-identity will lead them to increase their group effort in that team (as compared to alone effort), which is contrary to social loafing (exerting less effort when working in group than when working alone) (Karau, & Williams, 1993). Social loafing is shown to be significantly reduced when the collective identifies as a group and the individual expects the group to continue existing after the task. Having incorporated group identity, the members of a flowing group work in such a way that group output exceeds the sum of all individual outputs that come from the same task done

individually. However, this could be even more pronounced if there was **an outgroup** somewhere there: Ellemers and colleagues (2004) predict that the presence of a relevant outgroup, an object of comparison, is conducive to enhanced shared organizational identity (see also Rabbie & Bekkers, 1978).

These empirical findings highlight some of the processes related to group performance. Indeed, we could even say that meaningful membership combined with social identity salience may increase the motivation of people to work together and to combine their individual work efforts in a multiplicative rather than additive manner. This may lead to *social laboring* (Haslam, 2004; van Dick et al., 2009a; Worchel et al., 1998), in which individuals working as a group and for the group exhibit increased performance. Several other studies have supported the finding that the salience of group membership leads to improved performance. Today, we know that social identity cues such as group name (Alpha and Beta) or lab coats (Worchel et al., 1998, Study 3) are conducive to group salience in an intergroup context and in consequence improve group performance in a manual task.

In a more recent study, van Dick and colleagues (2009b), study 1) manipulated social identity salience in schoolteachers performing a brainstorming. High group salience (information that group performance would be compared to another group) led to increased creativity output than in low group salience conditions. Moreover, empirical findings (Guegan, et al. 2017) in a virtual context, show that when social identity cues are introduced on avatars' clothes, participants are more likely to engage in online collaborative creative task. Comparing face-to-face and virtual brainstorming environment, as well as having or not having meaningful social identity cues (traditional school garment) displayed or not, the authors measured group performance and social identification. The results show that the presence of social identity cues is conducive to increased creative performance both in face-to-face and virtual settings. They also increased group identification, but only in the virtual environment.

In conclusion, leading people to perceive themselves primarily as members of a group is therefore a relevant means to improve group performance: both in manual (paper chain-making task) and intellectual (brainstorming) tasks.

Motivation in group-work. We hypothesize that collective flow arises when group members are intrinsically motivated. Collective performance is often regarded as derived from individual motives. However, we believe in the possibility of a genuine group motivation. For instance, if we try to incorporate Social Identity Theory in the explanation of group motivation, we can imagine that there are situations in which individuals adopt their primary self-definition in collective terms and are intrinsically motivated to participate in the task. This, in turn, opens the possibility for group-based expectations, outcomes and goals, which, from this point of view, can be regarded as **intrinsic sources of motivation** (Ellemers, et al. 2004). Self-categorizing in collective terms would motivate people to work better on behalf of the group on three levels: 1) energize = make effort, 2) direction (focus on) toward collective, and 3) sustain long-term effort = persistence. The shift in the identity from personal to collective one is possible because the identity is something fluid, possibly varying across different situations over time and specifying the conditions under which a particular

social identity or self-definition is likely to step forward (Ellemers, et al. 2004). Emotional involvement of the self with the group can motivate the group to direct its efforts toward common goals. However, the sense of collective identity is not enough – “the way their effort will actually be directed depends on specific features of the social context” (p. 473) such as the level of abstraction and ambitiousness of it. As we have seen in the previous chapter, the high level of action identification enables both intrinsic motivations of the group members and promotes social identification.

Recognizing that group identification is beneficial for group productivity (Worchel et al., 1998), we assume that it also plays a role in the collective flow. Hence we hypothesise that group identification increases the chances that the work group reaches the state of collective flow by facilitating motivational and identification processes (see Figure 29. below).

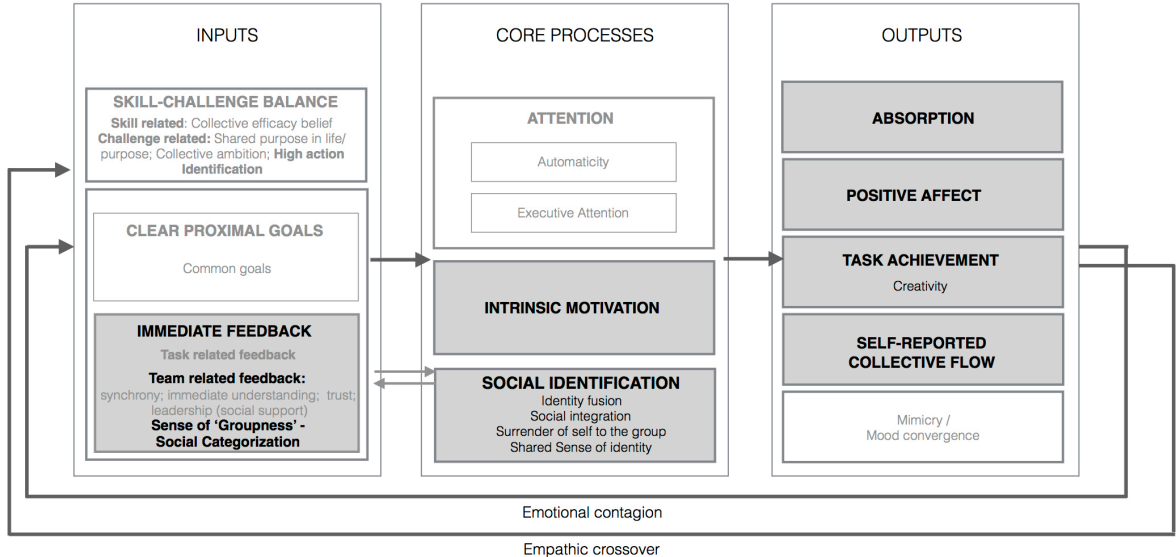


Figure 29. I-P-O diagram depicting a hypothetical relation between social identification and collective flow.

As a result, we decided to test these assumptions through an experimental study where we will increase the salience of group identity cues to some groups and not to other groups, compare them and verify the accuracy of our predictions. Wearing distinctive group-related apparel may activate the social categorisation of the groups. This will make the social identity cues relative to group membership accessible and salient (i.e., obvious and ready to be activated), comparatively fit across the groups who can clearly see that everyone wears uniforms, but that the uniforms are different colour for each group.

PILOT EXPERIMENT

Collective Flow and Social Identity Cues

Goals of the study. The aim of this experimental study is to test the impact of self-categorization on the creative collaborative work and the experience of collective flow. In the present study we attempt to make two contributions to the literature. First, knowing that group identification improves group productivity, we are curious to test if it fosters the well-being of group members as well. Second, we wish to test the impact of group identification by the means of self-categorization in terms of group belonging on the collective flow.

In order to induce the group identity salience, we used uniform-like clothes (as in Worchel et al., 1998). Oakes and colleagues (1994) suggested that sharing an aspect of a unique physical characteristic reinforces the process of group categorization. Therefore, we designed two conditions: condition with the *presence of the social identity cues* (the experimental condition) and the condition with the *absence of social identity cues* (control condition). The groups worked in the presence of outgroup such that there are several teams in the same room. Apart from the obvious organizational convenience, this choice was made because the literature suggests that the effects of social labouring are even more pronounced in the presence of an outgroup (Ellemers, et al. 2004) as there is a clear and available object of comparison. Therefore, we have not designed a separate condition, which would imply the absence of outgroups (like in their experiment 3, Worchel et al., 1998). Rather, we run the experiment in classroom with several different groups present and visible to each other at the same time.

Hypotheses. We hypothesize that the presence of salient social identity cues is beneficial to social identification, resulting in heightened group well-being and outcome.

H1: Salience of group identity, conveyed by group-related apparel, should improve affective state, motivation, and flow.

H2: Salience of group identity, conveyed by group-related apparel, should foster group creativity (the idea fluency and project originality).

Participants. The participants were French undergraduate engineering students from CESI Engineering School. The experimental procedure was run in form of innovation workshop, which was a part of student's curriculum. A total of 18 students participated in the study (4 female and 14 male) with an average age of 24.39 years (SD = 1.69). The participants were divided into 6 work groups. Four out of 6 groups had one female participant. Eleven participants went through the *social identity cues - SIC* (experimental, see Figure 31.) condition and 7 participants through the *no-social identity cues – no SIC* (control, see Figure 32.) condition.

Materials. Several weeks before beginning the experiment, the groups were already formed by the experimenter and were asked to choose together a group name and two group

colours without knowing why. The choices of experimental groups (randomly chosen) were retained in order to print the experimental material: cotton T-shirts with printed group name in the colours the groups chose. Consequently, the garments were custom-made and corresponded to the following (see Figure 30.)

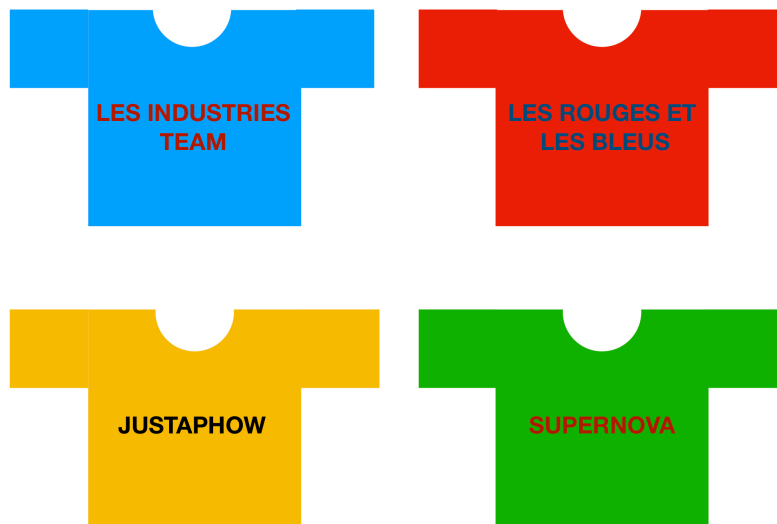


Figure 30. Physical social identity cues in the form of T-shirts for the participants of the experimental condition.

Procedure. For the workshop, we used a creativity method called *bissociation*⁶ (Koestler, 1960; Dubitzky et al., 2012), which facilitates the mixture of concepts from two contexts, categories of objects or ideas that are normally widely considered separate by the literal processes of the mind (Dubitzky, 2012). In the beginning of this half-day workshop, the experimental groups were given their T-shirts and were instructed to put them on. Next, all groups (experimental and control condition) were given the following bissociation matrix (see Table 33.):

⁶ According to Koestler (1960), bissociation stands for joining unrelated, possibly conflicting information in a novel way. It is a fusion in a new intellectual synthesis where new ideas arise by connecting previously unconnected matrices of experience or of perception. Creative act of bissociation is when two habitually independent matrices of reasoning interact with each other and result in a collision, fusion, confrontation and a new intellectual blend.

1 st category →	BOOK	SHOE	CHAIR	TEDDY BEAR	BALL
2 nd category ↓					
AUGMENTED REALITY					
GPS					
CAMERA					
ACCELEROMETER					
CLOUD					

Table 33. Bissociation matrix used to awake and challenge teams’ creativity.

Also, they received following oral and written instructions for the creativity task (how to use bissociation matrix) (see Table 34.):

The goal of this workshop is to train your capacities of bissociation (association of two elements coming from two different universes). The matrix here below crossbreeds objects from everyday life with some new technologies. Use this matrix, cell by cell, in order to imagine some original functionality that could result from combining the objects and technologies.

Table 34. Transcription of experimental instructions.

Participants received instructions to reproduce the given matrix on a big paper; search for original ideas in order to fill in the matrix (for example what product could result from the association of “a book” and “augmented reality (AR)"); write down their ideas on post-its and stick them on the matrix cells; try to fill in a maximum of matrix cells and produce a maximum of ideas. On average, a group could spend around two minutes for each matrix cell. The instructions were following (see Table 35.):

You can alternate solitary moments (each person writes down her/his won ideas on post-its, without influencing other people’s thinking) and interactive moments (read out loud the ideas, explain so that others group members can rebound and find new ideas). You have 50min for this (around two minutes per matrix cell).

Table 35. Transcription of experimental instructions.



Figure 31. Experimental condition groups with T-shirts, working on bissociation task.



Figure 32. Control condition groups without T-shirts, working on bissociation task.

Data collection

After the session, participants filled out a questionnaire individually, were debriefed and dismissed. The questionnaire was composed of:

- **Social Identification Measure** – consisting of Single-item Social Identification Scale (SISI) “I identified with my group” (Postmes et al., 2013) as well as four other items taken from Henry et al. (1999) (“I enjoyed interacting with the members of this group”; “I think the members of this group like one another”; “In this group, members need to cooperate to complete group tasks”; “This group accomplishes things that no single member could achieve” $\alpha=0.810$) with 7-point Likert scale.

- **FSS** – 13-item The Flow Short Scale (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters: absorption ($\alpha=0.454$; e.g., “I felt just the right amount of challenge”, “I didn’t notice time passing”), fluency ($\alpha=0.788$, e.g., “My thoughts run fluidly and smoothly”, “I had no difficulty concentrating”) and importance ($\alpha=0.436$, e.g., “Something important to me was at stake here”, “I was worried about failing”). We decided not to keep the importance sub-scale because of its moderate reliability. Aggregated clusters composed of absorption (4 items) and fluency (6 items) offered a reliable measure of total flow ($\alpha=0.822$).
- **Intrinsic motivation scale from SIMS –Situational Motivation Scale** (Guay et al., 2000), with 7 –point Likert Scale: $\alpha=0.933$ (e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant”).
- **16-item Brief Mood Introspection Scale - BMIS** (Niedenthal & Dalle, 2001) with 4-point scale. Composed of 3 clusters: positive moods (lively, happy, caring, content, peppy, loving, active; $\alpha=0.866$), negative moods (sad, tired, gloomy, jittery, drowsy, grouchy, nervous, fed up; $\alpha=0.871$), and calm (mood unrelated to all other moods).

Creative performance

Post-it fluency. Two hundred forty nine ideas from the divergent thinking phase were collected and examined. The fluency was measured in terms of the number of non-redundant ideas produced by group and by each individual in each group.

Idea-template originality. The 21 idea-templates were evaluated by one innovation expert, blind to the conditions on a 7-point Likert scale from 1 (not creative at all) to 7 (extremely creative).

Results.

Tests of H1 – Sociocognitive processes. In order to verify if the salience of group identity through the presence of social identity cues (SIC) enables positive sociocognitive processes during collaboration, we ran a simple (*SIC* versus *no-SIC*) ANCOVA with sex as a covariate for following variables: social identification, individual flow, intrinsic motivation, positive and negative mood (see Table 36. for more details). Analysis of variance on the individual level provided no support for our first hypothesis (H1). We observed no significant effect of the social identity cues on social identification ($F(1, 15) = 0.157, p = 0.697, \eta^2 p = 0.010$) with similar levels of reported identification to their group in both conditions (*no SIC* $M = 5.31, SD = 0.92$; *SIC* $M = 5.47, SD = 1.19$). No significant effect was found either for individual flow, intrinsic motivation, neither positive nor negative moods.

ANCOVA (sex as covariate)					Descriptives			
					Self-centered		Empathy	
Variable	df	F	p	η^2	M	SD	M	SD
Social Identification Score	1, 15	0.157	0.697	0.010	5.31	0.92	5.47	1.19
Flow	1, 15	0.246	0.627	0.016	1.65	0.39	1.70	0.72
Intrinsic Motivation	1, 15	0.915	0.354	0.054	5.07	1.37	4.57	1.17
Positive Mood	1, 15	0.001	0.971	0.000	2.59	0.62	2.61	0.58
Negative Mood	1, 15	0.051	0.825	0.003	1.65	0.39	1.70	0.72

Table 36. ANCOVA results with sex as a covariate.

Regressions. Regarding the fact that our experimental manipulation did not result with a significant difference in social identification scores between the conditions, we can consider that our experimental manipulation was unsuccessful. However, we run few multiple regressions in order to see what variables predict flow.

What does predict flow? The regression model with the flow score as the dependent variable included: intrinsic motivation, positive mood, negative mood, and social identification score as independent variables. The results show that no independent variable does predict the individual experience of flow. However, the social identification tends to significance as a positive predictor of flow ($t = 1.789$, $p = 0.097$, $\beta = 0.194$). This model explains $R^2 = 0.679$ of variance of flow (see Table 37.).

Model	Unstandardized	Standard Error	Standardized	t	p
1 intercept	0.998	1.284		0.777	0.451
Intrinsic Motivation	0.163	0.246	0.194	0.662	0.520
Positive Mood	0.532	0.530	0.296	1.005	0.333
Negative Mood	-0.308	0.340	-0.177	-0.906	0.381
Social Identification Score	0.346	0.194	0.356	1.789	0.097

Table 37. Multiple linear regression to predict total flow score.

Test of H2 - Creative performance of groups.

Post-it fluency. Contrary to our predictions, the number of ideas did not differ between the no-SIC condition and SIC condition ($F(1, 5) = 0.481$, $p = 0.519$, $\eta^2 p = 0.088$, *no-SIC* condition $M = 37.33$, $SD = 2.186$, *SIC* condition $M = 34.25$, $SD = 6.850$), which invalidates H2.

Idea-template originality. Similarly, we have not observed a significant effect of experimental conditions on the quality of idea-templates ($F(1, 19) = 1.520, p = 0.233$). The originality evaluations were quite similar for both conditions (*no-SIC* $M = 3.56, SD = 0.294$, *SIC* $M = 4.33, SD = 1.723$)

What does predict idea fluency? The regression model with post-it fluency as the dependent variable included following independent variables: aggregate intrinsic motivation group scores, aggregate flow group scores and aggregate social identity group scores. The results show that no independent variable does predict the post-it fluency of innovation teams. However, the social identification tends to significance as a negative predictor of fluency ($t = -2.418, p = 0.094, \beta = 3.576$). This model explains $R^2 = 0.821$ of post-it fluency (see Table 38.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	56.977	17.527		3.251	0.047
	Aggregate Intrinsic Motivation	8.638	4.606	1.100	1.875	0.157
	Aggregate Flow	-3.525	6.008	-0.362	-0.587	0.599
	Aggregate Social Identification Score	-8.648	3.576	-0.667	-2.418	0.094

Table 38. Multiple linear regression to predict fluency of post-its

Discussion. This study aimed to use social identity cues to enhance and foster the process of social identification of group members, which, in turn, was expected to have positive impact on collective flow and creative team output. Unfortunately, we cannot claim that we have managed to successfully induce the experimental manipulation and therefore we have not observed the hypothesized effects. We have not found any significant difference between the two conditions in terms of social identity, flow, intrinsic motivation, mood nor self-perception of creativity. Moreover, no difference was observed for creative performance, as both the volume of generated ideas and their creativity were similar between the conditions. Regression analyses indicate a positive, insignificant but marginal link between social identification and individual experience of flow. On the other hand, at a group level we found a negative marginal link between social identification and creative fluency. As those results remain tendencies we will refrain from attempting to interpret them.

In this experiment, social identification, dependent on accessibility, normative and comparative fit was ought to be reinforced by making the social identity cues salient. This was done by offering personalized T-shirts to one half of participants – to wear them during the workshop. In terms of accessibility, the T-shirts were perceptible enough to consider that this condition of social identification was satisfied. Also, T-shirt colours and printed team-names differed enough between the teams (blue, yellow, red and green T-shirts), so we can consider that comparative fit was satisfied as well. However, it might be the case that normative fit was lacking. The meaning and the symbolic content associated to these T-shirts might be too weak and possibly incoherent with teams' *raison d'être*. It may be the case that, normatively unfit, our T-shirts were not good enough in conveying the direction or content of intergroup differences.

As we know that social categories are hierarchical structures with different nested levels, it is possible that the participants of our study did in fact self-categorize in terms of the group, but on a higher level: as a class or as students of CESI engineering school. It might be that, just like in the example of British and French versus Chinese, the teams perceived bigger difference between the experimenter/teacher and them, than between the teams to whom they belonged for this occasion. In this case, the category *student of our class* may have been more salient, relevant and contrasting than the category *member of our team*. Unfortunately, as something we did not measure or control, we are unable to conclude if this was the case.

Another major and possibly fatal problem for this study was linked to weather conditions. Unfortunately, on the experimentation day, Paris region was hit by a rather exceptional heat wave with daily temperatures exceeding 35°C. Rooms without air-conditioning equipment were particularly hot that day which reflected on participants' mood, motivation and available energy levels. As there were no changing rooms, the participants of experimental condition were led to wear an additional T-shirt (social identity cues) on top of their own clothes, which may have made them feel even more hot and uncomfortable than the control condition participants.

EXPERIMENTAL STUDY

CESI Hackathon – Social Identification and Collective Flow

Goals of the study. Knowing that the high level of action identification fosters social identification (results of Persona experiment, see *Chapter 5*), we decided to replicate the pilot study by enhancing our means of inducing the self-categorisation. Just like the pilot study, the aim of this experiment was to test the impact of social identity with the help of social identity cues on the collective flow and creative group performance. Overcoming the issue of normative fit which was possibly weak or absent in the previous study, we decided to rethink our experimental materials as well as our experimental procedure. In order to convey more meaningful intergroup differentiation, we decided to make T-shirts that will reflect task ambition for each team's innovation project. For the sake of overcoming the issue of nested hierarchical social categories, which might have appeared in the previous study, we decided to measure social identification on four inclusive levels: *group*, *class*, *school*, and *profession*.

Hypotheses. We hypothesize that the presence of relevant and meaningful social identity cues is beneficial to the joint group work resulting in heightened group output and well-being.

H1: Presence of salient social identity cues in form of T-shirts with task-relevant logo should increase positive sociocognitive processes during hackathon (identification of team members to the group, motivation, and flow).

H2: Presence of salient social identity cues in form of T-shirts with task-relevant logo should increase the creative performance (assessed via quality of innovation projects).

H3: Presence of salient social identity cues with task-relevant logo should increase the group creativity and this relation should be mediated by the social identification process.

Participants. The participants were French undergraduate engineering-school students. The experiment was run in a form of one-week-long innovation hackathon, which was a part of student's academic curriculum. A total of 55 students participated in the study (6 female and 49 male) with an average age of 22.45 years ($SD = 1.91$). Participants were distributed into 12 work groups (7 groups of five people and 5 groups of four people). Half of the groups (6 teams) went through the condition involving the *presence of social identity cues* (*SIC*, experimental condition) and the other half (6 teams) went through the condition involving the *absence of social identity cues* (*no-SIC*, control condition).

Materials. Team outfits in form of colour T-shirts printed with a compelling project name on them were manufactured for the participants of the *social identity cues (SIC)* condition (see Figure 33.).



Figure 33. Experimental material: T-shirts with project-relevant logos

Procedure. The experiment was organized as one-week-long project-based hackathon for graduate students at Engineering School CESI. This hackathon was also a part of their compulsory curriculum in innovation. Each group was given a different subject to work on during five days. The experimenters and programme coordinator determined the following projects in advance: Connected Furniture, Smart Building, IT Production, E-health, Seniors and Parenting. For more details, see the Table 39. Below.

PROJECT TOPIC	SLOGAN	DETAILS
IT Production	Production-geniuses	Imagine a connected object, which allows your IT infrastructure to be always operational.
Smart Building	Building-superstars	Imagine a connected object, which will be implemented in a Smart Building.
Parenting	Care-champions	Imagine a connected object intended for young children.
E-health	Health-jedis	Imagine a connected object targeting healthcare and medical field.
Seniors	Senior-heroes	Imagine a connected object intended for elderly people.
Connected Furniture	Lifestyle-makers	Imagine a futurist piece of connected furniture.

Table 39. Group project details for the hackathon week

Experimental (*SIC condition*) groups wore outfits (colored cotton T-shirts) with the logo and the name of their project (see Figure 34.).

On the first day, after a brief introductory class on creativity, presentation of project topics and distribution of T-shirts and other materials, students started a whole-day long creativity workshop. The creativity workshop began with a divergent group idea generation phase (2 hours), followed by a convergent group idea selection phase (1 hour and a half), an elaboration of projects onto the idea-templates (one hour) and an elevator pitch in front of all other participants. The second day was dedicated to autonomous work on the group projects, while on the third day all groups had a tutorial about prototyping with *Arduino* single-board microcontroller kits for building digital devices. The fourth day was devoted to prototyping in the fab-lab and the last, fifth day was spent on project finalization and presentation rehearsals. At the end of the fifth day of the hackathon, all groups presented their projects and prototypes in front of the jury.



Figure 34. Experimental groups in their T-shirts receiving experimental instructions.

Data collection.

Self-reported questionnaires were distributed on the first, third and the fifth day after the lunch. The questionnaire was composed of:

- **FSS – 13-item The Flow Short Scale** (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters, but we kept only 2 of them: absorption ($\alpha = 0.658$; e.g., “I felt just the right amount of challenge”, “I didn’t notice time passing”), and fluency ($\alpha = 0.868$, e.g., “My thoughts run fluidly and smoothly”, “I had no difficulty concentrating”). Aggregated clusters composed of absorption (4 items) and fluency (6 items) offered a reliable measure of total flow ($\alpha = 0.851$).
- **SIMS – The 16 items Situational Motivation Scale** (Guay et al., 2000), with 7 –point Likert Scale. Composed of 4 clusters: intrinsic motivation ($\alpha = 0.806$, e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant”), identified motivation ($\alpha = 0.839$, e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me”), external regulation ($\alpha = 0.846$, e.g., “I was engaged in this activity: Because I was supposed to do it, Because it was something I had to do”), and amotivation ($\alpha = 0.804$, e.g., “I was engaged in this activity: I did this activity but I was not sure if it was worth it, There might be good reasons to do this activity, but personally, I didn’t see any”).

- **SISI – Single-item Social Identification Scale** “I identified strongly with my group” (Postmes et al., 2013), with 7-point Likert scale.
- **Self-perceived creativity** items (2 items: “The team had many ideas”; “The team had ideas of great quality”) with 7 –point Likert Scale ($\alpha = 0.727$).
- **Three self-categorization items**: “I identify strongly to my MSIA16 class”, “I identify strongly to students of CESI”, “I identify strongly to IT professionals”.
- **Collective Flow** measured by two homemade items (“Our team acted as a whole. The team members were absorbed in the collective activity, coordinating effectively and feeling good together”; “I feel that our team wants this activity to continue”) ($\alpha = 0.835$).

Creative performance. Here, we compared the grades the groups got at their final presentation. The grades for this project-assignment ranged from A (the best grade) to D (the worst grade). The grades were transformed into numerical values in the following way (see the table 40 below):

GRADE	VALUE
A	4
A-	3.5
B	3
B-	2.5
C	2
C-	1.5
D	1

Table 40. Grades transformed into numerals for later data analysis

The interjudge agreement when it comes to final grades, for the experimental condition teams was good ($\alpha=0.841$), as well as the interjudge agreement for the control condition ($\alpha=0.735$).

Results.

Tests of H1 – Sociocognitive processes. To test our hypothesis concerning the impact of salient social identity cues on positive sociocognitive processes during hackathon, we have run a simple (*SIC* versus *no-SIC*) ANCOVA with sex as covariate, on an individual level (see Table 41. for more detail). The analysis was done with a dataset where we aggregated individual participants’ results from the first, third and fifth day, as we did not have explicit hypotheses about the interaction between the time and condition. No difference whatsoever was found between the two conditions, which invalidates H1. The effect of social identity cues on group identification proved insignificant ($F(1, 52) = 0.659, p = 0.421, \eta^2_p = 0.012$) with roughly the same levels for *SIC* ($M = 5.24, SD = 1.17$) and *no-SIC* ($M = 4.96, SD = 1.46$) conditions. This means that our experimental manipulation was not successful.

ANCOVA (sex as covariate)					Descriptives			
					No SIC		SIC	
Variable	df	F	p	η^2	M	SD	M	SD
Flow Absorption	1, 52	0.111	0.740	0.002	4.54	0.76	4.61	0.75
Flow Total	1, 52	0.164	0.687	0.003	4.83	0.86	4.72	1.03
Intrinsic Motivation	1, 52	0.059	0.809	0.001	4.97	1.42	4.88	1.18
Collective Flow	1, 52	0.003	0.955	0.000	4.75	1.42	4.77	1.29
Self-Evaluation of Creativity	1, 52	0.576	0.451	0.010	5.51	1.06	5.30	1.01
Social Identification to the Group (SISI)	1, 52	0.659	0.421	0.012	4.96	1.46	5.24	1.17
Social Identification to the Class	1, 52	0.379	0.541	0.007	5.20	1.11	5.42	1.62
Social Identification to the School	1, 52	0.141	0.708	0.002	4.97	1.16	5.08	1.30
Social Identification to the Profession	1, 52	0.324	0.571	0.006	5.61	1.09	5.76	1.09

Table 41. Analysis of variance between the conditions

Regressions. As our experimental manipulation did not result in predicted difference for social identification scores nor any other variable between the conditions, we decided to perform linear regression analysis, confounding the two experimental conditions, in order to see what does predict individual and collective flow during hackathon.

What does predict the experience of individual flow? A regression model with the flow absorption as the dependent variable included following independent variables: intrinsic motivation, social identification to the group, social identification to the class, social identification to the school and social identification to the profession. The only variable that appeared as a significant positive predictor of individual flow experience was intrinsic motivation ($t = 8.831$, $p < 0.001$, $\beta = 0.052$). The other variables in the model were not significant predictors of flow experience (social identification to the group $t = 1.427$, $p = 0.160$, $\beta = 0.054$; social identification to the class $t = -0.221$, $p = 0.826$, $\beta = 0.060$; social identification to the school $t = 1.244$, $p = 0.219$, $\beta = 0.067$; social identification to the profession $t = -0.840$, $p = 0.405$, $\beta = 0.059$). This model explains $R^2 = 0.731$ of variance of flow (see Table 42.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	1.918	0.339		5.657	<.001
	Intrinsic Motivation	0.446	0.052	0.770	8.631	<.001
	Social Identif ^o Group	0.077	0.054	0.135	1.427	0.160
	Social Identif ^o Class	-0.013	0.060	-0.025	-0.221	0.826
	Social Identif ^o School	0.083	0.067	0.136	1.244	0.219
	Social Identif ^o Profession	-0.050	0.059	-0.072	-0.840	0.405

Table 42. Multiple linear regression to predict individual flow.

What does predict the experience of collective flow? Another regression model with the collective flow score as the dependent variable included following predictors: flow absorption, intrinsic motivation, social identification to the group, social identification to the class, social identification to the school, and social identification to the profession as independent variables. The analysis revealed two positive and significant predictors of collective flow: intrinsic motivation ($t = 2.007$, $p = 0.043$, $\beta = 0.141$) and social identification to the group ($t = 6.850$, $p < 0.001$, $\beta = 0.095$). Other variables were not significant predictors of collective flow (flow absorption $t = 0.395$, $p = 0.695$, $\beta = 0.246$; social identification to the class $t = 1.282$, $p = 0.206$, $\beta = 0.103$; social identification to the school $t = -0.420$, $p = 0.676$, $\beta = 0.117$; social identification to the profession $t = -0.838$, $p = 0.406$, $\beta = 0.102$). This model explains $R^2 = 0.758$ of variance of collective flow (see Table 43.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	-0.406	0.750		-0.541	0.591
	Flow Absorption	0.097	0.246	0.054	0.395	0.695
	Intrinsic Motivation	0.293	0.141	0.282	2.077	0.043
	Social Identification Group	0.648	0.095	0.633	6.850	<.001
	Social Identification Class	0.133	0.103	0.137	1.282	0.206
	Social Identification School	-0.049	0.117	-0.045	-0.420	0.676
	Social Identification Profession	-0.086	0.102	-0.069	-0.838	0.406

Table 43. Multiple linear regression to predict collective flow.

Tests of H2 – Creative performance. In order to test whether the presence of salient social identity cues increases the creative performance of groups we ran a simple ANOVA with two conditions (*SIC* and *no-SIC*). Contrary to our predictions, the quality of innovation projects presented on the last day of the hackathon did not differ between *SIC* and *no-SIC* condition ($F(1, 10) = 0.067$, $p = 0.801$, $\eta^2_p = 0.007$; *SIC* condition $M = 3.13$, $SD = 0.30$; *no-SIC* condition $M = 3.08$, $SD = 0.11$) which invalidates H2 as well.

What does predict team creativity? A regression model with the creative performance score as the dependent variable included following predictors: aggregate flow absorption, aggregate intrinsic motivation, aggregate collective flow, aggregate social identification to the group, aggregate social identification to the class, aggregate social identification to the school, and aggregate social identification to the profession. No variable appeared as a significant predictor of team creativity (flow absorption $t = 0.357$, $p = 0.739$, $\beta = 0.301$; intrinsic motivation $t = 0.453$, $p = 0.674$, $\beta = 0.273$; collective flow $t = 0.334$, $p = 0.755$, $\beta = 0.247$;

social identification group $t = -1.243$, $p = 0.282$, $\beta = 0.347$; social identification school $t = -1.921$, $p = 0.127$, $\beta = 0.182$; social identification profession $t = -2.044$, $p = 0.110$, $\beta = 0.255$). Nevertheless, we found a marginally significant value for aggregate social identification to the class, which showed as a positive, tendential and insignificant predictor of team creativity ($t = 2.678$, $p = 0.055$, $\beta = 0.260$). This model explains $R^2 = 0.767$ of variance of creativity (see Table 44.).

Model		Unstandardized	Standard Error	Standardized	t	p
1	intercept	4.655	1.055		4.410	0.012
	Agg. Flow Absorption	0.107	0.301	0.196	0.357	0.739
	Agg. Intrinsic Motivation	0.124	0.273	0.337	0.453	0.674
	Agg. Collective Flow	0.083	0.247	0.186	0.334	0.755
	Agg. Social Identification Group	-0.431	0.347	-1.054	-1.243	0.282
	Agg. Social Identification Class	0.697	0.260	1.407	2.678	0.055
	Agg. Social Identification School	-0.350	0.182	-0.865	-1.921	0.127
	Agg. Social Identification Profession	-0.520	0.255	-1.121	-2.044	0.110

Table 44. Multiple linear regression to predict team creativity.

Tests of H3 – Mediation analysis.

Mediation analysis. In order to test our third hypothesis (H3), we analysed a mediation model including Social Identity Cues as Independent factor, Social Identification as Mediator and Creative Performance as Dependent variable.

The results show that there is no indirect effect of social identity cues on performance through social identification (see Figure 35.).

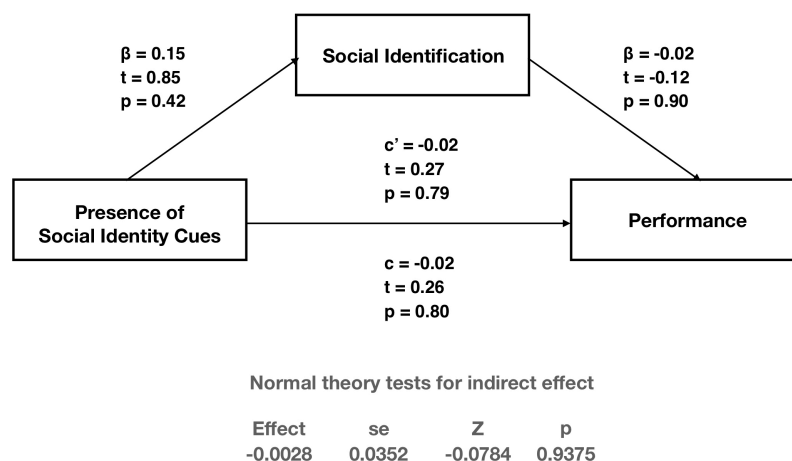


Figure 35. Mediation diagram: the impact of SIC on performance through the social identification.

Finally, we were also tempted to explore a mediation model including Social Identity Cues as Independent factor, Social Identification as Mediator and Flow Absorption as Dependent variable even though we had no explicit hypothesis about it.

The results show that there is no indirect effect of social identity cues on flow absorption through social identification (see Figure 36.). However, we have observed a positive and significant effect of social identification on flow absorption ($t = 4.36$, $p = 0.001$, $\beta = 0.29$).

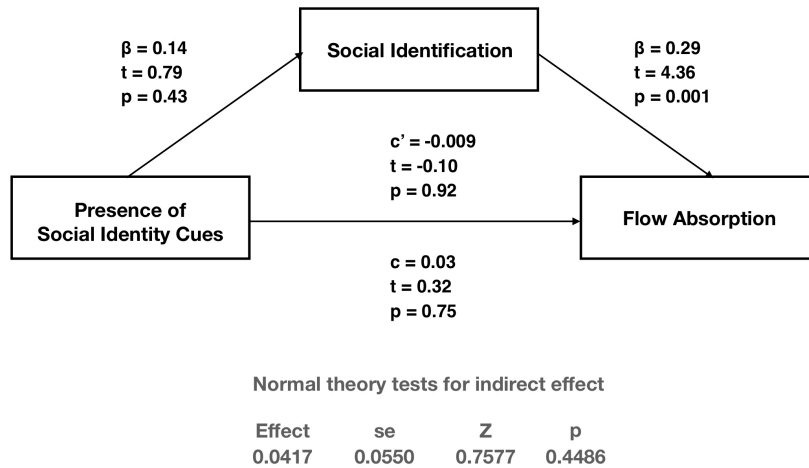


Figure 36. Mediation diagram: the impact of SIC on flow through social identification.

Discussion

The aim of this study was to test the impact of social identity cues on collective flow and creative team performance. Designed to overcome the issues and problems of the pilot experiment, we improved our material as well as the experimental procedure. Anchored in high action identification statement, the social identity cues in this experiment were designed to better reflect the normative fit of the social category *team member*. Also, this time, we measured the nested levels of social categorization by quantifying social identification on different levels.

In spite of these methodological differences, we replicated the results from the pilot study: meaning that we have not found empirical support for any of our operational hypotheses. No difference was observed between the two conditions for positive sociocognitive processes. Also, no significant difference was observed in team creativity between the two conditions. On a group level, no variable had a sufficient explanatory power to significantly predict the creative performance of teams. However, we found that social identification to the class marginally but insignificantly predicted team creativity, which means that the sense of belonging to the class (not a group, school or profession) could possibly have a positive impact on group creativity. This finding puts in light one of the limits of this experiment. Taken the fact that the project groups were not ad-hoc groups, but groups of students that knew each other, shared a history together and felt like a class, our attempt to artificially create sub-groups was not successful. Nonetheless, this identification to the class (a superordinate category) appeared beneficial for their performance.

Discussion

As we can see on the figure below (Figure 37.), the I-P-O model of collective flow is unlikely to contain social categorization among the inputs. However, intrinsic motivation and social identification to the group remain important and significant elements for the collective flow. Just as in the *Collective Flow and Dispositional Theory of Mind* study (Chapter 4) we found evidence that intrinsic motivation and group identification are positive and significant predictors of flow. Also, the regression analysis showed that collective flow was predicted by intrinsic motivation and social identification, but not by individual flow – just like in *Collective Flow and Dispositional Theory of Mind* study as well. Likewise, the mediation analysis, which showed no indirect link between social categorization and flow, nevertheless revealed a positive and significant effect of social identification on flow absorption. The pilot study uncovered an insignificant but marginal positive link between social identification to the group and the creative output (post-it fluency), while the later, hackathon study, revealed an insignificant but marginal positive link between social identification to the class and creativity.

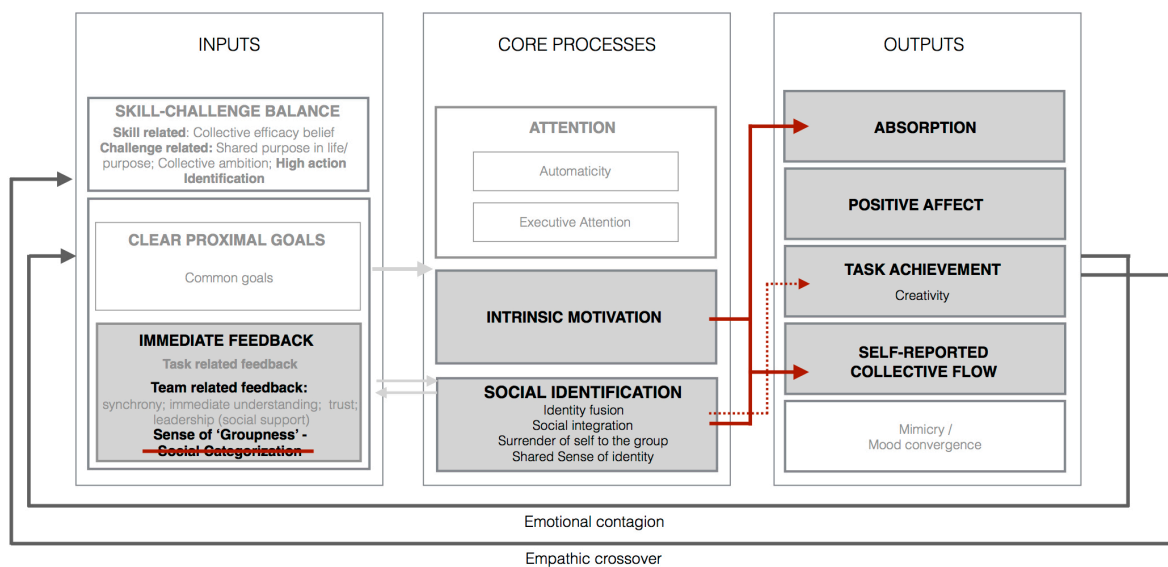


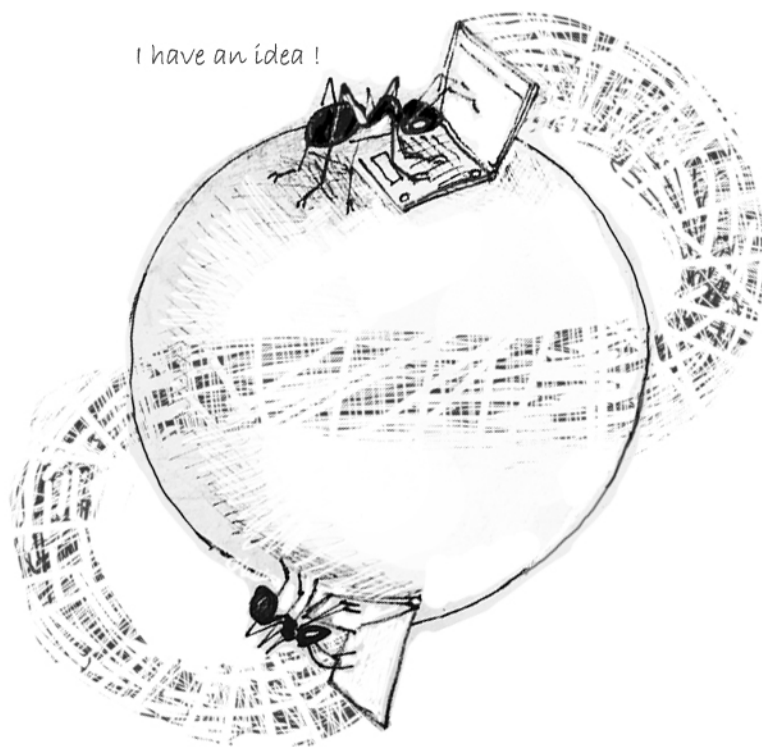
Figure 37. Theoretical I-P-O model of collective flow updated.

Both studies in this chapter examined the social identification phenomena in the context of face-to-face collaboration. Inducing experimental manipulation of social identity cues was not successful in any of the two: resulting in no significant difference of subjective and objective measures. Regression analysis indicated that social identification was positively linked to individual flow experience in the two studies, while in the second one we also found the link between the social identification and collective flow. This suggests that our theoretical hypothesis is valid, but not its specific operationalizations. We can conclude that there is effectively a link between identifying in terms of group (or other relevant category

like for example class) belonging and the experience of flow in social settings. As the operationalization of our hypotheses was not successful, we do not know if they are valid or invalid. These results, thus, do not invalidate our hypothesis, but do call into question its operationalization.

These two studies examined the impact of social identification on flow in face-to-face context. But, how all this works in the online setting? To explore social identification phenomena in the virtual collaborative environment, we designed an online experiment, which we present in the next chapter (*Chapter 7*).

CHAPTER 7: Collective Flow Online



In the previous chapter, we have tempted to assess the impact of the salience of social identity cues on the collective flow in nominal, face-to-face groups. As well as in the other studies (*Chapter 3, Chapter 4, Chapter 5*), this was a pursuit of better understanding of collaboration in physically present teams. It is still true that the majority of creativity workshops and seminars take place in tangible environment. Nowadays, after all, the main volume of client workshops done by SBT Human(s) Matter remains in these conventional, presential settings. Nevertheless, there is a growing tendency and increasing need for online collaboration. The demand for the work of geographically dispersed teams is progressively increasing. New digital technologies allow for more teleworking. Coworking offices are becoming not only widespread but also affordable. As all these phenomena are likely to widen exponentially – the interest for online collaboration is wholly legitimate. SBT Human(s) Matter shows a particular interest in the interaction between humans and new technologies and is motivated to further the understanding of mechanisms explaining what happens when people are physically separated while working. Therefore, it was obvious that the study of collective flow should be extended to online settings. In this chapter we will be testing our third theoretical hypothesis **H3**: Social identification fosters the collective flow, and thus examine our theoretical model, expanded to the framework of virtual collaboration.

Social identity in Computer-Mediated Communication

Technological and organizational evolutions shape a new reality of teamwork: in a globalized world, distributed collaborators have to work together and achieve high performance (Gilson et al., 2015). Virtual environments may constitute a promising tool to support remote collaboration, as long as they foster engagement, efficiency and provide meaning to teamwork. The present study, therefore, takes a social identity approach to investigate group identification, flow and creative performance online.

Global changes linked to the rise of new technologies. Apart from big multinational companies that, since several decades, are having offices on different continents across the globe, there is an increasing number of small to medium businesses, which are led to adopt this practice in order to cover the largest market possible. Not only its clients, but also SBT itself, internally, is led to conduct remote intercontinental projects with teams dispersed over different time zones. These distances are either partially convenient for synchronous distance working (e.g., Paris – New York 6h difference; or Paris – Hong Kong 6h difference) or completely inconvenient (e.g., New York – Hong Kong 12h difference). This case of remote collaboration where real-time interactions are very difficult or particularly unwanted imposes necessity for a sequential asynchronous collaboration mode. This corporate reality led us to also consider the temporal aspect of distance collaboration in our research project. Thus, the study of remote group identification, flow and creativity should be addressed not only in synchronous, but also in asynchronous situations.

New programs, platforms and applications for group collaboration are developed every day and thus constantly redefining the spatial and temporal constraints for collaborating teams. Such forms of computer technology are called Group Support Systems (GSS) or *groupware* - defined as network systems supporting teamwork on a common task by providing a shared virtual interface (Ellis et al., 1991). These are used for a broad array of different tasks such as negotiation, voting, communication, planning, decision-making, problem-solving, and idea generation (Michinov & Primois, 2005). With the rise of emerging communication technologies for collaboration and co-creation, organizations must recognize the advantages as well as limitations of these new technologies in order to optimize the productivity (Shirani et al., 1999) and to foster employee well-being.

Computer Mediated Communication and Social Identity. Behind a screen and a keyboard, many of the parameters seen in previous chapters are brought to a different dimension and slip the direct comparison with face-to-face collaboration. However, when talking about social identification, there are several possible ways of making the social identity salient: (1) putting forward the perceptual cues relevant to social identity, and (2) removing the perceptual cues relevant to personal identity. This is very important point for the *virtual* groups, such as those communicating online. It turns out that computer-based groups are not associated with weaker group effects than face-to-face groups (Spears, 2011). In order to extend the Social Identity Theory on virtual world, the Social Identity model of Deindividuation Effects (SIDE; Reicher et al., 1995; Spears & Lea, 1994) was developed. Provoked by anonymity, depersonalization (conformity to a group norm under conditions where a group identity is salient and where individual identity and individual differences are not salient) is shown actually to enhance the effects of group identity.

According to our theoretical I-P-O model (see Figure 38. below) removing personal identity cues from the collaborative interface might be a plausible way of triggering social identification, which in turn fosters flow and performance.

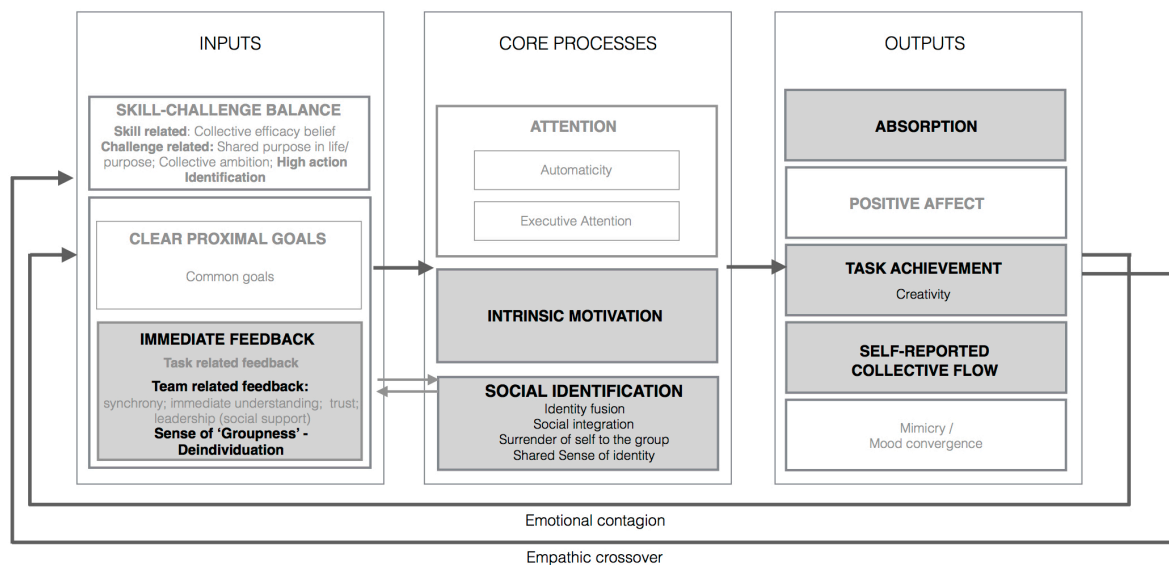


Figure 38. I-P-O diagram depicting a hypothetical relation between intrinsic motivation and social identification.

Following a social identity perspective, some specific features of Computer-Mediated Communication (CMC) - physical isolation and visual anonymity - may strengthen group processes related to group membership and performance. Indeed, the *Social Identity Model of Deindividuation Effects* (SIDE; Reicher et al., 1995; Spears & Lea, 1994) posits that the scarcity of individuating information combined to relevant membership cues (e.g., the name of the group) may lead to depersonalization (Turner et al., 1987). Interlocutors cease to pay attention to individual differences or personal characteristics of individuals, tend to reason on the basis of social categories and see themselves and others as prototypical group members. This cognitive effect, defined as the cognitive side of SIDE (Spears & Postmes, 2015), fosters group influence, adherence to group norms (Postmes et al., 2000), social attraction between group members and in-group favoritism (e.g., Postmes et al., 1998).

Although few studies have linked these cognitive effects to group performance, some findings indicate that anonymity may improve group identification in a collaborative task (Michinov et al., 2004). Tanis and Postmes (2008, study 1) also found that individuals in anonymous dyadic computer-mediated communication experienced more satisfaction and considered their performance as higher, this effect being mediated by social identification. Similar results were found on objective performance (Tanis & Postmes, 2008, study 2). In a recent study on brainwriting (Le Hénaff et al., 2018), anonymity of group members was manipulated through sticky notes (of different color for each group member vs. same color) used during the task. Following SIDE principles, results showed that participants generated more ideas in anonymity condition when social identity was rendered salient through intergroup comparison. We argue that it is possible that participants working in anonymous settings are less afraid of their peer's judgment and therefore feel more comfortable to express their ideas. Apart from objective performance, it would be interesting to assess the subjective

evaluation of participants' performance, which, together with objective indicators, constitutes a measure of task achievement.

Asynchronous or serial brainstorming, which mostly uses a writing medium, occurs in delayed time and does not require the simultaneous participation of team members. To our knowledge, literature on asynchronous electronic brainstorming is relatively scarce, and studies comparing web-based synchronous and asynchronous idea generation are even more rare. However, we will report on those that were existing and available.

In their study of asynchronous web-based electronic brainstorming, Michinov and Primois (2005) examined the impact of social comparison on participants' productivity and creativity. The study compared a condition where participants had a continuous feedback in a table displaying how much time others spent on the platform and how many ideas each one has generated, with a condition where there was not such a table and thus the comparison was not that easy. Participants in both conditions were identified by their full name and had five days to generate ideas. The results show that social comparison process has a positive impact both on productivity (number of ideas) and creativity (originality of ideas). This means that when working asynchronously and having access to compare contributions of each group member, thanks to an explicit entry-count, people adjust their performance level during idea generation task, increasing the overall performance (Michinov & Primois, 2005).

Ocker (2005) conducted a qualitative study exploring the impact of asynchronous collaboration mode on creativity of virtual teams. The analysis of semi-structured in-depth interviews revealed a number of elements that could impede or enhance the expression of creative ideas in this type of setting. Inhibitors included: domain knowledge, dominance, downward norm setting, lack of shared understanding, time pressure and technical difficulties. On the other hand, creativity enhancers included: stimulating colleagues, the existence of a variety of social influences, a collaborative team climate and both surfacing and reduction of equivocality.

De Vreede and colleagues (2000) compared synchronous and asynchronous electronic brainstorming in two big teams consisting of multiple subgroups. The two experimental conditions were designed to compare productivity and satisfaction of subgroups. In the first condition, every subgroup was generating ideas, independently of other subgroups (parallel, synchronous). In the second condition, every next subgroup had the ideas of the previous subgroup available to them and could build on the results from the previous subgroup (serial, asynchronous). The results suggest that subgroups working in the asynchronous mode felt significantly more satisfied and outperformed the synchronous subgroups in terms of total number of ideas.

Shirani and colleagues (1999) compared synchronous GSS system and asynchronous e-mail system of collaboration across structured (routine, well-established tasks with well-defined solution space) and unstructured (with no boundaries or well-understood procedure) team tasks in order to understand the implication of these functionalities on collaboration.

Results showed that synchronous groups generated more ideas than asynchronous groups, but that those generated by asynchronous groups exhibited more depth and elaboration. They conclude that asynchronous communication allows and encourages greater use of human information processing resulting in deeper analysis.

Overall, this limited literature provides few interesting insights about asynchronous mode of electronic brainstorming in groups. However, to our current knowledge, none of these studies attempted to assess the impact of synchronous versus asynchronous online settings on social identification, motivation and flow. Therefore, our contribution consists in bridging this theoretical gap by running an experimental study.

EXPERIMENTAL STUDY

SIDE Experiment – Collective Flow Online

Goals of the study. In line with the SIDE, we aim to study the effects of the presence of personal identity cues in a computer-mediated collaborative creativity task on the collective flow and on the creative performance. To further test our theoretical model of collective flow, we will analyze the effects on social identification and motivation along with the collective flow.

Given the growing interest in and practical relevance of asynchronous remote collaboration settings, we also decided to implement asynchronous collaboration conditions, resulting in a 2 Cues (With, Without) *2 Temporality (Synchrony, Asynchrony) factorial design (see Table 45.). The Temporality factor may challenge application conditions of the SIDE, which is usually tested in situations of synchronous remote collaboration.

EXPERIMENTAL DESIGN	PRESENCE OF PERSONAL IDENTITY CUES <i>(identified: name and biography)</i>	ABSENCE OF PERSONAL IDENTITY CUES <i>(anonymous: no name, no biography)</i>
SYNCHRONOUS BRAINSTORMING	<i>Synchronous, with personal cues</i>	<i>Synchronous, without personal cues</i>
ASYNCHRONOUS BRAINSTORMING	<i>Asynchronous, with personal cues</i>	<i>Asynchronous, without personal cues</i>

Table 45. Our experimental 2 x 2 design.

The originality of the study relies, firstly, on the analysis of the cognitive SIDE on collective flow and, secondly, on the study of the moderating effect of temporality on cognitive SIDE.

Hypotheses:

As the absence of the personal identity cues combined with the presence of social identity cues (group symbols) or *relative anonymity* is shown to foster group influence, adherence to group norms (Postmes et al., 2000), social attraction between group members and in-group favoritism (e.g., Postmes et al., 1998), we hypothesize that it is also beneficial in terms of positive sociocognitive processes and creative output. Therefore we hypothesize that:

H1: In line with the SIDE, we expect to find a positive influence of the absence of personal identity cues on most of the variables (Fluency, Self-rated creativity, Flow, Motivation, Evaluation apprehension).

In a more exploratory rationale, we are curious to see if this first hypothesized effect is prone to change across different collaborative modes (synchronous versus asynchronous). The impression of being exposed to others' judgment might decrease in the Asynchronous condition - because of the temporal absence of others. Hence, we propose our second hypothesis:

H2: We may observe an interaction effect between the presence of personal identity cues and temporality: although speculative, we expect that the effect of Cues would decrease in Asynchronous condition.

Finally, in order to gain a deeper understanding of these mechanisms, we propose two mediational hypotheses as well, stating that:

H3: We expect to observe a multiple serial mediation effect between Cues and Fluency, with Social identification and Flow as mediators.

H4: We expect to observe a multiple serial mediation effect between Cues and Fluency, with Intrinsic motivation and Flow as mediators.

Method:

Participants. One hundred fifteen undergraduate students of psychology at Paris Descartes University participated in the experiment (84 female and 31 male, age $M = 21.33$, $SD = 4.33$). Participation was voluntary and students received a credit for one of their courses.

Materials. For this experiment, we have developed a collaborative platform for online electronic brainstorming. This brainstorming platform had four versions: one for each experimental condition (see Table 46. below). When joining the brainstorming platform, one half of the participants, in the two *personal identity cues* conditions were asked to provide their personal details, while the other half of the participants, allocated to the two *no personal*

identity cues conditions were simply given a generic pseudo. In the two synchronous conditions, participants were able to generate written ideas and share them in real-time on the common interface. On the contrary, in the two asynchronous conditions, previous ideas of other group members were already on the common interface such that the participant was only to add her/his own ideas.

EXPERIMENTAL DESIGN	PRESENCE OF PERSONAL IDENTITY CUES <i>(identified: name and biography)</i>	ABSENCE OF PERSONAL IDENTITY CUES <i>(anonymous: no name, no biography)</i>
SYNCHRONOUS BRAINSTORMING	<i>Name and bio visible to all.</i> <i>Drag-and-drop ideas in real time.</i> N = 28	<i>Generic pseudos for everyone.</i> <i>Drag-and-drop ideas in real time.</i> N = 29
ASYNCHRONOUS BRAINSTORMING	<i>Name and bio visible to all.</i> <i>Previous ideas already there.</i> N = 30	<i>Generic pseudos for everyone.</i> <i>Previous ideas already there.</i> N = 28

Table 46. Four versions of the electronic brainstorming platform.

Experimental deception. In order to have a clearer assessment of individual experience of group brainstorming, we opted for a design and setting where we have the most of control. Thus, the experimental groups had three group members out of which only one was human, our participant. Without their knowledge, our experimental participants were collaborating with two computerized confederates.

Computerized experimental confederates (bots). Two computerized confederates were developed for this occasion such that their online behaviour resembles a typical human behaviour as much as possible.

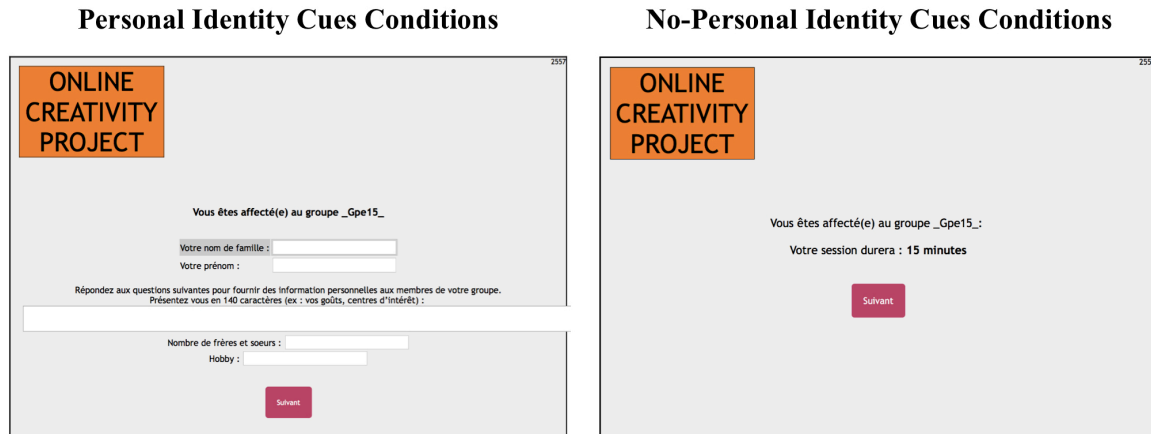


Figure 39. Platform interface for *Cues* versus *No-Cues* conditions.

Personal Identity Cues: Names. Similarly like in Postmes et al. (2002), participants were randomly assigned either to a *Cues* or *no-Cues* condition (see Figure 39. above). In the *no-Cues* condition, the username was a pseudo, composed of the team abbreviation such as *Gpe15* followed by member abbreviation (e.g. *Gpe15_Member3*). In the *Cues* condition, participants were represented by their group abbreviation followed by the first three letters of the participant’s first name and the first three letters of his/her last name (e.g. *Milija Simlesa* would appear as *Gpe15_Mil.Sim*) as in Le Hénaff et al. 2014. This was done to prevent activation of gender categories (first name) and ethnic categories (last name). The team abbreviation (*Gpe15_...*) was included in usernames in order to make an observable uniformization of groups, reinforcing the sentiment of belonging (Kim, 2009). For the identified condition, bots’ first and last names were chosen out of the top-ten most common names and surnames in France for the birth year corresponding to that of an average psychology undergraduate). In *Cues* conditions, one confederate was called **Gpe15_Ale.Rob** (corresponding to first name **Alexandre** – 8 864 births in France in 1996, the second most popular baby name in 1996 with two girl variants – **Alexia** and **Alexandra**; last name **Robert**, the fifth most common last name in France with 91 393 persons having it). The other confederate was called **Gpe15_Lau.Mor** (corresponding to first name **Laura** – 7 429 births in France in 1996, the seventh most popular baby name with a boy variant – **Laurent**; last name **Morel** the tenth most common last name in France with 78 177 persons having it). For the detailed representation of how names appeared on the platform across the four conditions, see Table 47. below:

NAME DISPLAY FOR:	PRESENCE OF PERSONAL IDENTITY CUES	ABSENCE OF PERSONAL IDENTITY CUES
PARTICIPANT	<i>Gpe15_Fir.Las*</i> Three first letters of the first name and three first letters of the last name.	<i>Gpe15_Member3</i>
THE TWO BOTS	<i>Gpe15_Ale.Rob</i> <i>Gpe15_Lau.Mor</i>	<i>Gpe15_Member1</i> <i>Gpe15_Member2</i>

Table 47. Bots’ and participants’ name display across the four conditions.

Personal Identity Cues: Biographies. *No-Cues* condition did not include any biographical description of virtual confederates. No individuating information was displayed, just the user ID, like in Postmes et al. (2005). On the other hand, the *Cues* condition included 140-character biographical information on robot confederates. Instead of using a digital photograph of participants like in Postmes, et al. 2002, we decided to use gender-neutral biographical information in order to hide the participant’s gender. This was done because knowing the gender of group members can generate expectations, stereotypes, and prototypical behavior, especially in the context of computer-mediated communication (Guegan et al., 2016). Following the procedure similar to Tanis & Postmes (2008), the two target descriptions containing biographic information were issued out of twenty pretested biographical descriptions produced by psychology students, calibrated to be of average attractiveness, niceness and interest (40 participants rated the biographies on how attractive, nice and interesting each description appeared on a Likert scale from 1 to 7). We chose two biographies scoring and average of 4.29 and 4.18 on attractiveness, 3.98 and 4.15 on niceness, 4.78 and 4.03 on interest.

Brainstorming Task. For the brainstorming task we used the same Persona method as in the Action Identification Study (see *Chapter 4*) but with only one Persona and not two this time. The groups received instructions to propose creative solutions for future application of a connected object that can do *almost anything*. The gadget is portable, connected, and can communicate with users and objects of all sorts. All groups were provided with one Persona and told to imagine applications of the connected object for disabled (Philippe Dubois, see Figure 40.).

Philippe Dubois

61 ans, Agent ferroviaire

La persévérance vient toujours à bout de tous les obstacles.

Aisance numérique: 4 dots (3 filled, 1 empty)

Fréquence d'usage de l'ordinateur: 6 dots (all filled)

Affinité pour le numérique: 4 dots (all filled)

Depuis 19 ans, Philippe souffre d'une maladie dégénérative rare qui touche sa moelle épinière. En conséquence il est paraplégique depuis une décennie. Ce handicap moteur entrave l'utilisation de ses jambes ce qui fait qu'il se déplace en fauteuil roulant. Philippe peut encore marcher quelques mètres, mais avec grande difficulté. Il rencontre de nombreux obstacles dans son environnement quotidien : des marches partout, des boutons d'ascenseur trop hauts, etc.

Néanmoins, Philippe a accepté sa maladie et s'y est adapté. Bénéficiant de l'obligation d'emploi des travailleurs handicapés (OETH) il est professionnellement actif à temps plein à la SNCF en tant qu'agent ferroviaire. Son rôle est de surveiller et coordonner la circulation des trains en salle de contrôle. Tous les jeudi soirs, il participe aux entraînements de son équipe de handibasket.

A part ses collègues et partenaires de sport, Philippe n'a pas une vie sociale très dynamique et il en n'est pas satisfait. Pour compenser, il regarde la télévision, parle à sa famille via Skype et lit des romans sur son Kindle. Sa série télévisée préférée est *Lost*.

Buts clés

- Remporter le championnat de handibasket 2017
- Avoir une vie sociale plus riche
- Se lancer dans l'entrepreneuriat avant l'âge de 65 ans

Personnalité

- Persévérant
- Patient
- Rêveur
- Parfois déprimé

Figure 40. Persona *Philippe Dubois* used in the electronic brainstorming task.

Ideas generated by computer confederates. In order to make the experimental setting as close as possible to reality, we used genuine ideas generated by human participants from a previous experiment. Each idea ($N = 372$) produced by participants of the Action Identification Experiment (*Chapter 4*), issued from the *high action identification condition*, and corresponding to Philippe's persona was taken and pretested for originality. The proportion of bad-average-good ideas was similar to the general distribution of idea-quality throughout the corpus related to this Persona. This respectively means 7% of bad ideas, 36% of average ideas and 57% of good ideas (1 bad idea per bot, 3 average ideas per bot and 5 good ideas per bot).

Rhythm of idea generation for the two bots. In the two *Synchronous* conditions, each computerized confederate produced 9 ideas during the 15 minutes session. This approximately corresponded to the average number of ideas produced by individual team members in face-to-face groups. The frequency of idea generation was made to decline throughout the session, while the quality of idea generation was made to increase throughout the session (Lubart et al., 2015).

Procedure

Participants arrived at the box and they were told they would be participating in an experiment about online creative collaboration. They were told (deceived) that it is a big inter-laboratory experiment and that there are many participants that are passing it simultaneously in different boxes on different floors of the laboratory. For *synchronous* conditions, experimenter made a fake phone-call to an imaginary colleague who is receiving other participants somewhere else in the laboratory. For *asynchronous* conditions, there was no need for that.

Preliminary test of group allocation. Next, participants were told that they would be allocated to a group depending on their creative personality profile (minimal groups paradigm). We have decided to use a form of minimal groups paradigm (Tajfel et al., 1971; Le Hénaff et al., 2014) in order to make participants feel the belonging to the ingroup. For this, we needed to make a situation where a test of irrelevant classification sorted out people into groups. In order to make participants believe they are allocated to a group on the basis of their personal creativity profile (which is task-relevant), they had to respond to *Openness, Originality, and Open-mindedness* subscale of French version of Big Five Inventory (BFI-Fr) (Plaisant et al., 2005). This subscale consisted of 10 items and was chosen for its particular verisimilitude as our participants were psychology undergraduate students and, for most of them, were familiar with BFI. In reality, this was a bogus questionnaire because there was no matching with other participants. In order to make this as believable as possible, a loading screen appeared, saying that we are calculating their score and looking for the match (see Figure 41. below).

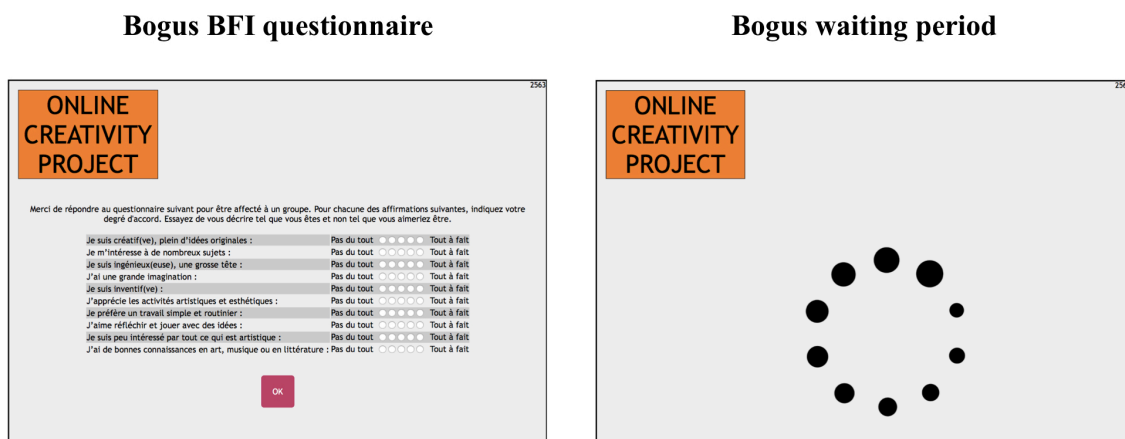


Figure 41. The BFI bogus questionnaire for minimal groups paradigm.

After few seconds of waiting, another screen appeared saying that depending on their creative personality result, we have allocated them to the group n°15. *Cues* condition's participants began by filling-in the personal information, while *No-Cues* condition's participants were automatically given a generic pseudo.

For the *Cues* conditions (synchronous identified and asynchronous identified), we asked them to fill few pieces of information about themselves: last name, first name, 140-character presentation (ex. your tastes and hobbies) and number of brothers and sisters. On the contrary, those participating in the anonymous condition did not do this. Instead they received another screen saying that their pseudonym will be Gpe15_Member3 and that their session will last 15 minutes. The identified condition participants received a screen saying that their pseudonym is Gpe15_Fir.Las (first three letters of the first name and the first three letters of the last name) and that their session will last 15 minutes.

During the brainstorming session, participants were asked to generate a maximum of ideas on a given topic. In the two *Cues* conditions, biographies and names of all three participants were displayed, while in the two *No-Cues* conditions, there were blank fields with only three generic pseudos (see Figures 42 and 43. below).

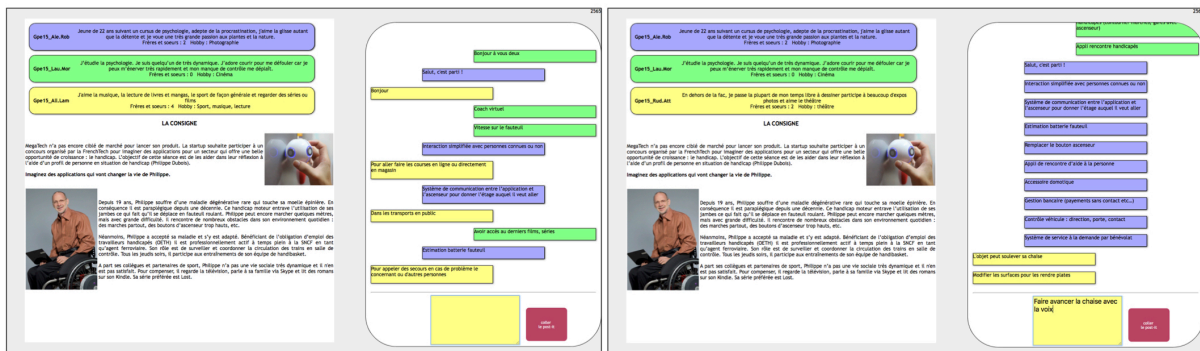


Figure 42. Brainstorming interface for the two conditions *With Cues*.

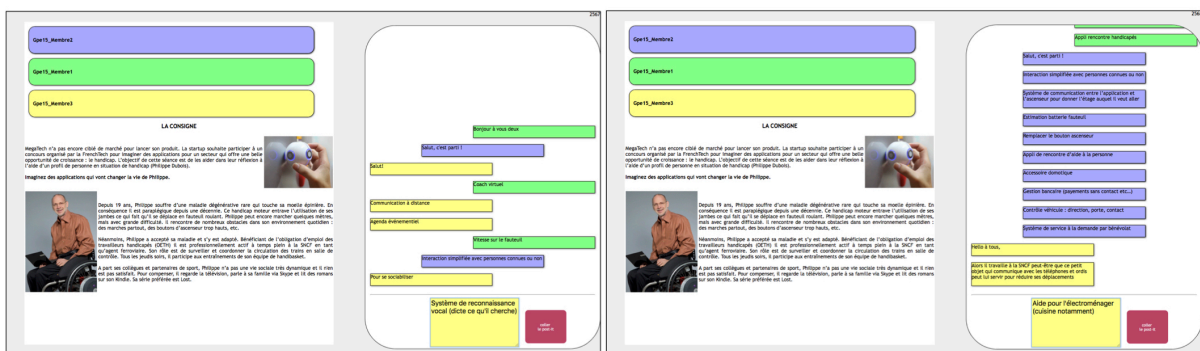


Figure 43. Brainstorming interface for the two conditions *Without Cues*.

After the brainstorming session finished, a new window with a self-reported questionnaire appeared. After completing the questionnaire, the participants were debriefed and dismissed. Only one out of 115 participants exhibited a doubt about the human nature of other two group members, and thus was immediately removed from the further analysis.

Data collected:

Manipulation check. The manipulation check of individuation consisted in two items from Postmes et al. (2002) “I could form an impression of the people in my group” and “The others in my group were personally identifiable to me” ($r = 0.365$, $p < 0.001$) with 7-point Likert scales.

Creative performance. Fluency of ideas was measured by counting the number of single-ideas generated by the participant during the online electronic brainstorming session.

Subjective variables.

- Self-rated creativity was measured with 2 items: “I had a lot of ideas” and “I had high quality ideas” ($r = 0.763$, $p < 0.001$) with 7-point Likert scale.
- FSS – 13-item The Flow Short Scale (Rheinberg et al., 2002) with 7-point Likert scale, with 3 clusters, but we kept only 2 of them: absorption ($\alpha = 0.620$; e.g., “I felt just the right amount of challenge”, “I didn’t notice time passing”), and fluency ($\alpha = 0.832$, e.g., “My thoughts run fluidly and smoothly”, “I had no difficulty concentrating”).
- SIMS - Motivation was measured through the Situational Motivation Scale (Guay et al., 2000) in which we selected the Intrinsic (e.g., “I was engaged in this activity: Because I thought this activity is interesting, Because I thought that this activity is pleasant” $\alpha=0.904$) and Identified motivation (e.g., “I was engaged in this activity: Because I was doing it for my own good, Because I thought this activity was good for me” $\alpha=0.894$) dimensions.
- Social identification was measured using the Single Item Social Identification (Postmes et al., 2013).
- Evaluation apprehension was assessed with 2 homemade items: “I was reluctant to give my ideas to the group” and “I was worried that my ideas would be badly received” ($r = 0.617$, $p < 0.001$) with 7-point Likert scales.

Results:

All dependent variables were processed with a 2 (Personal Identity Cues: Presence vs. Absence) x 2 (Temporality: Synchrony vs. Asynchrony) ANCOVA with Sex as covariate.

Manipulation checks. The effect of Cues proved significant ($F(1, 110) = 33.56$, $p < 0.001$, $\eta^2p = 0.234$) with higher individuation level in the presence of Cues ($M = 4.1$, $SD = 1.6$) than in the absence of Cues ($M = 2.6$, $SD = 1.2$). The other effects were not significant. Therefore, the experimental manipulation induced the expected effects (see Figure 44.).

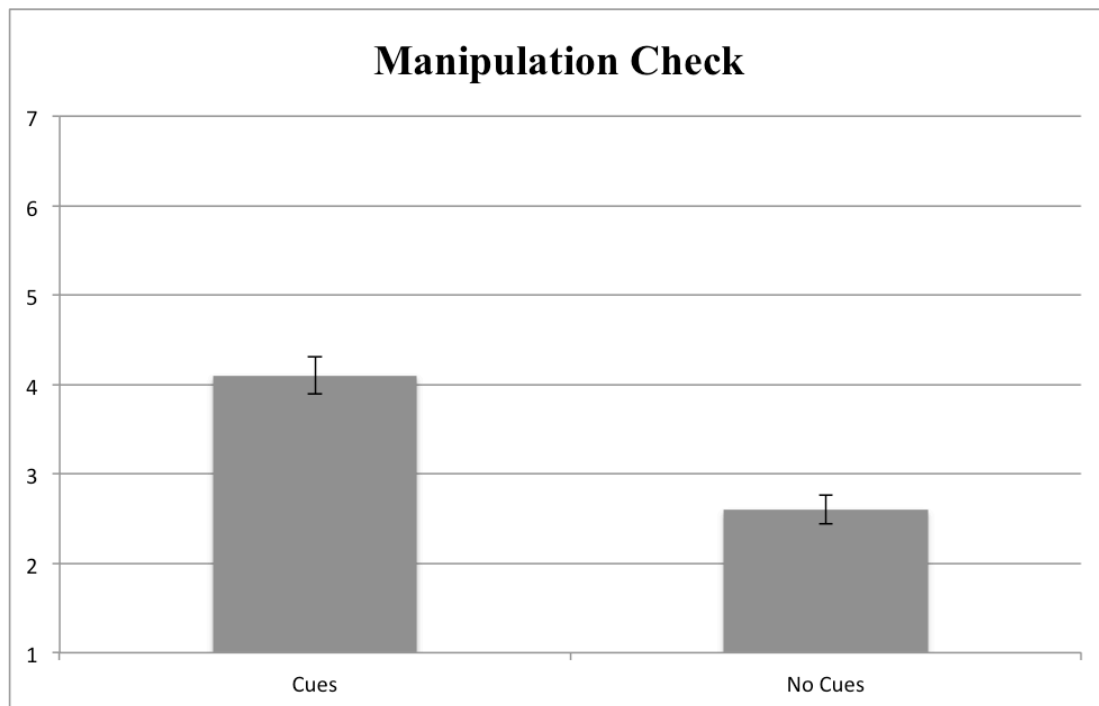


Figure 44. The main effect of Cues on social identification (manipulation check).

Creative performance. The main effect of Personal Identity Cues was not significant ($F(1, 110) = 0.530, p = 0.468, \eta^2p = 0.005$), with similar levels of fluency in the presence ($M = 9.6, SD = 6.8$) and in the absence of Cues ($M = 10.3, SD = 3.8$). The main effect of Temporality proved marginal ($F(1, 110) = 3.33, p = .071, \eta^2p = 0.029$) with slightly higher fluency in Asynchrony ($M = 10.9, SD = 6.4$) than in Synchrony ($M = 9.0, SD = 4.2$). The interaction effect was not significant either ($F(1, 110) = 1.76, p = .187, \eta^2p = .016$).

Positive Sociocognitive Processes. Regarding Self-rated creativity, we observed a main effect of Cues ($F(1, 110) = 4.37, p = 0.039, \eta^2p = 0.038$) with higher ratings in the absence ($M = 4.0, SD = 1.3$) than in the presence of Cues ($M = 3.5, SD = 1.3$). The main effect of Temporality was not significant ($F(1, 110) = 0.43, p = 0.515, \eta^2p = 0.004$) with similar self-ratings of creativity in Synchronous ($M = 3.8, SD = 1.1$) and Asynchronous conditions ($M = 3.7, SD = 1.5$). However, the interaction effect proved significant ($F(1, 110) = 4.63, p = 0.034, \eta^2p = 0.040$). The simple effect of Cues in Asynchrony proved not significant ($F(1, 110) = 0.002, p = 0.966, \eta^2p = 0.000$) whereas the effect of Cues in Synchrony was significant ($F(1, 110) = 8.90, p = 0.003, \eta^2p = 0.075$; see Figure. 45.).

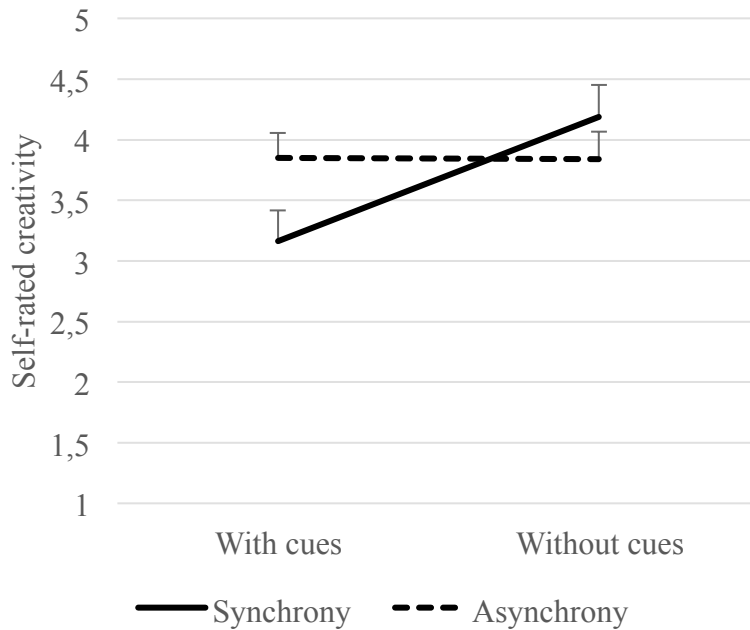


Figure 45. Levels of self-rated creativity as a function of the presence of personal identity cues and of the temporality (synchrony vs. asynchrony).

The scores of Flow-Absorption showed a marginal main effect of Cues ($F(1, 110) = 2.86, p = 0.094, \eta^2p = 0.025$) with absorption slightly higher in the absence of Cues ($M = 4.9, SD = 1.2$) than in the presence of Cues ($M = 4.5, SD = 1.1$). The main effect of Temporality was not significant ($F(1, 110) = 0.96, p = 0.329, \eta^2p = 0.009$), with similar levels of absorption in Synchrony ($M = 4.8, SD = 1.1$) and Asynchrony ($M = 4.6, SD = 1.2$). The Cue x Temporality interaction was not significant ($F(1, 110) = 0.60, p = 0.441, \eta^2p = 0.005$).

The Flow-fluency variable showed no main or interaction effects (all p 's > 0.116).

Regarding Intrinsic motivation, we observed no main effect of Cues ($F(1, 110) = 0.09, p = 0.769, \eta^2p = 0.001$; $M = 4.9, SD = 1.3$ with Cues; $M = 5.0, SD = 1.2$ without Cues) and no main effect of Temporality ($F(1, 110) = 0.31, p = 0.579, \eta^2p = 0.003$; $M = 5.0, SD = 1.1$ in Synchrony; $M = 4.9, SD = 1.3$ in Asynchrony). However, the interaction effect between Cues and Temporality on Intrinsic motivation proved significant ($F(1, 110) = 6.46, p = 0.012, \eta^2p = 0.055$). The simple effect of Cues in Synchronous condition ($F(1, 110) = 3.97, p = 0.048, \eta^2p = 0.035$) showed that participants in this condition were more motivated in the absence than in the presence of Cues, while the simple effect of Cues in Asynchronous condition was not significant ($F(1, 110) = 2.55, p = 0.113, \eta^2p = 0.023$; see Figure. 46.).

The Identified motivation variable showed no main or interaction effect (all p 's > 0.463).

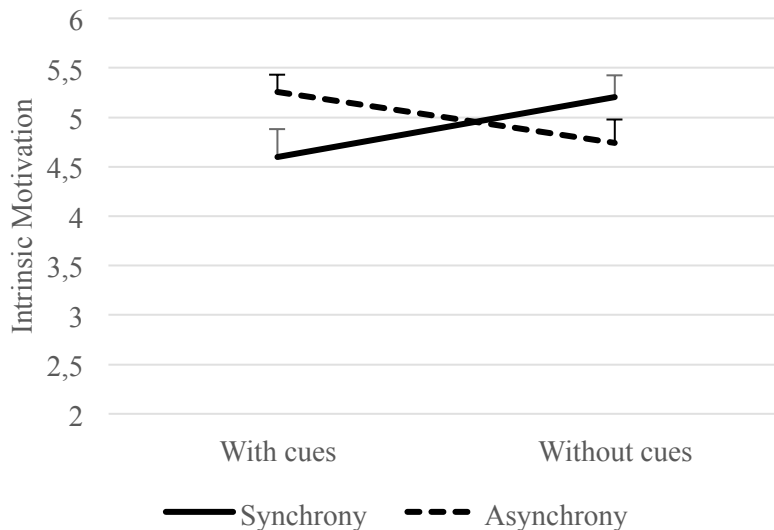


Figure 46. Intrinsic motivation ratings as a function of the presence of personal identity cues and of temporality (asynchrony vs. synchrony).

The analysis of Social identification showed that the main effect of Cues was not significant ($F(1, 110) = 0.005, p = 0.942, \eta^2_p = 0.000$) with similar levels of Social identification in the presence ($M = 4.00, SD = 1.78$) and in the absence of Cues ($M = 3.98, SD = 1.74$). The main effect of Temporality was marginally significant ($F(1, 110) = 3.097, p = 0.081, \eta^2_p = 0.027$) with slightly higher levels of identification in asynchronous ($M = 4.26, SD = 1.58$) than in synchronous condition ($M = 3.72, SD = 1.88$). The interaction effect was not significant ($F(1, 110) = 0.094, p = 0.76, \eta^2_p = 0.001$).

Regarding Evaluation apprehension, the main effect of Cues was not significant ($F(1, 110) = 0.112, p = 0.738, \eta^2_p = 0.001$), with apprehension ratings not different with ($M = 2.73, SD = 1.64$) or without Cues ($M = 2.82, SD = 1.58$). The main effect of Temporality was significant ($F(1, 110) = 4.204, p = 0.04, \eta^2_p = 0.037$) with higher levels of apprehension in synchronous ($M = 3.10, SD = 1.66$) than in asynchronous condition ($M = 2.45, SD = 1.49$). The interaction effect was not significant ($F(1, 110) = 0.265, p = 0.607, \eta^2_p = 0.002$).

Mediation analysis. The previous results show that there was no significant effect of Cues on Fluency. Furthermore, partial correlations between Social identification and Intrinsic motivation, controlling for Cues and Temporality, are significant (all r 's $> 0.332, p < 0.001$). This pattern of results rules out the hypothesized mediation analysis (H3 and H4).

However, in order to test our theoretical model of Collective Flow, we performed a mediation analysis including Social Identification, Intrinsic Motivation and Flow-Absorption - controlling for Cues and Temporality. The results show that the effect of Social Identification on Flow Absorption is fully mediated by Intrinsic Motivation (see Figure. 47). The indirect effect through Intrinsic Motivation is significant ($z = 3.13, p = 0.001$) and the

direct effect of Social Identification is non-significant when Intrinsic Motivation is integrated in the model (R^2 model = 0.34).

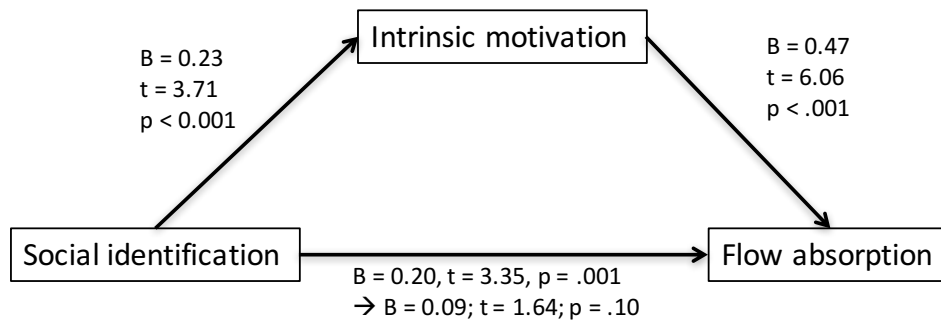


Figure 47. Results of the mediation analysis between Social identification and Flow absorption.

Discussion

The aim of this study was to assess the impact of presence of personal identity cues in a computer-mediated collaborative creativity task on positive sociocognitive processes as well as on creative output. Another goal of this study was to contribute to understanding of synchronous and asynchronous collaboration modes on these dependent variables. This resulted in 2 x 2 factorial experimental design comparing: *presence-of-cues-synchronous*, *presence-of-cues-asynchronous*, *absence-of-cues-synchronous*, and *absence-of-cues-asynchronous* conditions.

Given that previous SIDE studies demonstrated the benefit of absence of personal cues in online collaboration (Postmes et al., 1998; Postmes et al., 2000; Tanis & Postmes, 2008), we hypothesized that this relatively anonymised setting will improve positive sociocognitive processes as well as the creative output of our participants. Results show a partial support for this first hypothesis (H1). Self-rated creativity significantly increased in the absence of personal cues (just like in Tanis & Postmes, 2008) as well as flow (insignificant but marginal effect) meaning that when their personal information was hidden from the eyes of others, participants thought of their contributions as more creative and felt more absorbed in the activity at hand. We failed to find empirical support for this hypothesis (H1) concerning intrinsic motivation, identified motivation, social identification and apprehension of evaluation. However, if only synchronous condition is considered, the SIDE hypothesis (H1) is also verified on intrinsic motivation. When working in real-time conditions, participants feel more intrinsically motivated if their identity is hidden behind a generic pseudo. Identified participants generated roughly the same amount of creative ideas as the anonymised participants, so there was no main effect on the creative output.

Our second hypothesis (H2) concerned the interaction of cues with the temporality mode of collaboration. In an exploratory rationale, we guessed that SIDE effect would decrease in the asynchronous condition because of the temporal absence of others. Interaction effect was found on self-rated creativity and intrinsic motivation showing that SIDE effect indeed disappears in the asynchronous condition. Anonymised participants engaged in an asynchronous brainstorming felt their contributions were more creative than their identified peers. The same is true for intrinsic motivation. Fearing others' judgment – the evaluation of apprehension appeared significantly lower in the asynchronous condition.

We observed main effect of temporality on fluency (marginal) showing that people emit more ideas when working asynchronously than when working synchronously which is consistent with de Vreede et al. (2000) who found that subgroups working in the asynchronous mode felt more satisfied and outperformed the synchronous groups in terms of idea fluency.

Moreover, this effect of temporality was similar for social identification (marginal): asynchrony turned out to be beneficial for identifying oneself with their group. Finally, no effect of temporality was observed on flow neither as a main effect nor as interaction effect. The mode of collaboration did not impact the flow at all: asynchrony was not a flow killer and synchrony was not a flow booster.

Mediation hypothesis stating that social identification, intrinsic motivation and flow mediate the effect of personal identity cues of creative performance (fluency) was not empirically supported. Nevertheless, further mediation analyses showed that the effect of social identification with the group on flow was entirely mediated by intrinsic motivation. This reinforces our theoretical model (see Figure 48.).

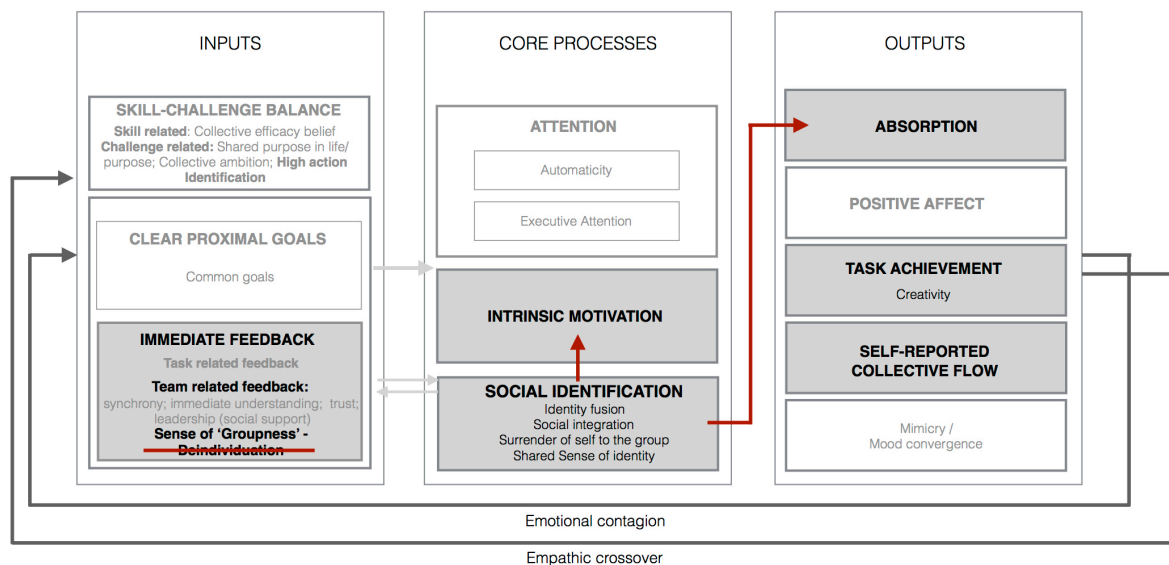
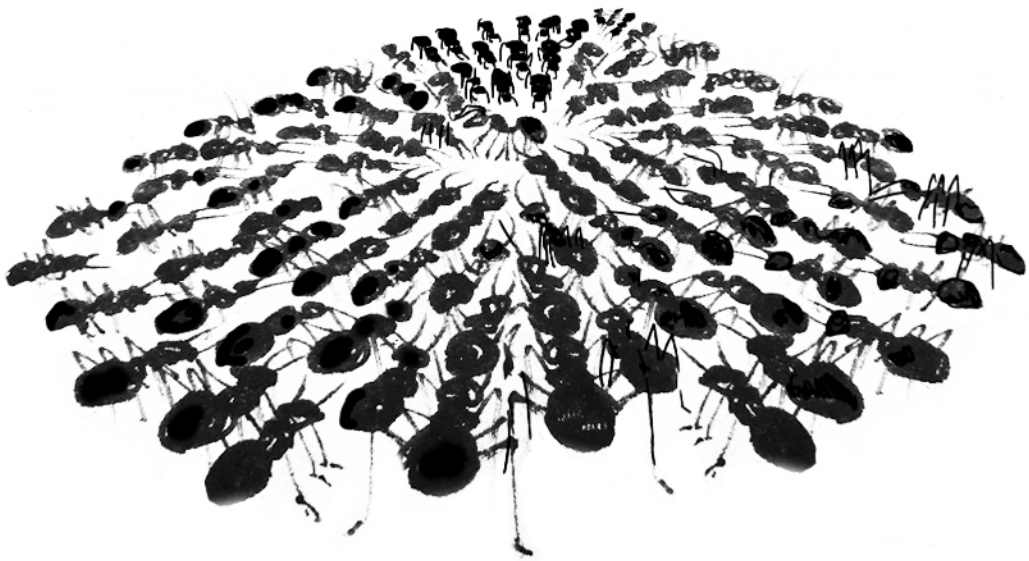


Figure 48. The corrected I-P-O model of Collective Flow

It is interesting to note that in the last three studies (*Chapter 6* and *Chapter 7*) we failed to observe the categorization effect of cues (presence of social cues or absence of personal cues) on participants' reported social identification to their group. Nevertheless, social identification appeared as a predictor of flow experience both in face-to-face and online settings. It is evident that group identification happens without our (experimenters') wilful action of cues manipulation and that it does have an effect on the positive sociocognitive processes.

Having experimented with synchronous versus asynchronous mode of online collaboration helped us gain some important and, to our knowledge, pioneering insights about their impact on positive sociocognitive processes as well as their impact on creative performance. The fact that SIDE effect disappears in the asynchronous condition is a novelty. Due to the absence of other group members, it is possible that the weight of self-expectations, social comparison, fear of judgment and need to conform disappear. As if the synchrony was stress-inducing, the asynchronous mode was probably perceived as more relaxed setting. Interestingly, the mode of collaboration did not impact collective flow.

CHAPTER 8: Discussion and Conclusion



In this final chapter, we summarize, integrate, and discuss the main findings of this research project, suggest a concluding model of collective flow as well as directions for future research.

A modest contribution to society's need. In the global context, business innovation is vital but difficult. Being for most of its part a human matter and social issue, innovation requires thoughtful study of human interactions in innovation teams as groups. Depending largely on the expression of creative potential, innovation in organizations needs favorable environmental conditions for employees to thrive, last and create in a sustainable manner. Thus, throughout this research project we attempted to answer the question *how to stimulate the collective flow in order to increase group productivity at the same time?* By studying flow as an enabler of creativity and well-being in innovation settings, we hope to have contributed to this rising social and global need.

Supporting the partner company in its progress. Being one of the French pioneers in implementing knowledge from cognitive science and organizational psychology into their products and services, our partner company, SBT Human(s) Matter wanted to better understand the sociocognitive bases of team creativity and well-being in order to improve the innovation potential of its clients. Grasping several particles of immensely obscure universe of social interactions, we have arrived to a clarification of few previously vague phenomena, and thus provided scientific knowledge to those in need. Hence, we have knitted-in several insights and handful of conclusions in the intellectual and strategic tissue of this company which is being tailored each day with the purpose of answering specific needs of their clients.

Theoretical contribution in clarifying a concept that was unclear. Studying unexplored, *new* phenomena is extremely challenging for every researcher but also incredibly exciting. A major theoretical contribution of this dissertation lies in the new conceptualization of the research object, which was remarkably unclear. Having performed a thorough examination of existing research on both individual and collective flow, we have proposed a dynamic, causal theoretical framework for both notions. Anchoring those two dynamic frameworks in fundamental cognitive and sociocognitive theories from psychology, we managed to open a research highway for a more comprehensive, experimental approach of these phenomena – sometimes contemptuously considered *esoteric* by research communities external to positive and applied psychology. Consequently, we have made first steps on this highway attempting to provide answers to our hypotheses concerning preconditions, core processes and outcomes of collective flow.

Our empirical results. After the first survey study which comforted us in continuing to believe that collective flow, even though less frequent than solitary flow, is a part of human reality, we have raised our hypotheses and pursued their empirical confrontation to gathered data. Hypothesizing that social sensitivity of group members, the ambitiousness of common goal and the feeling of belonging to the group enable positive sociocognitive processes as well as the team performance, we have conducted five experiments, one correlational study, one survey and three field studies.

Our three main theoretical hypothesis from the beginning were:

H1: Empathy of group members fosters the collective flow.

H2: High Action Identification fosters the collective flow.

H3: Social identification fosters the collective flow.

Among our three hypotheses we have validated the second one: high level of action identification showed to influence the increase in flow indirectly by the means of intrinsic motivation and group identification. This confirms and extends on Vallacher and Wegner's (1989) findings that the level of action identification and intrinsic motivation are correlated. The findings of this study provide insight into mechanism of optimal collaboration. Big vision motivates the team members intrinsically, enables the fusion of the group via group identification and therefore allows better quality collaboration expressed in higher level of well-being. To our knowledge, this study is the first one to test the influence of action identification in group settings and certainly the first one to successfully manipulate the level of action identification ahead of the collaboration through a simple brief, and relate it to sociocognitive process of collective flow.

The link between intrinsic motivation, social identification (as predictors) and flow (as the dependent variable) reappeared constantly and consistently through almost every study. The exploratory field study with SBT's client yielded results indicating that group identification predicts flow; RMET study in CESI Engineering School showed that both individual and collective flow were predicted by intrinsic motivation and social identification. Pilot experiment varying the presence of salient social identity cues also revealed a marginal significance of social identification when predicting flow. Next, the hackathon study which varied the presence of salient social identity cues was one more in line to show that intrinsic motivation and social identification were predictive of individual and collective flow without them being interrelated amongst themselves. Also, the social identification to students' class was marginally predictive of creative performance. In our last study, which dealt with creativity and flow online, we found that when working synchronously, participants felt more intrinsically motivated if their identity was hidden (marginal effect). The link between intrinsic motivation and flow was not that surprising. It has been found to be a moderating factor in a relation to perceived challenge and reported enjoyment (Abuhamdeh & Csikszentmihalyi, 2012b) and is widely recognized as one of the constitutive parts of flow experience. However, a consistent, positive relationship between social identification and flow was a novelty. In social settings, individual flow is predicted by social identification. Identified as a group member, the flowing individual becomes the part of one whole. The question arises: is the individual flow experienced by someone identifying as a group member still *individual* flow or something else? We have no answer to this twisted question. Nevertheless, we allow ourselves to believe that flow experience in social settings is qualitatively different than the flow experience in solitary settings and therefore challenge our community to reflect upon it, propose experimental designs to verify it, interpret it and propose a clearer answer.

Even though the preliminary field study with SBT's client yielded support that perceived ingroup empathy is predictive of flow, in other, more refined laboratory examination, we did not find support for this. Induction of empathetic point of view in the pilot experiment was particularly difficult, and did not land the support for our hypothesis. Furthermore, the correlational study examining the predictive power of Theory of Mind dispositions did not provide support for believing that the dispositional social sensitivity plays any role whatsoever in the process of creative collaboration. This finding was later replicated on the field in the context of hackathon competition (Mind Hack) confirming that Theory of Mind is not related to positive sociocognitive processes and performance. These results are quite surprising because they are in contradiction with Woolley et al., (2010) findings that average ToM group score predicts the team performance on a wide variety of tasks. Consequently, we are led to conclude that our first hypothesis is not validated.

Our operational hypothesis concerning the means of making the social category of group salient by either adding salient social identity cues (in face-to-face groups) or by removing personal identity cues (in virtual setting) found no empirical support. Instrumental operationalization of social categorization did not impact the flow experience or creative output of innovation teams. However, the process of social identification did take place in spite of our manipulations (adding social or removing personal identity cues) and did impact the flow: both individual and collective flow were found to be significantly influenced by the reported social identification of participants to their respective teams. Social identification consistently and repeatedly appears to be a part of collective flow mechanism. We are able to capture it, but we were not able to willfully manipulate it. Therefore we can conclude that our third theoretical hypothesis is not invalidated, but admit having difficulties to intentionally handle its operationalization.

The online study of virtual creative collaboration and flow, as a genuine pioneering work yielded very interesting results and furthered the understanding of stakes, issues and challenges of online work. Testing the impact of the absence of personal identity cues on flow and performance in synchronous versus asynchronous virtual interface, we discovered that the classic effect of SIDE tends to disappear when people are working asynchronously (notably for self-rated creativity and intrinsic motivation). A considerable decrease of evaluation apprehension in the asynchronous conditions made us think that, in comparison to the synchronous conditions, this mode of working was perceived as less stressful for the participants. The mode of collaboration, or the temporality of interaction did not influence flow at all: asynchrony was not a flow killer and synchrony was not a flow booster – as one would intuitively assume. This being the very first study exploring these notions in an online environment, we would like to point out a strong necessity for future research to explore the functioning of the collective flow online.

Findings concerning performance are not that straightforward. Two studies (*Collective Flow and Dispositional Theory of Mind* study and *Autrans Teambuilding Example* study) demonstrate that individual flow was a significant predictor of team performance. Two other studies (*Collective Flow and Social Identity Cues* study and *CESI Hackathon – Social*

Identification and Collective Flow study) demonstrate that social identification is a marginal but insignificant predictor of team performance. Regarding assumed collective flow inputs: empathy/ToM, high action identification and social categorization levers – we failed to observe the main direct effect of these on the performance. Overall, the relationship between flow preconditions and the team output was unclear and inconsistent. We argue that, probably, the sociocognitive processes do not necessarily result in performance and that there are other parameters that should be taken into account in order to understand and predict team output.

A body of evidence in flow research suggests inconsistent results concerning the relationship between flow and performance. For example, some literature suggests there is a positive relationship between flow and performance, especially in learning settings (e.g., Engeser et al., 2005; Schüler, 2007; Schiefele & Rheinberg, 1997, as cited in Schüler & Brunner, 2009), artistic and scientific creativity (e.g., Perry, 1999; Sawyer, 1992, as cited in Schüler & Brunner, 2009). However, we may also mention that these potential interrelations between flow and performance are not always supported empirically: divergent results were reported in the domains of sport (Bakker et al., 2011; Jackson et al., 2001), music (Iusca, 2015), and work setting (Demerouti, 2006). These inconsistencies might be due to various reasons: the big disparity of nature of tasks measured, heterogeneity of flow assessment methods and plurality of performance measurements. One possible explanation for this result can be that enabling beneficial sociocognitive processes does not necessarily transform into easily traceable immediate achievement. The other explanation would be that intergroup frame of reference when comparing performance is inappropriate for capturing this effect. It is possible that, effectively, there is a positive change in output but on the individual level (comparing the team with itself – its earlier version). Measuring the number of generated post-its after a workshop and scoring idea-templates might not be the best measure of performance. In the beginning, Csikszentmihalyi (1975-2000) and his colleagues studied exceptional individuals and thus built the Flow Theory. Likewise, we can imagine studying exceptional groups like start-up unicorns, music bands and similar in order to grasp a better understanding of the optimal collaboration.

As a result of our empirical studies, a final model of collective flow emerged (see Figure 49. below). This model indicates causal paths of the mechanism of flow in social settings with, as inputs, high action identification and absence of social identity cues (if online). The present model is a schematic representation of the quasi-totality of our current results. However, we suggest future research extending it and pursuing to build even better, even more robust explanatory framework.

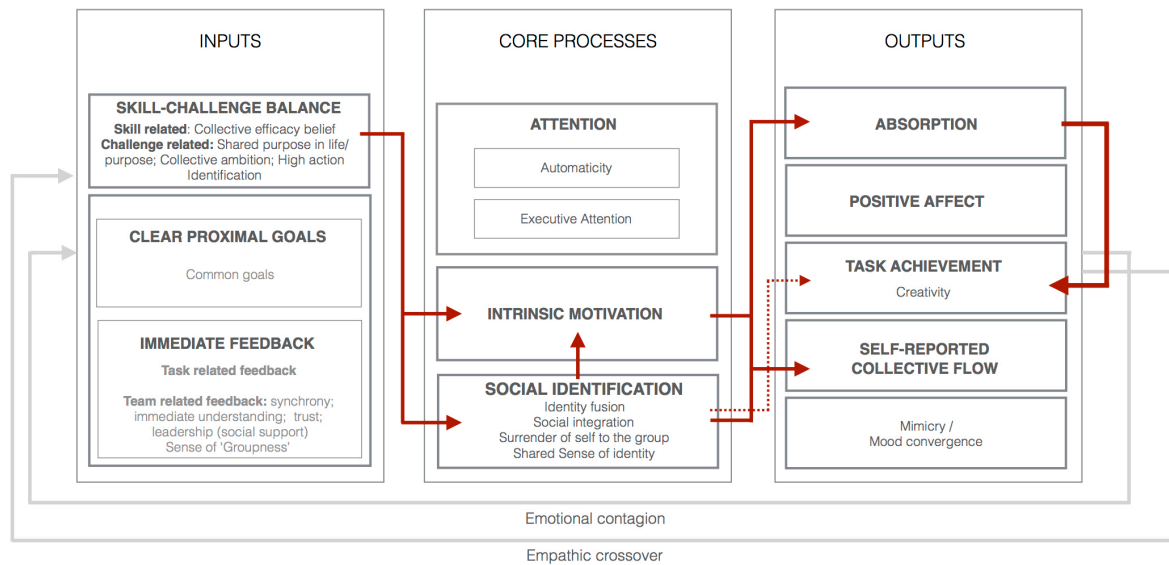


Figure 49. The final I-P-O model of Collective Flow.

Aggregate individual flow in social settings or collective flow? As Walker (2010) noticed, flow in social context may qualitatively differ from flow experienced in isolation. “Classic research in social psychology has amply demonstrated that people act, think, and feel qualitatively differently within a group than by themselves” (Allport, 1954; Asch, 1956; Latane & Darley, 1968; Lewin, 1952; Milgram, 1965; Zimbardo, 1969; in Walker 2010, p. 4). Moreover, Sawyer (2003) points out that the approach to the group flow requires attention from social psychology, “and must proceed by examining the interactional dynamics among members during performance” (p. 16) because the group can be in flow even when the members are not; or the group might not be in flow even when the members are. In their 2018 paper about conceptualization of team flow, van den Hout and colleagues while conceding that a group can attain a *collective state of mind*, they disagree with Sawyer’s view that group flow allows individuals not to experience flow. Their conception of team flow is a concatenative, aggregate one rather than being solely a group phenomenon: all team members must be in flow.

In our studies, we were obviously interested in group phenomena. These can be measured in various ways, but in organizational sciences, the most common method to assessing group phenomena is collecting individual self-report data and aggregating it to the group level (Klein et al., 2001; Mossholder & Bedeian, 1983; Rousseau, 1985; van Mierlo et al., 2009). This corresponds to composition model of data analysis (Klein et al., 2001; Rousseau, 1985; van Mierlo et al., 2009), which aims at describing how a construct that is operationalized at one level of analysis is related to another form of that construct at a different level (Rousseau, 1985; van Mierlo et al., 2009). One of the most commonly used composition models in organizational research is direct consensus model (Chan, 1998; van Mierlo et al., 2009) which uses a “within-group consensus of the lower-level units as the functional relationship to specify how a construct conceptualized and operationalized at the lower level is functionally isomorphic to another form of the construct at the higher level”

(Chan, 1998, p. 237; van Mierlo et al., 2009). Composition issues linked to this kind of research are both conceptual and methodological.

Explaining group phenomena by aggregating measures of central tendency of the group impoverishes the reach and the potential scope of group related research. Like many other authors, our study suffers from this methodological defect. However, there are many situations in which the conceptual model is framed at the level of the group, while the only feasible procedure to collect data is individual self-reporting (van Mierlo et al., 2009). Problems arising from self-reported measures can range from social desirability bias to self-delusional judgments of the self. Therefore, combining self-reported measures, physiological measures, and behavioural measures (such as observing behavior with multiple trained coders that are quantifying the observed behavior) would seem to be the most complete approach to studying collective flow and other adjacent psychosocial processes. To address this concern, future directions include conceptual cross-fertilization with social and organizational psychology, and developing reliable self-reported and behavioural measures of the phenomenon, experimentation and longitudinal studies. Finding a measure for assessing interindividual flow as a group phenomenon, without passing through aggregation of self-reported individual data is a major methodological challenge for future research of this topic.

Strengths of our research. The advantage of our research lays in its particular verisimilitude to real-life settings. We underline these lengthy procedures as an advantage because they allowed us for creating a potent and convincing setting to stage laboratory experiments that have a benefit of both of relatively controlled environment and a relatively plausible ecological context. Measuring both subjective parameters in form of self-report questionnaire and objective performance data (counting the volume of generated ideas and judging the quality of the final projects) permitted a broader examination of the research question as well as running a thorough analysis.

Applying our newly acquired knowledge in real life. The practical implications of our findings are quite easy to apply in the real-life contexts. Allowing, letting or encouraging a project team to dream big and have a real vision will hopefully increase individual member's self-determined motivation on the one hand and boost the group identification on the other. One might, for example, imagine an application of this principle at the workplace. Project teams working together can, for instance, take their time to carefully clarify their ultimate goal by deliberately formulating this vision ambitiously, leaning on the purpose of the project or so-called *the why* of the business (Sinek, 2009). Also, one could employ it in the educational setting where, instead of making the students believe their main job is to validate exams and acquire diploma, the teachers could give more purposeful and more ambitious goals as well as inviting students to find their own *why*. Obviously, all this is applicable in the animation of any innovation project such as the animation of seminars, hackathons, incubation and acceleration of start-ups, etc.

Nevertheless, the applications of these results should refrain from blind determinism and oversimplifications. Having a *big vision* of a project does not mean that *proximal goals*

should disappear. Both are necessary and need equal attention. Van den Hout and colleagues (2018), for example, differentiate between a collective ambition (abstract, e.g., become an excellent rowing squad) and a long-term common goal (more concrete, e.g., medaling the Olympics) pointing out that the collective ambition directs common goals. Visions, limitless and abstract are there to point the direction of joint efforts. Therefore, the vision might be considered as an ideal destination. Goals, on the other hand are the baby steps on the path to that destination. Necessary for experiencing the flow (Nakamura & Csikszentmihalyi, 2002; Šimleša et al., 2018), proximal goals exist so that the action can unfold in a real time. Clear proximal goals allow consequent cognitive and conative unburdening of a person's consciousness while doing the task. As such, they allow autotelic processes to take place and therefore are related to motivational process as well.

Another simple and effective immediate application of our findings can be imagined in virtual domain. We suggest creating online team brainstorming tools which operate both in synchronous and asynchronous mode, where participants go automatically anonymous when someone else logs-in simultaneously in order to maintain high intrinsic motivation, preventing evaluation apprehension and production blocking.

Theoretical and experimental leads in the short-term. Concerning the study of collective flow, this domain represents an emergent field of study, but still remains poorly documented and relatively unexplored. Effort has been made to study flow in certain group tasks (e.g., school activities and team sports), but mostly treating the individual as the focus of analysis (Nakamura & Csikszentmihalyi, 2002; Šimleša et al., 2018). The findings of our studies represent exciting new direction of small group research, which combine social psychology with positive psychology. Yet, much is to be done and therefore we are inviting researchers all over the world to join the scientific efforts of unravelling of the secrets of collective flow.

Through our study about action identification, we have tackled the *challenge* aspect of the skill-challenge balance. Nevertheless, there is still the *skill* part of the formula that remains. In their conceptualization of team flow, van den Hout and colleagues (2018) suggest that high skill integration acts as a prerequisite for team flow. This *integration* calls a certain coordination between each person's knowledge which made us think of the concept of transactive memory, a sort of skills network of knowing who knows what and who is good at what in a given team (Wegner, 1987; Michinov & Michinov, 2013). Transactive memory was first used by Wegner (1987) to understand how couples coordinate in problem-solving tasks. He observed that couples use the other person as *external memory drive*. Research has demonstrated that training students to work together helps develop transactive memory and even increases their team performance (Liang et al., 1995; Levine & Moreland, 1999). Form these elements, we can propose future research on transactive memory as an input for collective flow and invite fellow colleagues to consider this lead.

In our preliminary survey study about the frequency of occurrence of solitary versus collective flow, respondents reported experiencing collective flow most frequently in

convivial activities (chat with friends, family meal, etc.). Moreover, their open-ended answers about flow experience were full of examples of convivial and intimate activities: talking, partying, and spending time with friends, family and children (30.91%), and making love – spending intimate time with their partner (16.36%). As these activities are performed with friends, with family or with intimate partner, this may suggest the need for trust, psychological safety, or a certain level of proximity for the collective flow to happen. Approaching the study of collective flow in convivial settings with more qualitative methods can be interesting in understanding what elements from this environment of proximity are transferable and transformable to organizational settings and which of them are not.

Dreaming big. Future directions for studying collective flow can include relying on Big Data and Analytics as well as the Artificial Intelligence and quantum computing. Using the data produced by users, companies and things (Internet of Things), we could extract useful information from everyday life of people and organizations in order to better understand what are the antecedents, processes and outcomes of an optimal collaboration, its impact on performance, well-being, health, and many other important areas. Moreover, we suggest exploring behavioural markers of flow experience: behavioural synchrony, mirroring, patterns of speech, ocular fixations, facial expressions, bodily postures, etc.

Finally, in the long-term, it is possible to imagine portable personal neuroware which, based on physiological data, recognizes flow and emits biofeedback to the person and/or to others around her or him. Moreover, we can envision mobile and web applications for collaborative work that recognize collective flow in teams and accordingly make suggestions to prolong the experience as much as possible. After using the artificial intelligence to study human flow, a study of collective flow between non-human artificial intelligence. Next, the experience of flow could have its place in the normative framework: evaluating job positions by a new criterion – how much flow did you experience in this company, working on these projects, collaborating with this team; taking into account the *flowability* of human solutions in public policy-making.

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