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Rémi Yin

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UNIVERSITÉ PARIS 1 - PANTHÉON SORBONNE  
ÉCOLE D'ÉCONOMIE DE PARIS

**Thèse pour le Doctorat de Sciences Économiques**  
*soutenue publiquement par*

**Rémi YIN**

*le Mardi 11 décembre 2018*

**ON THE ECONOMICS AND THE PSYCHOLOGY OF  
INTERTEMPORAL CHOICES**

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L'Université Paris I Panthéon-Sorbonne n'entend donner aucune approbation, ni improbation aux opinions émises dans cette thèse; elles doivent être considérées comme propres à leur auteur.



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*“Heureux qui, comme Ulysse, a fait un beau voyage,  
Ou comme cestuy-là qui conquit la toison,  
Et puis est retourné, plein d'usage et raison,  
Vivre entre ses parents le reste de son âge!”*

- Joachim DU BELLAY, *Les Regrets*, XXXI

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1. La stratégie d'engagement qu'il a mis en place à mon égard sont justement discutés de manière extensive dans la sous-section 3.5 du chapitre I pour les lecteurs les plus avertis.

2. Confer le chapitre II pour les mécanismes psychologiques sous-tendant ces écarts alimentaires.

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3. "*in which we assume all of our biases [sic]*" (JZK, 2014)

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4. Nectars car les cafés étaient généralement accompagnés d'au moins six morceaux de sucre.



### ***Avertissement***

Mis à part l'introduction et la conclusion de cette thèse, les différents chapitres sont issus d'articles de recherche rédigés en anglais et dont la structure est autonome. Par conséquent, des termes "papier" ou "article" y font référence, et certaines informations, notamment la littérature, sont répétées d'un chapitre à l'autre.

### ***Notice***

Except the general introduction and conclusion, all chapters of this thesis are self-containing research articles. Consequently, terms "paper" or "article" are frequently used. Moreover, some explanations, like corresponding literature, are repeated in different places of the thesis.

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# RÉSUMÉ SUBSTANTIEL EN FRANÇAIS

## 1. Motivation Générale

L'objectif de cette thèse est de contribuer à la littérature en économie en mettant en lumière certains déterminants psychologiques de la manière dont les individus prennent des décisions dans le temps. Les chapitres de cette thèse analysent principalement trois aspects psychologiques qui expliquent comment les individus réalisent des choix intertemporels en utilisant des méthodologies et des ressources inscrites autour d'une approche qui se veut pluridisciplinaire.

Dans cet ouvrage, les choix intertemporels sont caractérisés par des arbitrages à réaliser entre des coûts et des bénéfices qui n'ont pas lieu au même instant. De tels choix, nous en faisons quotidiennement : lorsque nous devons choisir entre manger des frites aujourd'hui ou jouir d'un corps d'éphèbe dans le futur ; passer des vacances luxueuses cet été à Bogota ou économiser notre argent pour les vieux jours ; ou encore profiter des plaisirs de la jeunesse ou rédiger notre introduction générale de thèse. Le temps est ainsi une caractéristique distinctive de la plupart de nos décisions. Cependant, la difficulté liée à compréhension de ce sujet d'étude provient du fait que les individus ont une préférence pour le présent qui a une incidence considérable dans la manière dont ils prennent de telles décisions.

Ainsi, il est peu surprenant de voir l'étude des choix intertemporels au cœur de sciences comportementales comme l'économie ou la psychologie. Bien que les méthodologies et les terminologies puissent différer d'une discipline à l'autre, et parfois au sein même d'une discipline, l'économie moderne et la psychologie sont toutes deux mues par un objectif commun : celui d'expliquer et de décrire les mécanismes psychologiques sous-jacents qui motivent ces préférences.

Ainsi, cette thèse vise à montrer les avantages, mais également les limites de l'approche économique dans l'étude des choix intertemporels en la mettant en perspective avec la littérature

psychologique. En particulier, elle souhaite montrer que la science économique bénéficierait grandement de la ré-intégration des éléments issus de la psychologie pour étudier les comportements individuels. À ce titre, les études présentées dans cet ouvrage sur les comportements de santé suggèrent également que l'analyse croisée de l'économie et de la psychologie peut s'avérer particulièrement utile pour des décideurs publics puisqu'elle peut fournir de nouvelles perspectives de recherche autour de la prévention de maladies chroniques liés à de mauvais comportements de santé.

L'approche pluridisciplinaire adoptée dans cette thèse n'a pas toujours été au cœur de la discipline économique. Notamment, La théorie néoclassique visait à fonder l'analyse économique sur des concepts et des objets théoriques indépendants de la psychologie humaine (Masson, 2000). L'individu est représenté comme une construction théorique abstraite aux préférences exogènes et parfaitement rationnelles. Une lente reconnaissance dans la discipline des limites de la rationalité humaine a permis d'offrir un rôle de plus en plus important à la psychologie dans l'analyse économique des choix.

## **2. Une Histoire des Travaux sur les Choix Intertemporels**

### **2.1. Les Premiers Arguments Psychologiques**

Les choix intertemporels sont loin d'être un sujet récent en économie puisque l'attention portée à ce sujet a commencé dès les premiers balbutiements de la discipline. Rae (1834) a notamment exprimé un intérêt explicite à ce sujet en tant qu'objet d'étude à part entière (Loewenstein and Elster, 1992). Il a permis un foisonnement d'idées autour des déterminants psychologiques qui expliquent les choix intertemporels. Selon lui, la différence de richesse entre les nations est en partie liée à ce qu'il appelle le "désir effectif d'accumulation" correspondant à une préférence pour le futur. Ce désir est vu comme étant le produit conjoint de quatre déterminants psychologiques qui

favorisent—comme le motif de prévoyance, ou de legs— ou qui limitent cette préférence pour le futur—comme l’incertitude de la vie humaine et l’excitation procurée par la jouissance immédiate de biens.

Ce premier point de départ a permis l’émergence de nombreuses études tentant d’expliquer psychologiquement et cognitivement pourquoi les individus ont une préférence pour le présent. Selon l’approche normative de [Jevons \(1905\)](#) et [Senior \(1836\)](#), si l’existence d’un individu doit être vue comme un tout, les événements futurs doivent avoir le même poids que les événements actuels. Bien que ces deux auteurs partagent l’idée que les émotions immédiates limitent l’horizon du décideur, ces deux diffèrent dans le mécanisme psychologique qui sous-tend la préférence pour le présent. Alors que pour [Jevons \(1905\)](#), elle résulte d’une transcription imparfaite des événements futurs en utilité immédiate, [Senior \(1836\)](#) voit la préférence pour le présent comme due à la difficulté inhérente à retarder des gratifications immédiates qu’il considère comme les efforts les plus douloureux de la volonté humaine.

[Bohm-Bawerk et al. \(1890\)](#) fournit une théorie alternative de la préférence pour le présent par la sous-estimation systématique des besoins futurs, qui est lié à la capacité partielle des individus à imaginer le futur. Contrairement à Jevons, il considère que quand bien même deux événements surviennent à différentes périodes, ces événements sont comparables sur un même plan cognitif. Böhm-Bawerk décrit une composante émotionnelle additionnelle qui empêche le décideur d’atteindre ses objectifs. Il reconnaît que lorsque les individus doivent choisir entre un plaisir immédiat ou futur, ils peuvent privilégier le plaisir immédiat par manque de maîtrise de soi en sachant parfaitement que le plaisir futur est plus grand et que le bien-être total de leur vie serait réduit. Ainsi, Böhm-Bawerk introduit une perspective émotionnelle des choix intertemporels qui s’écarte d’une maximisation purement rationnelle de l’utilité.

[Fisher \(1930\)](#) a formalisé l’approche de Böhm-Bawerk dans un cadre théorique où les choix intertemporels entre la consommation actuelle et future sont conçus comme des choix de consom-



mation entre deux différents biens. En considérant une telle répartition, Fisher suppose que le taux marginal de substitution entre la consommation actuelle et future dépend à la fois de la préférence temporelle et de la diminution de l'utilité marginale. Cette préférence temporelle en-capsule en un seul paramètre tous les déterminants psychologiques proposés par ces prédécesseurs. Fisher a également décrit un déterminant inédit des choix intertemporels correspondant à l'influence de facteurs situationnels et environnementaux.

## 2.2. Une Table Rase des Déterminants Psychologiques

La généralisation de la modélisation économique a progressivement acquis une place centrale dans la discipline pour des questions de légitimité scientifique. Elle a fait apparaître une nouvelle représentation abstraite de l'individu dégagée de toute considération émotionnelle des préférences. L'individu "Homo Economicus" fait alors des choix rationnels en maximisant son utilité sous un ensemble de contraintes et étant donné ses ressources initiales. Dans ce cadre, les préférences de l'individu sont exogènes. Leur existence n'est pas contestée mais la discipline ne cherche plus à comprendre comment elles sont déterminées. Ce tournant épistémologique a conduit à l'émergence de modèles hypothético-déductifs dont le but n'est pas nécessairement de refléter la réalité mais d'en imiter le fonctionnement dans des contextes particuliers (Masson, 2000).<sup>5</sup> En conséquence, la préférence temporelle était devenue un concept neutre vis-à-vis de la physiologie, de l'anthropologie et de la psychologie en renonçant à certains aspects importants qui semblent essentiels pour étudier les comportements dans le monde réel.

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5. Le principal avantage de ces modèles réside dans leur pouvoir heuristique. Ils permettent d'évaluer les conséquences produites par des politiques alternatives, d'explorer d'autres environnements, qu'ils soient imaginaires ou réels, et d'expliquer l'écart entre les prédictions du modèle et la réalité par certains phénomènes temporairement omis par la formalisation.

## Le Modèle d'Utilité Escomptée

Samuelson (1937) proposait dans son article "A Note on Measurement of Utility" un modèle général de choix intertemporels applicables à des horizons infinis. Le modèle spécifie les préférences d'un décideur sur une séquence de niveaux de consommation ( $c_0 \dots c_T$ ) pondérées par la fonction d'actualisation  $D(\cdot)$ . Ces préférences peuvent être représentées par la fonction d'utilité suivante :

$$U_t(c_0 \dots c_T) = \sum_{k=0}^{T-t} D(k) u(c_{t+k}) \quad (1)$$

où  $u(c_t)$  correspond à l'utilité instantanée de la consommation à la date  $t$  et  $D(\cdot) \in [0; 1]$  est une fonction d'actualisation monotone et décroissante par rapport au temps :

$$D(t) = \delta^t = \left( \frac{1}{1 + \rho} \right)^t \quad (2)$$

$\delta$  est un paramètre subjectif et idiosyncratique appelé facteur d'actualisation exponentiel. Il correspond aux pondérations attribuées aux utilités futures. Premièrement, plus le paramètre  $\delta$  est proche de l'unité, plus l'horizon décisionnel de l'agent est long. Deuxièmement, plus une utilité est éloignée dans le temps, plus l'actualisation sera grande : cela est dû à la fonction puissance qui dépend du temps  $t$ . Quant au paramètre  $\rho$ , il désigne le taux pur de préférence temporelle qui est constant et dont le rôle est de refléter toutes les considérations psychologiques qui ont été mentionnées précédemment.

L'avantage de ce modèle réside dans sa simplicité. Une telle formulation du comportement fournit un cadre intelligible et élégant pour analyser le profil de consommation d'un individu au cours du temps. Une des spécificités les plus importantes du modèle réside dans la cohérence temporelle des choix faits par l'agent : les préférences de l'individu ne sont pas affectées par les dates de la décision mais uniquement par l'écart entre les dates de la décision.<sup>6</sup>

6. Pour des valeurs de consommation  $x$  et  $y$  données, si l'individu préfère une consommation  $x$  à la date  $t$  à une

## Des Anomalies du Modèle d'Utilité Escomptée

Malgré la simplicité et l'élégance du modèle d'actualisation exponentielle, il ne permet pas d'expliquer de nombreuses régularités empiriques des comportements qui sont incompatibles avec le modèle d'actualisation exponentielle. Un catalogue exhaustif et détaillé de ces anomalies est dressé par [Loewenstein and Prelec \(1992\)](#).

L'une des anomalies les plus discutées du modèle exponentiel est l'incohérence temporelle. L'observation et l'introspection des comportements humains nous offrent une multitude d'exemples et d'anecdotes de choix temporellement incohérents. Les gens se fixent souvent des objectifs en promettant d'arrêter de fumer, d'épargner davantage ou de terminer leur thèse. Ce sont également souvent ces mêmes personnes qui continuent de fumer, dépensent leur argent dans des frivolités qu'ils regrettent souvent plus tard, et décalent leur date de soutenance de thèse. Le modèle d'actualisation exponentielle, ne laissant aucune place à la question du regret dans nos choix, ne permet pas de rendre compte de ce type de phénomène.

Les preuves empiriques et expérimentales qui montrent que le taux de préférence pour le présent n'est pas constant mais décroissant au cours du temps s'accumulent. Lorsque l'on propose à des sujets de faire un ensemble de choix entre recevoir un gain faible à une date  $t$  et un gain supérieur à une date  $t + \tau$ , le taux d'actualisation implicite à long terme est généralement inférieur au taux d'actualisation à court terme ([Thaler and Shefrin, 1981](#)). De plus, les préférences entre un gain  $x$  à la date  $t$  et un gain  $y$  à la date  $t + \tau$  peuvent être inversées en faveur du gain  $x$  à la date  $t$  lorsque cette date est plus proche ([Kirby and Herrnstein, 1995](#), [Ainslie, 1992](#)).

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consommation  $y$  à la date  $t + \tau$ , alors l'individu va également préférer une consommation  $x$  à la date  $t + s$  à une consommation  $y$  à la date  $t + \tau + s$ , et ce, quelle que soit la valeur de  $s$ .

## 2.3. La Résurrection de l'Approche Psychologique dans les Modèles Économique

Lorsque la science économique moderne commençait à reconnaître les limites cognitives et intellectuelles de l'esprit humain, elle a dû attribuer un rôle de plus en plus important à la psychologie dans la compréhension du comportement des individus. La discipline a commencé à rechercher une description plus réaliste du comportement humain et à améliorer la capacité des modèles à prédire de façon cohérente les décisions. Les choix intertemporels, entre autres, ont fait l'objet d'importants changements méthodologiques dans la tentative générale de concilier économie et psychologie. L'un des exemples les plus frappants est la reconnaissance de l'incohérence temporelle comme un fait stylisé du comportement. C'est dans cette optique de décrire plus précisément des comportements intertemporels que des nouveaux modèles alternatifs d'actualisation ont émergé.

### Les Modèles d'Incohérence Temporelle

Avant l'essor de la psychologie en économie, [Strotz \(1955\)](#) a été le premier à noter que la fonction d'actualisation exponentielle pourrait ne pas caractériser fidèlement les choix des individus. Il a souligné qu'une attention particulière devrait être accordée à des taux d'actualisation décroissants, qui semblent être des représentations plus réalistes des comportements individuels comme le modèle hyperbolique ([Ainslie and Herrnstein, 1981](#)) ou le modèle quasi-hyperbolique ([Laibson, 1997](#)).

**Le Modèle Hyperbolique** Des formes spéciales d'actualisation ont été utilisées pour rendre compte de la décroissance de l'actualisation à l'instar du modèle hyperbolique :

$$D(t) = \frac{1}{(1 + \alpha t)^{\frac{\beta}{\alpha}}} \quad (3)$$

où  $\alpha, \beta > 0$  et  $\alpha$  correspondent à l'écart de l'actualisation constante dans le temps.<sup>7</sup> Toutefois, cette formulation n'a pas été prédominante dans la littérature économique en raison de la complexité calculatoire résultante de cette fonction d'actualisation (Laibson, 1997).

**Le Modèle Quasi-Hyperbolique** Le modèle quasi-hyperbolique, introduit par Phelps and Pollak (1968) est une approximation du modèle hyperbolique qui saisit son essence même tout en conservant le cadre parcimonieux de l'actualisation exponentielle :

$$D(t) = \begin{cases} 1 & \text{if } t = 0 \\ \beta\delta^t & \text{if } t > 0 \end{cases} \quad (4)$$

$\delta$  est le facteur d'actualisation exponentiel et le paramètre  $\beta$  correspond à un biais pour le présent. Ce dernier paramètre représente la surévaluation de l'utilité immédiate au temps  $t = 0$  par rapport à toutes les utilités ultérieures au temps  $t > 0$ . Le modèle quasi hyperbolique suppose ainsi que le taux d'actualisation diminue entre aujourd'hui et la période suivante, mais qu'il demeure constant pour toutes les périodes futures, comme c'est le cas des modèles d'actualisation exponentielle. Cette formulation est la plus populaire dans la littérature et la raison en est sa simplicité. Le biais pour le présent  $\beta$  se comprend comme une perturbation à court terme des préférences standards générée par une préférence forte pour des gratifications immédiates. Il permet de tenir compte d'un taux d'actualisation décroissant à court-terme dans un modèle intertemporel en imitant la

7. Dans le cas limite où  $\alpha$  tend vers zéro, cette fonction d'actualisation est équivalente à une fonction d'actualisation exponentielle respectant la cohérence temporelle des choix.

fonction hyperbolique tout en préservant la simplicité analytique de la fonction d'actualisation exponentielle.

### **Les Implications des Modèles d'Incohérence Temporelle**

**Laibson (1998)** a notamment été le premier à discuter des implications de l'actualisation quasi-hyperbolique en économie en insistant sur le risque d'erreur lié à l'actualisation exponentielle à la place d'une fonction quasi-hyperbolique dans une spécification économétrique. Par ailleurs, l'actualisation quasi-hyperbolique permet de mieux expliquer une variété d'observations empiriques dans la littérature s'intéressant à l'épargne des ménages qui était difficilement réconciliable avec la théorie standard comme les covariations excessives du revenu et de la consommation, les faibles niveaux d'épargne de précaution et la coexistence d'une forte richesse de pré-retraite et de niveaux de dettes élevées (**Angeletos et al., 2001**). De manière générale, le recours à l'actualisation quasi hyperbolique a été étendu de la théorie de la consommation standard à des études sur d'autres phénomènes non économiques liés à des problèmes de maîtrise de soi, comme la procrastination (**O'Donoghue and Rabin, 1999**), l'addiction (**O'Donoghue and Rabin, 2002, Gruber and Köszegi, 2001, Carrillo, 1998**), le manque d'exercices physique (**DellaVigna and Malmendier, 2004, 2006**), ou l'obésité (**Komlos, Smith and Bogin, 2004**).<sup>8</sup>

La section qui suit présente trois pistes de recherche indépendantes qui découlent de cette littérature florissante. Ces pistes d'investigation sont loin d'être exhaustives mais elles représentent les trois directions développées dans cette thèse.

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8. Ce qui fait du modèle quasi-hyperbolique un cadre pertinent pour étudier ces problèmes réside dans la structure simple de ces choix : ils sont tous le résultat d'un arbitrage à faire entre une gratification immédiate (comme le plaisir immédiat de fumer une cigarette, de ne pas aller à la salle de sport, ou de se délecter d'un éclair au chocolat) et des bénéfices à long terme (comme la réduction du risque d'avoir un cancer du poumon, ou avoir un corps svelte résultant d'une meilleure alimentation et d'une augmentation de ses activités physiques).

### 3. Les Trois Pistes de Réflexion Étudiées dans cette Thèse

#### 3.1. Les Dispositifs d'Engagement

La première piste de réflexion étudiée dans le chapitre I analyse les dispositifs d'engagement en tant qu'outil potentiel pour remédier à des comportements temporellement incohérents. De manière plus spécifique, ce chapitre analyse pourquoi et comment les individus choisissent un dispositif d'engagement pour atteindre un objectif spécifique.

Les individus qui souhaitent être en meilleure santé doivent changer leurs comportements en se mettant par exemple à pratiquer une activité physique, à avoir une alimentation plus saine ou en arrêtant de fumer. Or, ces changements dans les comportements se soldent généralement par des échecs, et ce, en raison d'une surévaluation, induite par un biais pour le présent, du coût immédiat que ces changements de comportements nécessitent.

Une solution pour contrer ses propres incohérences temporelles consiste à se créer pour soi-même des obstacles à la tentation en utilisant des dispositifs d'engagement. [Bryan, Karlan and Nelson \(2010\)](#) définissent un dispositif d'engagement comme "un arrangement conclu par un individu dans le but de l'aider à réaliser un plan futur qui aurait été difficile à suivre en raison d'un conflit intrapersonnel résultant, par exemple, d'un manque de maîtrise de soi". L'éventail des applications des dispositifs d'engagement est large, comme en témoigne la diversité des études de recherche visant à aider les gens à surmonter leurs problèmes d'autorégulation comme le dispositif d'épargne-retraite de "Save More Tomorrow™" ([Thaler and Benartzi, 2004](#)), le dispositif de cessation tabagique aux Philippines ([Giné, Karlan and Zinman, 2010](#)) ou les programmes pour perdre du poids ([John et al., 2011](#), [Toussaert, 2018](#)).

L'examen des dispositifs d'engagement est une question importante tant la demande pour de tels dispositifs est en constante augmentation. Compte tenu de sa portée et de son potentiel impact bénéfique sur la santé publique, il est important de comprendre comment les gens

choisissent leurs dispositifs d'engagement afin d'en améliorer leur efficacité et leur conception. L'existence de telles interventions peut constituer une alternative aux taxes comportementales en tant qu'instrument politique pour promouvoir de meilleurs comportements de santé. Ces taxes peuvent en effet avoir un effet néfaste sur le bien-être de la société parce qu'elles représentent des violations du principe de souveraineté des consommateurs, c'est-à-dire la liberté des individus de choisir comment répondre à leurs propres besoins. En effet, dans le cadre d'une taxe qui augmente le prix de certains produits jugés mauvais pour la santé, ceux qui ne souffrent pas de problème d'autorégulation devront également payer davantage pour ces produits alors que leur choix est rationnel. Ainsi, l'avantage des dispositifs d'engagement repose sur le libre arbitre des individus à s'autoréguler et à améliorer leurs comportements en matière de santé, contrairement à des contraignantes taxes comportementales universelles.

### **3.2. L'Autorégulation comme une Ressource Limitée**

La deuxième piste de réflexion autour des choix intertemporels que je souhaite aborder dans cette thèse part du constat que les problèmes d'autorégulation sont souvent liés à des environnements et à des situations particulières. Or, les décisions impulsives liées aux comportements de santé sont souvent analysées sous le prisme de l'actualisation quasi-hyperbolique. L'une des hypothèses implicites de ce modèle est que les décisions impulsives sont systématiques et indépendantes du contexte.

**Loewenstein (1996)** affirme que la divergence entre nos intérêts de long-terme et nos comportements ne provient pas nécessairement d'une actualisation hyperbolique mais peut être attribué à une diminution de nos ressources d'autorégulation provoquée par des facteurs viscéraux comme, par exemple, la faim, le stress ou la fatigue. Ces facteurs se caractérisent par un effet hédonique direct et ont une influence sur la désirabilité relative de différents biens ou actions, souvent



associés à des problèmes de maîtrise de soi.<sup>9</sup>

Il est judicieux de tenir compte des facteurs viscéraux dans la prise de décision, car la plupart de nos comportements autodestructeurs tels que la suralimentation ou la toxicomanie peuvent être le résultat d'une influence excessive des facteurs viscéraux sur le comportement. Pour tenir compte des facteurs viscéraux dans le processus de prise de décision, une abondante littérature en psychologie avait proposé un modèle de ressources limitées d'autorégulation (Muraven, Tice and Baumeister, 1998, Baumeister, Heatherton and Tice, 1994, Baumeister, Vohs and Tice, 2007). Ce modèle suppose que le stock de ressources d'autorégulation est limité et généralisé à tous les domaines. Ces ressources s'épuisent temporairement après un exercice d'autorégulation dû aux facteurs viscéraux. Ainsi, l'épuisement de ces ressources peut avoir des répercussions sur la réussite ultérieure d'autorégulation comme le montrent un certain nombre d'études expérimentales étudiant l'effet de l'épuisement cognitif sur des choix alimentaires<sup>10</sup> (Shiv and Fedorikhin, 1999) ou sur des décisions d'achats<sup>11</sup> (Vohs and Faber, 2007).

À la lumière des preuves expérimentales du modèle de ressources limitées d'autorégulation, on peut se demander si ce modèle est également pertinent pour étudier des comportements en dehors du laboratoire. En particulier, on peut suspecter certains environnements et certaines conditions institutionnels comme générateurs de stress, de fatigue et d'anxiété. Le cas échéant, la présence de ces facteurs viscéraux affecte-t-elle les comportements d'autorégulation de ces travailleurs et, a fortiori, leur comportement de santé? De manière générale, l'étude du rôle de l'environne-

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9. Les facteurs viscéraux n'impliquent cependant pas un changement permanent des dispositions comportementales d'un individu dans la mesure où une fois les désirs satisfaits, les dispositions comportementales reviennent à un état normal.

10. Shiv and Fedorikhin (1999) ont étudié dans une expérience en laboratoire les choix alimentaires des sujets entre une collation saine et une collation malsaine après une tâche de mémorisation dont la difficulté variait selon les sujets. La collation malsaine a été choisie plus souvent lorsque la tâche de mémorisation était difficile (c.-à-d. lorsque les ressources d'autorégulation des sujets étaient réduites) que lorsque la tâche de mémorisation était facile.

11. Vohs and Faber (2007) a également montré que les participants dont les ressources ont été épuisées par une tâche impliquant une présentation orale avaient des comportements d'achats jugés plus impulsifs, puisqu'ils se sentaient plus enclins à faire des achats impulsifs, à dépenser plus et ont effectivement dépensé plus d'argent pour des achats imprévus, comparativement aux participants dont les ressources n'étaient pas épuisées.

ment institutionnel dans les comportements d'autorégulation peut fournir des arguments supplémentaires pour justifier la nécessité d'une amélioration des conditions de vie des individus.

### 3.3. Préférences temporelles et Identité Personnelle

Enfin, le troisième volet de cette thèse souhaite entreprendre l'investigation d'un nouveau déterminant psychologique de la préférence pour le présent en s'intéressant à la question de l'identité personnelle. La vision normative de [Jevons \(1905\)](#), de [Senior \(1836\)](#), et, relativement plus récemment, de [Rawls \(1971\)](#), soutient qu'il est alors toujours préférable de choisir une récompense plus grande qu'une récompense moindre, peu importe la date, tant qu'elle survient au cours de la vie d'une personne car elle confère une utilité plus grande et donc une utilité totale plus importante.

Cette vision normative suppose implicitement une conception de l'individu comme unique, irréductible et durable à travers le temps, pour qui, toute utilité future peut lui-être pleinement attribué. Le philosophe Derek Parfit rejette cette hypothèse et soutient qu'une personne est, au contraire, une succession de "soi" au cours du temps, liés à des degrés divers par des continuités physiques, des souvenirs et des similarités de personnalité et d'intérêts ([Parfit, 1971, 1984](#)).<sup>12</sup> La force et la quantité de continuités psychologiques entre les "soi" sont ce qui constitue le chevauchement entre le "soi" présent et le "soi" futur. Parfit affirme que ces liens psychologiques ont tendance à faiblir avec le temps, dans la mesure où l'individu partage de moins en moins de similarités avec son "soi" d'un futur lointain. Ce point de vue implique que le degré de préoccupation à l'égard de son utilité future devrait être évalué en fonction du degré de "continuité psychologique"

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12. L'idée selon laquelle nous ne sommes pas la même personne au cours du temps est parfaitement décrite par Héraclite, un philosophe du 6ème siècle avant J.-C, qui soutient que tout est en perpétuel changement, s'opposant à l'idée de permanence, d'essence et d'identité : "Un fleuve n'est jamais le même car il s'écoule constamment et nous-mêmes sommes en constante évolution. Entre la première et la seconde baignade, l'eau et le baigneur auront tous deux changé!"

que l'on partage avec ses "soi" futurs.<sup>13</sup> Ainsi, la re-conceptualisation de l'identité personnelle des individus au fil du temps pourrait permettre une justification normative du principe de préférence pour le présent, que Rawls considère comme irrationnelle.

La question qui se pose alors est de savoir sur quels éléments de l'identité se basent les individus pour estimer le degré de continuité à ses "soi" futurs. Les travaux qui analysent la relation entre continuité psychologique et préférence pour le présent font l'hypothèse implicite que l'identité personnelle est restreinte à ce qui différencie l'individu des autres (Bartels and Urminsky, 2011, Frederick, 2003, Bartels and Rips, 2010). Or, cette conception restreinte de l'identité fait fi d'un contexte interpersonnel et social qui peut permettre à l'individu de se définir. Par exemple, l'individu peut se définir comme membre d'une famille ou comme appartenant à un groupe social. À ce titre, la littérature psychologique émergente sur l'identité considère que les individus ont tendance à se définir à quatre niveaux différents d'orientation identitaire : en fonction de leurs traits uniques (identité personnelle), de leurs relations dyadiques (identité relationnelle), de leur comportement public (identité publique) et de leur appartenance à des groupes (identité collective) (Schwartz, Luyckx and Vignoles, 2011, Sedikides and Brewer, 2015, Cheek and Briggs, 2013, Cheek et al., 2014).

Par conséquent, la réintégration de la complexité dans l'interprétation de l'identité de l'individu pourrait aider d'une part à déterminer si le point de vue de départ de Parfit sur l'identité a un contenu descriptif aussi bien que normatif, c'est-à-dire s'il peut expliquer et justifier la préférence pour le présent. D'autre part, elle repense l'individu en économie par l'intégration de la subjectivité dans sa propre définition. Un tel point de vue peut permettre d'adopter une approche complètement différente pour résoudre les dilemmes de la maîtrise de soi : la création d'un sentiment de continuité avec ses soi futurs peut aider les individus à surmonter leurs choix impulsifs

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13. La préoccupation à soi future peut alors s'appréhender comme la préoccupation que l'on a pour des personnes qui nous sont similaires. De la même manière que nous nous soucions moins de ce qui se passe à quelqu'un qui n'est pas similaire à nous, nous pouvons rationnellement moins nous soucier de nous dans le futur qui ne partage pas nos caractéristiques identitaires.

et impatientes plutôt que de recourir à de la culpabilité ou à des systèmes complexes de motivation qui opposent les intérêts du soi actuel et des futurs soi. Si le point de vue de Parfit est correct, le simple fait de stimuler la perception de la stabilité de ce qui compte le plus dans notre auto-définition peut représenter un outil puissant pour nous aider à persister dans l'atteinte d'objectifs importants.

## 4. Les Méthodologies Adoptées dans cette Thèse

L'analyse des développements récents sur les choix intertemporels met en évidence l'émergence d'un champ d'étude caractérisé par un va-et-vient perpétuel entre l'économie et la psychologie. Le défi soulevé par cette littérature est de fournir une caractérisation complète et cohérente de la décision de l'agent au fil du temps. Pour relever ce défi, l'analyse des choix intertemporels doit nécessairement être intégrée dans une approche subjective et psychologique. Une compréhension claire de ces processus décisionnels peut s'avérer utile pour fournir de nouveaux outils pour que les individus parviennent à atteindre leurs objectifs à long terme, notamment pour des questions d'épargne et de santé.

Cette thèse s'inscrit dans une quête déjà entamée d'analyse de la formation des choix intertemporels. Dans la mesure où cette analyse se situe à la frontière de l'économie et de la psychologie, les approches doivent être nécessairement plurielles, tant en termes de disciplines que d'outils méthodologiques. En ce sens, cette thèse ne prétend pas être une théorie générale des choix intertemporels<sup>14</sup> pour deux raisons principales. Premièrement, les choix intertemporels ne peuvent qu'être pleinement caractérisés de manière riche, profonde et réaliste qu'en renonçant à une certaine parcimonie et simplicité de la modélisation. Deuxièmement, comme de tels choix dépendent fortement d'un contexte particulier dans lequel il s'inscrit, certaines considérations

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14. C'est-à-dire un cadre unifié, caractérisant chaque aspect des choix intertemporels et viable pour analyser toute situation

psychologiques semblent plus pertinentes que d'autres pour étudier un choix spécifique. Ces différents contextes exigent non seulement de choisir une considération psychologique particulière, mais aussi d'utiliser différentes méthodologies en fonction de la question de recherche et de la disponibilité des données. Ainsi, les chapitres de cette thèse, qui s'intéressent à trois domaines distincts, ont chacune une méthodologie également distincte. Les sous-sections suivantes décrivent les quatre méthodologies utilisées et leurs avantages comparatifs pour le programme de recherche que je présente dans cet ouvrage.

#### **4.1. Le Recours à la Théorie**

La caractéristique commune des trois axes de recherche de ces quatre chapitres de la thèse réside dans l'utilisation systématique de la modélisation théorique. Mon objectif est de fournir un cadre de référence intelligible pour une investigation empirique ou expérimentale qui aide à identifier les "bonnes" questions : ils peuvent aider à explorer les conséquences des changements de l'environnement et des changements des paramètres idiosyncratiques sur les choix individuels qui ne seraient pas toujours possibles empiriquement. Mais au-delà de cette caractéristique commune aux trois chapitres, ils diffèrent tous par leurs méthodologies et stratégies empiriques.

#### **4.2. Les Expériences en Laboratoire**

L'émergence de l'économie expérimentale s'est inspirée de la psychologie expérimentale et son but a d'abord été utilisé pour tester les prédictions théoriques avec des personnes réels (Cot and Ferey, 2016). Les expériences sont généralement réalisées en laboratoire dans un environnement plus contrôlé que les études sur le terrain, ce qui permet d'identifier les effets causaux.

L'avantage de l'expérience en laboratoire réside dans la possibilité d'avoir des participants effectuant des tâches rémunérées selon leurs choix. Ces tâches permettent notamment d'estimer

des prédispositions comportementales vis-à-vis du risque ou du temps.

### **4.3. Données Naturelles**

Malgré l'utilité d'une expérience puisse étudier un mécanisme particulier dans un environnement artificiel, on peut se demander si certaines preuves en laboratoire sont toujours valables en dehors du laboratoire avec une population représentative dans une situation réelle.

En particulier, nous avons utilisé le "German Socio-Economic Panel" (GSOEP) pour étudier le comportement de santé dans l'environnement naturel. Le GSOEP est une enquête longitudinale menée auprès d'environ 11 000 ménages en Allemagne de 1984 à 2016. La diversité de l'information disponible dans le GSOEP comme la richesse des ménages, les conditions de travail, les comportements de santé et des prédispositions comportementales font de l'étude économétrique la méthodologie la plus appropriée pour étudier les comportements liés à l'autorégulation en dehors du laboratoire.

### **4.4. Enquêtes sur Internet**

Nous avons utilisé Qualtrics, une plate-forme d'enquête pour la collecte de données pour réaliser des enquêtes en ligne. Cette plateforme nous a permis de recueillir des informations entièrement dédiées à notre sujet de recherche avec une population représentative.

Non seulement elle nous a permis de recueillir de l'information pertinente pour nos recherches, mais nous avons également pu cibler un échantillon précis d'une population et l'affecter à des traitements afin d'évaluer un effet causal.

## 5. Résumé des Articles

### 5.1. Chapitre I- Parier contre Soi-Même pour Perdre du Poids : Une Étude Théorique et Expérimentale

Le chapitre I étudie les dispositifs d'engagement en tant qu'outil potentiel pour traiter les comportements temporellement incohérents liés à la perte de poids. À l'aide d'un modèle théorique et d'une étude expérimentale, ce chapitre examine pourquoi et comment les individus choisissent des dispositifs d'engagement pour atteindre un objectif spécifique donné.

Ce chapitre présente un modèle d'effort où un individu a des préférences quasi-hyperboliques. L'individu doit exercer un effort coûteux (*e.g.* faire du sport) pour accroître ses bénéfices espérés futurs (*e.g.* espérer perdre du poids). Dans ce modèle, l'individu a des préférences temporellement incohérentes sur l'exercice de l'effort si le biais pour le présent est suffisamment élevé.

L'individu peut utiliser un dispositif d'engagement dont la difficulté de l'objectif (*i.e.* le niveau de bénéfice à atteindre) est donnée. Ainsi, le dispositif d'engagement sert d'outil externe pour le motiver à exercer un effort dans le futur. Il décide d'un montant financier qu'il serait prêt à payer s'il n'atteignait pas l'objectif qui lui a été assigné. Ce chapitre montre que la pénalité qu'ils doivent s'auto-infliger doit être infiniment grande lorsque les objectifs donnés sont soit trop faciles, soit trop difficiles. La pénalité qu'il se fixe à lui-même est minimale lorsque l'exercice de l'effort a la plus grande influence sur la probabilité de succès de l'objectif. Cependant, l'autorégulation présente des limites puisque l'individu ne va pas prendre de dispositif d'engagement lorsque les objectifs sont trop difficiles à atteindre, c'est-à-dire lorsque la probabilité d'échouer l'objectif est trop forte quand bien même il exercerait un effort. Je montre également qu'une augmentation du biais pour le présent va accroître le niveau de pénalité qu'il doit s'auto-infliger quel que soit l'objectif à atteindre. Cependant, cela implique également que le niveau de difficulté de l'objectif pour lequel l'individu n'utilise pas ce dispositif d'engagement sera plus faible. Ces résultats théoriques sont

robustes à l'ajout de mécanismes psychologiques dans le modèle comme l'aversion à la perte ou la naïveté partielle.

Ce chapitre présente également une étude expérimentale sur la perte de poids pour illustrer l'effet de la difficulté de l'objectif et du biais pour le présent sur les choix d'engagements. En utilisant des méthodes expérimentales et psychométriques pour mesurer des préférences temporelles, je montre qu'une plus grande impulsivité et une plus grande considération des conséquences immédiates sont associées à la non-participation au dispositif d'engagement lorsque les objectifs à atteindre sont trop difficiles.

## **5.2. Chapitre II- Maîtrise de soi, Fatigue et Masse Corporelle : une Étude des Passages en Quarts de Nuit**

*Ce chapitre est une collaboration avec Fabrice Étilé.*

Dans cet article, nous examinons et reconsidérons la relation entre l'indice de masse corporelle (IMC) et le travail de nuit, et nous analysons spécifiquement le rôle modérateur de la maîtrise de soi dans cette relation.

En utilisant un panel allemand de 13 146 personnes suivies entre 2007 et 2014, nous trouvons des corrélations significatives entre le travail du soir et de nuit et l'IMC. Toutefois, les régressions à effet fixe montrent que le passage d'un horaire de travail régulier à un horaire de travail de soir et de nuit n'a un impact significatif sur l'indice de masse corporelle que pour les personnes qui ont un score élevé d'impulsivité et qui sont affectées à des horaires de travail irréguliers en soirée et de nuit. Le passage à des quarts de soir et de nuit réguliers n'a aucun effet sur l'IMC.

D'autres régressions révèlent que le résultat peut s'expliquer par des changements dans la propension à adopter un régime alimentaire sain, mais n'est pas lié à des changements dans les exer-



cices physiques. Nos résultats sont conformes aux prédictions de la théorie de l'autorégulation comme stock de ressource et sur le rôle de l'impulsivité et des facteurs environnementaux dans l'épuisement de ces ressources d'autorégulation.

### **5.3. Chapitre III- Mesurer les Orientations de l'Identité pour Comprendre les Préférences : une Validation Française du Questionnaire des Aspects de l'Identité**

*Ce chapitre est une collaboration avec Fabrice Étilé.*

Nous avons traduit en français la quatrième version du questionnaire sur les aspects de l'identité (AIQ-IV) visant à mesurer l'importance que les individus accordent à divers attributs de leur identité lorsqu'ils construisent leurs propres définitions. Ce questionnaire mesure quatre orientations de l'identité, à savoir l'identité personnelle, l'identité relationnelle, l'identité publique et l'identité collective. Cette traduction a été faite dans le but de mettre en œuvre une série d'études, avec des participants francophones portant sur la relation entre l'identité et les préférences économiques.

Pour que cette traduction française soit considérée comme valide, elle doit passer une série de tests psychométriques évaluant la qualité et la fiabilité de l'instrument. Pour cette raison, nous avons administré la version française du questionnaire à un échantillon représentatif de jeunes adultes français ( $N = 1,118$ ).

Nous montrons que la version française du questionnaire des aspects de l'identité est une mesure fiable et valide ce qui permet d'ouvrir de nouvelles pistes de recherche sur la relation entre les orientations de l'identité et les préférences économiques.

## 5.4. Chapitre IV- Préférence pour le Présent et Identité Relationnelle

*Ce chapitre est une collaboration avec Fabrice Étilé.*

Dans cet article, composé de trois études indépendantes réalisées grâce à des enquêtes en ligne sur une population française, nous examinons quelle orientation de l'identité est la plus importante dans la continuité de soi et dans l'actualisation du temps. Dans la première étude, nous examinons les corrélations entre orientations de l'identité et continuité de soi. Dans la deuxième étude, nous mesurons l'effet de la manipulation la saillance de l'identité personnelle, relationnelle ou publique sur la continuité de soi. Enfin, dans la troisième étude, nous mesurons l'effet de la manipulation de l'instabilité perçue de l'identité personnelle ou relationnelle.

Contrairement aux hypothèses implicites des études antérieures, nous ne trouvons aucune preuve que l'identité personnelle est un aspect important pour la continuité de soi. En revanche, nous trouvons que les personnes orientés vers leur identité relationnelle—c'est-à-dire, qui se définissent par rapport à leurs personnes proches— ont des continuités de soi plus élevées. Les manipulations d'amorçage mettent également en évidence l'importance de l'identité relationnelle. D'une part, Une augmentation de la saillance de l'identité relationnelle augmente la continuité de soi à court-terme. D'autre part, la perception d'instabilité de l'identité relationnelle diminue la continuité de soi à long-terme et augmente l'impatience mesurée grâce à des choix intertemporels.



# GENERAL INTRODUCTION

*“Je ne pense pas à demain,  
parce que demain, c’est loin.”*

- IAM, *Demain c’est loin*

## 1. General Motivation

This thesis aims to shed light on some psychological determinants of choices over time. The chapters of this thesis contribute to the economic literature by focusing on different psychological determinants of intertemporal choices and by using various approaches and methodologies integrated in a pluridisciplinary approach.

In my work, intertemporal choices are defined as involving trade-offs between costs and benefits occurring at different points in time. We constantly make intertemporal choices over the course of our lives: when we must choose between eating French fries today or having a lean body in the future, between spending luxurious holidays in Colombia now or saving for our retirement, or when we must choose between enjoying the pleasures of life or redacting the general introduction of one’s thesis.

Hence, time is a distinctive characteristic of most of our decisions. Puzzling issues arise from the fact that individuals exhibit preferences for the near future over a more distant one, and these preferences dramatically affect how they make these choices. It is therefore unsurprising to see intertemporal choices at the heart of both economics and psychology. Although methodologies and terminologies might differ across disciplines, and sometimes within a discipline, they are both

driven by the same objective: to explain and describe the underlying psychological mechanisms that drive intertemporal choices.

In this respect, this thesis intends to illustrate the advantages and limitations of the economic approach to the study of choices over time by putting it in perspective with the psychological literature. My studies of health behaviors also suggest that the cross-analysis of economics and psychology can be particularly relevant for public policy as they can provide new perspectives for intervention programs.

The pluridisciplinarity approach adopted in this thesis was not always at the core of economic discipline. Neoclassical theory intended to base economic analysis on concepts and theoretical objects that are independent from psychological knowledge (Masson, 2000). In this approach of human behavior, the individual is thought as a theoretical representation with exogenous and rational preferences. The progressive recognition of the limits of human mind's rationality in modern economics has made it possible to give an increasingly important role to psychology in the economic discipline. The following section thus presents the evolution of the role of psychology in economists' conceptualization of time preference.

## **2. The History of Studies on Intertemporal Choices**

### **2.1. The Early Psychological Arguments of Choice over Time**

Intertemporal choices are far from being a new research topic in economics as attentions paid to this subject started at the very beginning of the discipline. Rae (1834) notably expressed an explicit interest in this topic as a research investigation on its own (Loewenstein and Elster, 1992). He generated an in-depth discussion on the psychological motives underlying intertemporal choices. The difference in wealth across nations is, according to him, partly attributable to the “effective desire of accumulation”. This psychological factor is a joint product of four determinants that either

limit or promote the preference for the future.

The first two motives that promotes the preference for the future are self-restraint,<sup>1</sup> and bequest.<sup>2</sup> The self-restraint motive is what economists would call foresight and is often handled as the precautionary motive for saving. Rae saw culture as a critical determinant of the effective desire of accumulation in more primitive societies and lower orders of society, where intellectual powers, habits of reflection, and prudence were less developed. On the other hand, the bequest motive can be understood as the manifestation of individuals' desire for immortality to transcend their own ends, and leads individuals to seek survival through their significant ones and ultimately broadens the decision-makers horizon beyond their own existence.

The two other motives that limits the effective desire of accumulation is the uncertainty of human life, and the excitement/passion of immediate consumption. The uncertainty of human life limits the desire of accumulation as unhealthy and hazardous places suffering from war and famine for instance tends to reduce the likelihood of benefiting from the accumulation of their provisions for the years to come (Rae, 1834, p. 57). The pleasure provided by the immediate presence of an object of desire also limits the preference for the future. In particular, the real presence of the immediate object of desire leads to a very living conception of enjoyment which it offers to their instant possession. John Rae himself mentioned that there is probably no man who would not see any difference between the enjoyment of a good today and the enjoyment of the same good but in a very distant future, even if that enjoyment was certain in both cases (Rae, 1834, p. 120). Although Rae's first intention was not to study individual behavior *per se*, but rather the determinants of a nation's collective desire to explain differences in capital accumulation, his work laid the first psychological foundations of the research on intertemporal choices.

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1. "The extent of the intellectual powers, and the consequent prevalence of habits of reflection, and prudence, in the minds of the member of society" (Rae, 1834, p. 58)

2. "the prevalence throughout the society of the social and benevolent affections" (Rae, 1834)

Following Rae's work, one can distinguish two emerging opposite views that intend to summarize these determinants—those of Jevons and Senior—of the underlying psychological emotions driving intertemporal choices. While both support the normative view of equal treatment between the present and the future, they explain individual's deviations from that prescription using two different emotional explanations.

According to [Jevons \(1905\)](#), individuals are only concerned by their immediate utility: precautionary behaviors only stems from the ability to derive utility from the present anticipation of future consumption rather than the future consumption itself. Hence, a decision maker who defers a consumption does not defer a pleasure but substitutes a pleasure now with the pleasure derived from the anticipation of a future pleasure. The variation in intertemporal choices hence arises from the individual's variation of the imperfect transcription of future events into present utility.

For his part, [Senior \(1836\)](#) explained the inability to view equal treatment between the present and the future as resulting from the pain of refraining from immediate consumption<sup>3</sup> which he viewed as “the most painful exertions of the human will” ([Senior, 1836](#), p. 60). Contrary to Jevons, Senior analyzes individuals' differences in intertemporal choices as being caused by the difference in the inherent difficulty to delay immediate gratifications.

Although these two views differed in the underlying psychological mechanism driving the preference for the future, both share the idea that the immediately experienced emotions limits the horizon of the decision maker, either because of the immediate pleasure of anticipation or because of the immediate suffering of abstinence.

[Bohm-Bawerk et al. \(1890\)](#) provided one alternative theory of intertemporal choices that is based on a cognitive perspective: while he recognized that future utility weight less than current utility, he did not believe, unlike Jevons, that the decision maker is solely oriented toward her im-

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3. In his abstinence theory, Senior wondered why capital provides a return at a positive interest rate: if the return on an investment is positive, why don't investors just keep investing until it is zero?

mediate utility: "It can be hardly maintained, as some of our older economists and psychologists used to be fond of assuming, that we possess a gift of literally feeling in advance the emotion we shall experience in the future" (Bohm-Bawerk et al., 1890, p. 60). Instead, the decision maker Böhm-Bawerk depicts makes the trade-off between pain and pleasures that are comparable on the same cognitive dimension even though they occur at different points in time.

According to him, people discount the future as they have a systematic tendency to underestimate their future needs due to the ability (or lack, thereof) of imagination and abstraction of the future especially in the distant future. It is based on a sophisticated cognitive psychology similar to the modern concept of availability of Tversky and Kahneman (1973): "we accord to goods which are intended to serve future ends a value which falls short of the true intensity of their future marginal utility" (Bohm-Bawerk et al., 1890, p.268 - p. 269).

In addition, Böhm-Bawerk adds an emotional component that refrains the decision maker to achieve her goals. He acknowledges the fact that when people choose between a present and a future pain or pleasure, they can decide to favour the present pain or pleasure although they know perfectly that the future disadvantage of making this choice is greater and that their total life's well-being would be smaller. Thus, in introducing this additional component that refers to a lack of self-control, Böhm-Bawerk endorses an emotional perspective of intertemporal choices that deviates from a purely rational utility maximization.

Böhm-Bawerk's characterization of intertemporal choices consists in the allocation of consumption among time periods, Fisher (1930) formalized this perspective in a theoretical framework whereby intertemporal choices between current and future consumption could be conceived as a choice of consumption's allocations between two different goods: Fisher plotted the intertemporal consumption decision on a two-goods indifference diagram with current consumption on the x-axis and future consumption on the y-axis. By treating the allocation of consumption over



time as the atemporal allocation of consumption between two different goods, Fisher assumed that the marginal rate of substitution between current and future consumption depends on both time preference and diminishing marginal utility.

In his contribution, Fisher encapsulated all the previous psychological determinants of the intertemporal choices proposed by all the predecessors into a single parameter. The time preference parameter includes the inverse of Böhm-Bawerk systematic tendency to underestimate future wants and the four determinants mentioned by Rae. Fisher also added the fashion motive as a novel determinant of intertemporal choices corresponding to the influence of the peers or a community in the way individuals behave. This new determinant of time preference is of great importance as it allows to understand time preferences as the result of situational factors present in the society in which the individual belongs. Fisher illustrated this new determinant by the English poor people who developed the habit of saving when postal savings banks were introduced (Fisher, 1930). Thus, his analytical framework describes time preference as the amalgamation of all the motives mentioned above.

Thus, the genesis of intertemporal choices as a field of study in economics is deeply embedded in a psychological approach. Interestingly, each of these early perspective adopts the same normative statement: they all viewed equal treatment between the present and the future as an ideal and time discounting is construed as an explanation of the deviation from that norm. Fisher's representation of intertemporal choice had a great impact on the economic discipline. Despite an extensive discussion of the psychological and situational origins of such a parameter, the intertemporal analysis he proposed is not dependent on the value of the psychological insights: intertemporal choice in such a model can be seen as a generic atemporal problem of consumption between two goods. This mathematical representation of intertemporal choices thus paves the way for the emergence of economic models avoiding a discussion on the psychological origins of time preferences.

## 2.2. The Clean Slate of Psychological Foundations in Modern Economics

The rise of economic modeling, which gradually reached centre stage for legitimacy purposes, has resulted in a new representation of the decision-maker. Economic models propose an abstract and coherent formalism that attempts to produce theoretical objects that are extricated from their psychological and subjective connotations: the individual is reduced to an *Homo Oeconomicus* agent who makes rational decisions to maximize her utility with respect to a set of constraints given initial endowments. Within this framework, the individual's true preferences are given: their determination are not denied but has been relegated to a black box at the expense of all previous developments on the origins of such preferences and their roles in intertemporal choices. This epistemological turning point has led to the emergence of hypothetico-deductive models whose aim is not necessarily to reflect reality but to imitate how it works in particular applications (Mason, 2000). The main advantage of these models lies in their heuristic power. They make possible the assessment of the consequences produced by alternative policies, the exploration of other environments—imaginary or real— or the attribution of the gap between predictions and reality to certain phenomena temporarily omitted by the formalization. Hence, time preferences had become a neutral concept with respect to physiology, anthropology, and psychology, by sacrificing some important aspects that are relevant to study real-world behaviours

### The Discounted Utility Model

Samuelson (1937) proposed in his article "A Note on Measurement of Utility" a general model of intertemporal choices that could be applied over infinite horizons, unlike Fisher's model which could only represent two periods. The intertemporal analysis is a maximization of the sum of discounted instantaneous utilities, in which the utility function is separable and additive. Similarly to Fisher's representation of time preference, the discounting parameter of instantaneous utilities potentially encapsulated all of the previous psychological motives into one single and unique pa-

parameter for the sake of parsimony. The model specifies the preferences of a decision maker over a sequence of consumption levels  $(c_0 \dots c_T)$  weighted by the discounting function  $D(\cdot)$ . Such preferences can be represented by the following utility function:

$$U_t(c_0 \dots c_T) = \sum_{k=0}^{T-t} D(k)u(c_{t+k}) \quad (\text{I.1})$$

where the discounting function  $D(\cdot) \in [0; 1]$  is monotonically decreasing with respect to time:

$$D(t) = \delta^t = \left( \frac{1}{1 + \rho} \right)^t \quad (\text{I.2})$$

$\delta$  is a subjective and idiosyncratic parameter called the exponential discount factor. It corresponds to the weights attributed to future utilities. The closer from unity  $\delta$  is, the longer the decision-making horizon.  $\rho$  refers to the pure rate of time preferences whose role is to reflect all the psychological considerations that have been previously mentioned. Its content is subjective and can be thought as the propensity of the agent to magnify forthcoming pleasures and pains relative to very distant ones.  $u(c_t)$  is a concave<sup>4</sup> instantaneous utility function of consumption at date  $t$ .

The advantage of such a simple specification lies on the tractability of the behavioural model: such a formulation provides a simple and elegant framework to analyse an individual's consumption profile over time.

**Koopmans (1960)** showed that this model could be derived from a set of axioms that make the discounted utility compatible with the ordinal approach. In particular, Samuelson's model represents time preferences only if it satisfies five axioms. While the first three axioms of completeness,<sup>5</sup>

4. The concavity assumption is necessary for optimization purposes and assures that the individual spreads her consumption over time.

5. This axiom indicates that every element  $x$  of a set  $E$  can be ordered by the relation of preference

monotony,<sup>6</sup> and continuity<sup>7</sup> are usual in decision theory, the two last axioms of impatience and stationarity are specific to time preferences and are the most important features of the exponential discounting function.

The axiom of impatience says that it is always better to receive something later than sooner. More formally, if an outcome  $x$  is desirable, then the individual would prefer getting  $x$  sooner than later and zero is the time-neutral outcome: the individual is indifferent between getting zero sooner or later. This axiom hence holds the spirit of the impatience trait of [Rae \(1834\)](#) and [Bohm-Bawerk et al. \(1890\)](#).

The last axiom for the representation of time preference is stationarity. It asserts that if an individual is indifferent between getting  $x$  in  $t$  and getting  $y$  in  $t + \tau$ , if the two times  $t$  and  $t + \tau$  are advanced or deferred by the same amount  $s$ , then indifference will be preserved. Stated differently, the indifference between two time-dependent outcomes depends only on the delay between the periods ( $\tau$ ) but not the periods themselves. This axiom of time consistency is the most discussed feature of the exponential model because it has the most important implication in time-related decision making. The individual optimally plans in a time-consistent manner her consumption needs until the end of her life: she should neither revise his plans, nor experiencing regrets of her past choices.

These two last axioms for the representation of time preferences provide an ambiguous view on the interconnection between economics and psychology. While the first axiom shows that the representation of time preferences is necessarily grounded in the psychological realm, the second is more debatable from a psychological perspective and had lead plenty of researchers to document anomalies of the exponential discounting model.

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6. This axiom ensures that if one element  $x$  of a set  $E$  is preferred to  $x'$  of  $E$ , then  $x$  should be also preferred to  $x''$  if  $x'$  is preferred to  $x''$

7. if  $\{(x, t) : (x, t) \succ (y, s)\}$  and  $\{(x, t) : (y, s) \succ (x, t)\}$  are closed in the product topology of  $X \times T$

### **Anomalies In the Discounted Utility Model**

Despite the appealing tractability and elegance of the exponential discounting model, it fails to match several empirical regularities. Few decades after Samuelson's article, behavioural sciences had evidenced several behavioural regularities which are incompatible with the exponential discounting model. For example, people prefer to get quickly unpleasant outcomes rather than defer them as predicted by the standard model (Loewenstein, 1987). Losses are generally discounted at a lower rate than gains (Thaler, 1981), People have asymmetric preferences for speeding-up vs. delaying of consumption whereas, according to the discounted utility model, these preferences should be symmetrical (Loewenstein, 1988). A full list of discounted utility anomalies is enumerated by Loewenstein and Prelec (1992), including their explanations and a variety of other phenomena.

One of the most documented anomalies of the exponential discounting model is time inconsistency. Evidence is accumulating, both in the economic and psychological literature, that people do not have time consistent preferences and that their discount rates are declining over time. First, casual observations and introspection on people behaviours can provide great examples of time inconsistent choices. While people set goals by promising to stop smoking, to save more, and to finish their Ph.D dissertation, they often fail to meet their goals: they keep smoking, they spend money on things they often regret later on, and they fail to redact their thesis for the due date. Yet, the exponential discounting model fails to account for these choices we often regret and, in that sense, time inconsistency is in the same spirit as Bohm-Bawerk et al. (1890)'s lack of willpower.

Experimental studies from both economics and psychology have also shown that people do not make time consistent choices. When participants are asked to choose between a sooner and smaller reward and a later and larger reward, the implicit discount rate over long horizons is generally lower than the discount rate over short horizons. This generates a declining discount rate

which is inconsistent with the exponential discounting model. For example, [Thaler \(1981\)](#) asked subjects to specify the amount they would like to receive in one month, one year, and ten years that would make them indifferent to receiving 15 dollars today. The median responses of 20, 50, and 100 dollars imply that the annual implied discount rate of such choices is 345%, 120% and 19%.

In addition, individual preferences between two future rewards can be reversed in favour of the most proximate reward as the time of both reward diminishes. For example, someone may prefer to receive 110 euros in one month and a day over 100 euros in one month, but also prefer 100 euros today over 110 euros tomorrow. Such preferences reversals have been observed both in human beings ([Kirby and Herrnstein, 1995](#)) and in pigeons ([Ainslie, 1992](#)).

### **2.3. The Resurrection of the Psychological Approach in Economic Research**

As modern economic started to recognize the cognitive and intellectual limits of the human mind, it has assigned an increasingly important role to psychology in the understanding of individual's behaviour. Recognition of the anomalies of rational choices has notably been one of the factors stimulating the reintroduction of psychology into economics. The discipline started to search for a more realistic description of human behaviour and to improve the ability of models to predict consistently decision outcomes (which, given the anomalies, standard theory of rational choice was not fully able to achieve). Great advances have been made on various sub-fields of the discipline by taking into account psychological biases in economic modelling or other motives than self-interest. Examples include loss aversion [Kahneman and Tversky \(2013\)](#), the endowment effect ([Kahneman, Knetsch and Thaler, 1991](#)) and the inclusion of fairness motives ([Rabin, 1993](#)). Economic development is hence subject to a permanent and potentially fertile tension between the desire for objectification and abstraction and certain concessions to the individual's subjectivity.

Following the evolution of the discipline, intertemporal choices are also being subject to important and fruitful methodological changes in the general attempt to reconcile economics and psychology. One of the most striking example is the recognition of time inconsistency as a stylized fact. Not only time inconsistency models helped to explain puzzling discrepancies between theory and reality in saving behaviours, it also allowed a new modelling framework for analysing non-economic behaviour such as dieting, addictions, and procrastination.

### Models of Time Inconsistent Choices

Even before the emergence of the boom of psychology in economic research, [Strotz \(1955\)](#) was the first to note that the exponential discounting function might not accurately represent individual's preferences. More notably, he stressed that a special attention should be devoted to declining discount rates as they may capture a more realistic behavior. Motivated by all the previous evidence, special forms of discounting has been used to capture the declining discounting pattern. [Ainslie \(1992\)](#) first proposes the simple specification of hyperbolic discounting that can be written as follows:

$$D(t) = \frac{1}{1 + kt} \quad (\text{I.3})$$

where  $D(t)$  is the discount factor that is time dependent,  $t$  is the delay of the reward and  $k$  is the individual's parameter governing the degree of discounting. Not only this discounting function entails the decrease over time of the discount rate but it can also account for preferences reversals that have been found in experimental studies. However such a specification, which is supposed to represent more realistic preferences, moves in the extreme opposite direction as it implicitly assumes that every individual exhibits a declining discount rate. An intermediate solution has

been found by [Loewenstein and Prelec \(1992\)](#) who suggests a more general form:

$$D(t) = \frac{1}{(1 + \alpha t)^{\frac{\beta}{\alpha}}} \quad (\text{I.4})$$

where  $\alpha, \beta > 0$  and  $\alpha$  corresponds to the deviation of constant discounting over time. In the limit case where  $\alpha$  tends to zero, this discounting function is equivalent to a time consistent exponential discounting function. However, this formulation fails to be predominantly used in the economic literature because of the poor tractability and the resulting complexity of the discounting function ([Laibson, 1997](#)).

### The Quasi-Hyperbolic Discounting Model

The quasi-hyperbolic discounting function was a way to circumvent the trade-off between generality and parsimony. This functional form has first been introduced by [Phelps and Pollak \(1968\)](#) to study inter-generational altruism and has been applied for decision making by [Elster \(1979\)](#). It is an approximation of the hyperbolic discounting model that captures its very essence while preserving a similar and convenient framework of exponential discounting:

$$D(t) = \begin{cases} 1 & \text{if } t = 0 \\ \beta\delta^t & \text{if } t > 0 \end{cases} \quad (\text{I.5})$$

where  $\beta, \delta \leq 1$ .

$\delta$  is the exponential discount factor. The  $\beta$  parameter refers to the present-bias parameter and represents the over-evaluation of the immediate utility at time  $t = 0$  compared to every subsequent utility at time  $t > 0$ . More specifically, it assumes that the discount rate between today and the next period is  $\frac{1-\beta\delta}{\beta\delta}$  whereas the discount rate between any future period and its subsequent period is



$\frac{1-\delta}{\delta}$  where :

$$\frac{1-\delta}{\delta} < \frac{1-\beta\delta}{\beta\delta}$$

Hence, the quasi-hyperbolic model assumes that the discount rate is declining between today and the subsequent period but remains constant for all future periods as it is the case in exponential discounting models. This formulation is the most popular in the literature and the reason lies in its appealing tractability: when the utility function is CRRA<sup>8</sup>, and  $\beta = 1$ , the model can be reduced to the familiar case of exponential discounting with homothetic and time additive preferences. Cases where  $\beta < 1$  can be thought as a short-term perturbation in standard preferences. It allows to account for a declining discount rate in a standard model by mimicking the hyperbolic function while conserving the analytical tractability of the exponential formulation.

### The Implication of Time Inconsistent Models in the Real World

Laibson (1998) was notably the first to discuss the implication of quasi-hyperbolic discounting in economics. In particular, he stressed out the risk of error resulting from an econometric misspecification by using an exponential discounting function instead of a quasi-hyperbolic one. Using macroeconomics data, he showed that the elicited constant discount factor is 0.977 in an exponential-discounting world whereas the estimated discount factor is 0.99 and a present bias value of 0.6 in a quasi-hyperbolic discounting world. The economist can thus erroneously attribute an impatience rate of around 2.3% per year instead of a correct rate of 1%. The misspecification error becomes more important in the very long term because of the power function.

The quasi-hyperbolic discounting specification also better explains a variety of empirical observations in the consumption-saving literature that were considered puzzling, such as excessive co-movements of income and consumption, low levels of precautionary savings, and the coexis-

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8. CRRA stands for constant relative risk aversion and the utility function is isoelastic and with the following form:  $u(c) = \frac{c^{1-\eta}-1}{1-\eta}$  if  $\eta \neq 1$  or  $u(c) = \ln(c)$  if  $\eta = 1$

tence of high pre-retirement wealth, low liquid asset holdings and high credit card debt (Angeletos et al., 2001).

More importantly, the use of quasi-hyperbolic discounting has been extended from standard consumption theory to studies on other non-economic phenomena related to self-control problems, such as procrastination on tedious tasks. For instance, O'Donoghue and Rabin (1999) theoretically showed that when people exhibit such preferences on activities that they must perform within a length of time, they procrastinate (*i.e.*, they wait when they should do it) if actions involve immediate costs (writing a paper), and preproperate (*i.e.*, they do it when they should wait) if actions involve immediate rewards (seeing a movie). In a more general way, it had provided a new angle approaching the problem of addiction (O'Donoghue and Rabin, 2002, Gruber and Köszegi, 2001, Carrillo, 1998), lack of physical exercises (DellaVigna and Malmendier, 2004, 2006) or obesity (Komlos, Smith and Bogin, 2004). What makes the quasi-hyperbolic a relevant framework to study these problems lies in the simple structure of such choices: they all are the results of a trade-off between immediate gratification (*i.e.*, the immediate pleasure of smoking a cigarette, sitting on the couch instead of going to the gym, or enjoying the delicate sweetness of a *Éclair au chocolat*) and long-term benefits (*i.e.*, the reduced risk of developing lung cancer or the lean body resulting from all the self-sacrifice in one's diet and physical activities).

As the development of alternative models and the increase of studies devoted on time inconsistency suggest, the rational model of discounted utility with a constant and subjective discount factor appears to be very limited to analyse theoretically and empirically self-control behaviours problems. Yet, this formulation has served as a theoretical benchmark model of rational choice to construct alternative theories. In particular, it allowed researchers to integrate some of the psychological determinants of time preference that were already present in the discipline in a math-

ematical framework. These new behavioural models allowed for an extended research program in economics not only in terms of contexts but also in terms of theoretical extensions.

The following section presents three independent avenues of investigations that are derived from this blossoming literature. These avenues of investigations are obviously far from exhaustive but they represent the three directions that are developed in this thesis.

### **3. Three Directions for Further Investigations**

#### **3.1. Commitment Devices**

The first line of consideration I address in this thesis corresponds to commitment mechanisms developed in order to overcome one's own time inconsistency. In particular, I examine why and how people restrict voluntarily their future choices in order to meet their personal goals.

##### **Unhealthy Behaviors resulting from Time Inconsistency**

Many people intend to improve their health behaviours, by exercising more, eating well and quitting smoking. But when those people need to actually change their health behaviours, they often fail to do so because of time inconsistent preferences. Those who intend to improve their health behaviours often come up with strategies to follow-through. For example, people buy long-term gym memberships rather than paying by the day, they buy junk food in small packages rather than buying in bulk, or they commit to give money to charities if they start smoking again. Can these strategies be integrated in the framework of quasi-hyperbolic discounting?

##### **The Intrapersonal Conflict as an Agency Problem**

Time inconsistent choices can be viewed as the result of a dilemma between two different "selves" at two different periods: the individual is supposed to be at one moment the planner

of investments choices for the long-term and at another moment the doer who acts in a myopic way according to her short-term best interest (Thaler and Shefrin, 1981). Hence, the time inconsistency problem can share the same theoretical structure as principal-agent problems that can be encountered in industrial organizations set-ups: the doer (the agent) is able to make decisions that will impact the planner (the principal), and the preferences of both selves may generate conflicts in terms of decisions to make. Such convenient set-ups also allow to study the demand for commitment devices, *ie.* strategies implemented by an individual to herself to make him act according to her best long-term interest.

### Strategies to Overcome Intrapersonal Conflicts

The objective of the commitment device is to create obstacles to the doer's temptations in order to increase the costs of temptations.<sup>9</sup> Bryan, Karlan and Nelson (2010) define a commitment device as "an arrangement entered into by an individual with the aim of helping fulfill a plan for future behavior that would otherwise be difficult owing to intrapersonal conflict stemming from, for example, a lack of self-control". Hence, not only the quasi-hyperbolic discounting framework characterizes the intrapersonal conflict, but it may help to explain various strategies one set for oneself to stick to goals that are best for our long-term well-being. Some commitment programs have been implemented in light of theoretical and experimental insights, such as Thaler and Benartzi (2004) designed a retirement saving device in the United-States called called Save More Tomorrow™ in which people commit in advance to allocate a portion of their future salary increases toward retirement savings. They showed that a high proportion of those offered the plan joined and the

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9. Commitments devices are as old as the world itself. The first example of a commitment device, I am aware of, can be found in Greek mythology, and in particular in the Odyssey (Elster, 1979). Ulysses, a respected warrior who is returning home, to the island of Ithaca, from the Trojan War wanted to listen to the Sirens song, during his trip back on his ship, although he knew their song would make him incapable of rational thought. He decided to put wax in his men's ears so that they could not hear, and had them tie him to the mast so that he could not jump into the sea. That way, Ulysses could listen to the Sirens' song tied to the mast with the guarantee that he won't join the sirens, which would have meant his death.

average saving rates increased from 3.5 to 13.6 percent over the course of 40 months. The range of applications of commitment devices is large as shows the diversity of research studies aiming at helping people to overcome their self-control problems including a smoking-cessation contract in the Philippines (Giné, Karlan and Zinman, 2010), a fertilizer coupon program in Kenya (Duflo, Kremer and Robinson, 2011), and a weight-loss program (John et al., 2011, Toussaert, 2018).

## Chapter I: Motivations

The investigation of the demand for commitment device is an important issue. The demand for software and phone-based applications that propose commitment devices is increasing. Most of them are intended either to refrain people from potential addictive activities—such as browsing the internet, using the cellphone and binge watching TV shows—or to help people commit to specific goals. For instance, “DietBet” is a social gaming website that uses financial incentives and social influence to promote weight loss. Players bet money and join a game. All players have one month to lose 4% of their initial body weight. At the end of the month, all players within each game who lose at least 4% of initial body weight are declared winners and split the pool of money bet at the start of the game. Other internet-based commitment devices include “BeeMinder”, “StickK”, “Write or Die”, and the list is far from exhaustive.

Given the reach and potential public health impact, understanding what makes a commitment contract attractive and how people choose their contract is one important to improve the efficiency and the design of those devices. The existence of such interventions may constitute an alternative to sin taxes as a policy instrument to promote healthier behaviors. Taxes may indeed be detrimental in certain circumstances because they represent a violation of consumer sovereignty, *i.e.* the freedom of individuals to choose for themselves in order to satisfy their needs: even people without self-control problems will have to pay more for consumption choices that are perfectly rational. On the other hand, the advantage of commitment devices is that people choose whether

they want to commit, and are free to decide whether they need an external help to improve their health behaviours unlike in a universal sin tax system.

### **3.2. Resources of Self-control**

The second line of consideration around intertemporal choices that I address in this thesis examine whether self-regulation problems—such as unhealthy behaviors—are triggered by particular environments and situations.

#### **The limitation of the Quasi-Hyperbolic Discounting**

As previously described in the previous section, impulsive decisions that relate to health behaviours are often analysed under the prism of the quasi-hyperbolic discounting. One of the implicit assumption of this model is that impulsive decisions are systematic and are context-independent. However, casual introspection can provide anecdotal evidence that we exhibit different degrees of self-control which depend on particular environments—the spatial proximity of an object of desire, or the presence of associated smells or sounds—and/or specific drive states such as hunger, stress, fatigue. [Loewenstein \(1996\)](#) argues that the discrepancy between perceived self-interests and behaviour do not necessarily come from hyperbolic discounting but can also be attributed to a depletion of self-control resources resulting from visceral factors.

#### **Visceral Factors**

Examples of visceral factors include hunger, sleepiness, stress, depression, effort and so on. They are first characterized by a direct hedonic impact: one would always be better off satiated rather than hungry, calm rather than stressed, rested rather than sleep deprived. Second, they have an influence on the relative desirability of different goods or actions, often associated with problems of self-control such as hunger and dieting, sexual desire and heat of the moment behaviours,

craving and drug addiction. However, they do not imply a permanent change in a person's behavioural dispositions. Once the desires have been satisfied, behavioural dispositions go back to a normal state.

### **Resources of Self-Control**

It makes good sense to take visceral factors into account in decision making as most of our self-destructive behaviours such as overeating or substance abuse can be the result of excessive influence of visceral factors on behaviour. To take visceral factors into account in the decision making process, an extensive literature in psychology had proposed a model of limited self-control resources (Muraven, Tice and Baumeister, 1998, Baumeister, Heatherton and Tice, 1994, Baumeister, Vohs and Tice, 2007). It assumes that the stock of self-control resources is limited and generalized across domains. Consequently, regulatory resources become temporarily depleted by situational self-control demands triggered by visceral factors. This model predicts that immediately after having exerted self-control a person may be unable to draw upon enough regulatory resources to reach subsequent goals.

### **Experimental Evidence of Visceral Factors on Behaviors**

A number of experimental studies have shown that self-control resources can be depleted by fatigue and cognitive exhaustion. For instance, Shiv and Fedorikhin (1999) studied participants food choices between a healthy and an unhealthy snack after a memorizing task that varies in difficulty across subjects. The unhealthy snack was chosen more often when the memorizing task was difficult (i.e, when subjects' self-control resources were reduced) as compared to when the memorizing task was easy. Yet, this effect is significant for impulsive consumers only, whereby impulsiveness is measured through a psychometric scale. Vohs and Faber (2007) showed that participants, whose resources were depleted by a task involving an oral presentation, exhibit impulsive

behaviours as they felt stronger urges to buy, were willing to spend more, and actually did spend more money in unanticipated buying situations, in contrast to participants whose resources were not depleted.

## **Chapter II: Motivations**

In light of this review of the experimental evidence of the effect of visceral factors on self-control, one may ask whether the model of limited resources of self-control still holds outside the laboratory. In particular, one may suspect that certain working conditions may generate stress, fatigue, and anxiety. If this is the case, would that affect the self-regulatory behaviours of those workers such as dieting and physical exercises? This issue goes beyond the frontiers of working conditions and health behaviours and questions the role of institutions in behaviours related to the self-control of individuals. In particular, do the institutions we live in influence the architecture of our choices regarding self-regulation? This aspect is closely related to one of Böhm-Bawerk's determinants regarding the role of situational factors in individuals' self-control behaviours. The study of the role of the institutional environment in self-regulatory behaviour can provide additional arguments to justify the need to improve people's living conditions.

### **3.3. Time Preferences and Personal Identity**

Finally, the third direction of research investigated in this thesis investigates a novel psychological determinant of time preference by focusing on personal identity.

#### **The Normative view of Intertemporal Choices**

If one adopt the normative view of [Jevons \(1905\)](#), [Senior \(1836\)](#), and, relatively more recently, [Rawls \(1971\)](#), arguing that life should be treated as a whole, it is always better to chose a larger reward rather than a smaller one regardless of the timing, as long as it occurs within the lifetime of a



person. The larger reward confers a higher instantaneous utility, whenever it occurs, and therefore a greater total lifetime utility. In that sense, one should act according to one's self-interests by achieving goals which include not only goals in the present, but also those in the future. Implicitly, every modern model of intertemporal choices adopts the normative view that the future should not be discounted. Situations wherein individuals maximize their short-term utility rather than their long-term ones are referred to as self-control's failures. This view fundamentally entails the conception of an individual who is the same person through time. The person is reduced to a single and enduring entity to whom all future utility can be ascribed. Hence, re-conceptualizing what a person is over time could motivate very different principles for behaviour and choice and can help to justify short-term utility maximization that the normative standards could refer to as impatient and irrational choices.

### **The Individual as a Succession of Selves**

The philosopher Derek Parfit denies the assumption that an individual can be reduced to a single and irreducible entity. Instead, he argues that a person is a succession of overlapping selves related to varying degrees by physical continuities, memories, and similarities of character and interests<sup>10</sup> (Parfit, 1984). The strength and the quantity of psychological connections between the selves are what constitute the overlapping between the present self and future selves. Parfit argues that these psychological connections tend to decrease over time as we share less similarities with our very distant selves. This view implies that the degree of concern one has for one's future self should be scaled by the degree of "psychological connectedness". Thus, the separation between selves may be just as significant as the separation between persons, and discounting one's own future utility may be no more irrational than discounting the utility of someone else: one is not

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10. The view that we are not the same person in time is illustrated by Heraclitus' metaphor that said: "You could not step into the same river twice; for other waters are ever flowing on to you." In the same way, you are not the same person you were yesterday because you have moved on, incorporating new information, new memories, and new thoughts.

rationally required to care as much about most others welfare as one's own. In the same way, if one's future self is sufficiently different in terms of identity from one's current self, one is not rationally required to care as much about one's future self's welfare.

### **Experimental Evidence**

The first attempt to analyse the correlation between connectedness and discounting is the experimental study from [Frederick \(2003\)](#). In a laboratory experiment, he measured the psychological connectedness by asking subjects to rate on a scale how similar they expected to be with their future selves. In these judgements, respondents were told to think of "characteristics such as personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals, etc.". Individual discount rates were elicited by asking respondents to report the amount of money in one, five, ten, twenty, thirty and forty years that would make them indifferent to receive 100 dollars tomorrow. He fails to find any correlation between future similarity and discount rates. He interprets this null result as being suggestive of people endorsing the view that people believe they are the same person through time and that change in personality is not one of the things that should affect their valuation of future rewards. By using roughly a similar procedure, [Bartels and Rips \(2010\)](#) found that perceived connectedness in identity was, in fact, related to the discount rate for monetary rewards. The difference in the result is attributed to the fact that they used correlations across time points which has the virtue of to lessen the noise generated by idiosyncratic interpretations by participants, contrary to [Frederick \(2003\)](#) who used correlations within time points. [Bartels and Urminsky \(2011\)](#) provide a causal evidence that manipulating people's sense of connectedness to their future selves induce them to make more impatient purchase decisions and steeper discounting of money.

### **The Subjectivity of Identity**

In all of the previous studies that analyse Parfit's theory, self-connectedness is elicited through a restricted view of personal identity: all of the characteristics used to help subjects think of their identity refers to private aspects of one's identity only such as personality, likes and dislikes, beliefs and so on. Restricting identity as referring at what define oneself relatively to the others ignores the conception of personal identity in psychology. An individual's identity is subjectively defined and also depends on an interpersonal and social context. For instance, the identity of an individual can be defined as being a member of a family ("I am the mother of three children"), a member of a wider social category ("I am French") or by my public representation ("my social behavior, mannerisms, stylistic quirks, and expressive qualities"). A growing psychology literature on identity considers that individuals tends to define themselves on four different levels of identity orientations: in terms of their unique traits (personal identity), in terms of dyadic relationships (relational identity), in terms of public conduct (public identity), and in terms of group memberships (collective identity).

### **Chapter III and IV: Motivations**

Hence, re-integrating the complexity in the interpretation of individual's identity could help to determine whether Parfit's view about identity have descriptive as well as normative content, that is to say, whether they might explain and justify intertemporal choices. Impatient behaviour resulting from lack of connectedness could be in fact considered normative depending on the accuracy of one's beliefs about connectedness with future selves. Such view may allow a completely different approach to solve self-control dilemmas: generating a sense of connectedness with future selves may help people to overcome impulsive and impatient choices rather than employing guilt or complex incentive schemes that set the interests of current and future selves against each other. If Parfit's view is correct, simply stimulating the perception of stability of what matters the most in

our self-definition may represent a powerful tool to help us persist in achieving important goals.

## 4. The Methodologies of the Thesis

The analysis of the recent developments on intertemporal choices highlights an emergence of a field of study that is characterized by perpetual back-and-forth between economic and psychology. In short, the challenge raised by this literature is to provide a full characterisation of agent's decision over time that will be consistent with experimental and empirical evidence. In order to meet this challenge, the analysis of the decision-making process should be necessarily integrated into a subjective and psychological approach. A clear understanding of these processes may be useful to provide novel tools that help people achieving their long-term goals.

This thesis is part of a quest, already under-way, for an improved understanding of the formation of intertemporal choices using the methodology of economics. Since the initial question lies at the frontier of economic and psychology, this understanding necessarily requires a plural approach, both in terms of knowledge and methodologies. In that sense, this thesis does not claim to be a general theory of intertemporal choices (*i.e.*, a unified frame work, characterizing every aspect of intertemporal choices and viable for analysing any situation) for two reasons. First, intertemporal choices can be fully characterized in a rich, deep and realistic way, addressing all of the psychological mechanisms involved in this choice, only by giving up on parsimony. Second, I believe that such choices are highly context-dependent, so that some considerations might more relevant than other to study an intertemporal choice in a specific domain. For instance, it might be not (or at least, less) relevant to study personal identity on the choice of commitment devices.

This contextualization of intertemporal choices not only requires to choose a particular consideration of intertemporal choices, but it also requires using different methodologies depending

on the research question and on the availability of data. Relying on these and other considerations arising from the literature scrutinized above, the thesis investigates three separate domains—each one with a distinctive methodology. The following subsections describe the four methodologies and their comparative advantages for the research program I present in this thesis.

#### **4.1. Theory**

The common characteristic of the three avenues of investigations in these four chapters of the thesis lies in the systematic use of theoretical modelling. My objective is to provide an intelligible reference framework for an empirical or experimental investigation that help to identify the “good” questions: they may help to explore the consequences of changes in the environment, and changes in the idiosyncratic parameters on individual’s choices that would not always be possible empirically. But beyond this common feature of the three chapters, they all differ with respect to their empirical methodologies and strategies.

#### **4.2. Laboratory Experiments**

The emergence of experimental economics was inspired by experimental psychology and the purpose was initially used to test theoretical predictions with real people (Cot and Ferey, 2016). Experiments are generally implemented in the laboratory with a more controlled environment than field studies, allowing for the identification of causal effects. Experimenters must follow three main rules: participants must have incentives, they have to make their decisions in a context-free environment, and they should not be deceived (Croson, 2005). Designing an experiment, the experimenter should pay as much attention as possible to the internal validity of the experiment: the environment that is designed by the experimenter should be the driver of the behavior that he is aiming to test.

There are at least two advantages of using laboratory experiments. The first advantage of the laboratory experiment lies in the possibility of having participants performing tasks that are remunerated according to their choices. These tasks are intended to elicit behavioral predispositions such as risk, time or pro-social preferences. For instance, it would be possible to elicit the discount rate for each individual by giving them a series of choices between  $x$  euros at date  $t$  and  $y$  euros at date  $t + k$  and to actually pay them depending on the choices they have made. The second advantage of the laboratory experiment is related to the economic environment participants are in. The situation they are in might not even occur in a real-world situation. Thus, this artificial situation may help the researcher to establish a link between two variables that might be difficult to get with naturally occurring data.

### **4.3. Naturally Occurring Data**

Although a laboratory experiment may be useful to study a particular mechanism in a sterile environment, it however questions the external validity of the mechanisms: we can wonder whether some laboratory evidence still holds outside the laboratory environment with a more representative sample of the population and in a real-world situation. In particular, we used the German Socio Economic Panel (GSOEP) to study health behaviour in the natural environment. The GSOEP is a longitudinal survey of approximately 11,000 households in Germany from 1984 to 2016. The database is produced by the Deutsches Institut für Wirtschaftsforschung (DIW), Berlin. At each wave, the GSOEP collects information on individual characteristics, household wealth, and general work conditions. Specific questionnaire modules are implemented at some waves to include more information on topics of interest such as impulsiveness, atypical working hours and health aspects. The diversity in the information available in the GSOEP makes an empirical study the most appropriate methodology for investigating behaviours related to self-control outside the laboratory.

#### **4.4. Online Surveys**

Online surveys can be more convenient than a laboratory experiment for empirical research as it allows to get a larger and more representative sample of a population, with a higher flexibility in the schedules, and a reduced cost per subjects. They are also very attractive as it allows to run sessions entirely dedicated to the researcher topic and to collect piece of information that would not have been possible with already implemented surveys such as the GSOEP, for instance. In particular, we used Qualtrics, a survey platform for data collection. Qualtrics is a platform mostly used for market research, customer satisfaction and loyalty, product and concept testing, employee evaluations and website feedback. Not only it enabled us to collect relevant information for our research focus, but we could also target a specific sample of a population and allocate them into treatments in order to assess a causal effect. Hence, online surveys are a solution in between the laboratory experiments and the naturally occurring data: it is possible to get a representative sample of a population in an environment setting aiming to identify a causal effect.

## 5. Outline of the Thesis

### 5.1. Chapter I- Betting Against Yourself for Weight-Loss: a Theoretical and Experimental Investigation

Chapter 1 studies commitment devices as a potential tool to address weight-loss related time inconsistent behaviours. Using a theoretical model and an experimental study, this paper examines specifically the demand for commitment device to achieve a specific goal whose difficulty is given.

This chapter first presents a discrete effort task model, wherein sophisticated quasi-hyperbolic individuals must exert a costly effort to increase their expected benefit in the future. In this setting, the individual has time inconsistent preferences on the optimal level of effort to exert if present-bias is sufficiently severe.

Individuals can use a commitment device whose difficulty of the objective (*i.e.*, the level of benefit to reach) is given. By doing so, the commitment device serves as an external tool to motivate them to provide a high level of effort in the future. They can decide the amount of money that would lose if they fail to reach the objective that is assigned to them. I show that the penalty they should set to themselves must be infinitely large when the goals are either too easy or too hard. The minimal penalty amount is when the changing in the level of effort has the highest influence on the goal success. However, there are limits to self-regulation since people opt out when goals are too hard *i.e.* when the likelihood of failure is high even if they exert a high effort. I also find that while individuals with higher levels present-bias need higher levels of penalty, they also opt-out for easier goals. These theoretical results are robust to the addition of psychological mechanisms such as loss aversion and partial naiveté.

This chapter also presents an experimental study on weight-loss to illustrate the impact of the difficulty of the goal and of present-bias on commitment choices. Using experimental and psycho-



metric methods to elicit time preferences, I find that higher impulsiveness and a higher consideration of immediate consequences are associated with commitment opting-out when goals are too difficult.

## **5.2. Chapter II- Self-Control, Fatigue and Body Weight: Evidence from Transitions to Night Shifts**

Chapter 2 is a joint work with Fabrice Étilé. In this paper, we examine and reconsider the relationship between Body Mass Index (BMI) and night work, and we analyse specifically the moderating role of self-control in this relationship.

Using a German panel data set of 13,146 individuals followed between 2007 and 2014, we find significant cross-sectional correlations between evening and night work and BMI. However, fixed-effect regressions show that transitioning from a regular working schedule to evening and night work has a significant impact on body mass index only for those individuals who score high on an impulsiveness scale and are assigned to irregular evening and night work schedules. Transitions to regular evening and night shifts have no effect on BMI.

Additional regressions reveal that the result may be explained by changes in the propensity to implement health-conscious diet but are unrelated to changes in physical exercises. Our results are line with predictions of self-control theory about the role of trait impulsiveness and environmental factors in self-control depletion and impulsive behaviors.

### **5.3. Chapter III- Measuring Identity Orientations for Understanding Preferences: a French Validation of the Aspects of Identity Questionnaire**

Chapter 3 is a joint work with Fabrice Étilé. We translated in French the “Aspect of Identity IV” (AIQ-IV) questionnaire aiming to measure the relative importance or value that individuals subjectively place on various identity attributes when constructing their self-definitions. This questionnaire measures four identity orientations, namely personal identity, relational identity, public identity and collective identity. This translation was done in order to implement a series of studies, with French speaking participants, focusing on the relationship between personal identity and economic preferences. The AIQ-IV contains a set of items that represent either personal, relational, public and collective orientations of identity. For this French translation to be considered valid, it has to pass a series of psychometric tests assessing the quality and the reliability of the instrument. For this reason, we administered the French version of the questionnaire to a representative sample of French young adults ( $N = 1,118$ ).

We show the reliability and validity of the AIQ-IV in French and opens up new research opportunities on the relationship between identity orientations and economic preferences.

## 5.4. Chapter IV- Time Preferences and Relational Identity

Chapter 4 is a joint work with Fabrice Étilé. In this paper, consisting in three independent studies performed on web-based platform on a French representative sample, we explore the relationship between identity and self-continuity by examining which identity orientation matters the most for self-continuity judgments and time discounting.

We (a) examine the cross-correlations between identity orientations and self-continuity, (b) measure the effect of increasing the salience of (i) personal, (ii) relational or (iii) public identity on self-continuity judgement, and (c) measure the effect of manipulating the stability of one's (i) personal, and (ii) relational identity on self-continuity and time discounting. Contrary to implicit assumptions in prior studies, we find no evidence that personal identity matters for self-continuity. Instead, we found that relational identity—that is, the self-definition in terms of relationships with ones significant others—have higher level of psychological continuity with their future selves. Priming manipulations reveal that increasing the salience of relational identity makes people more psychologically connected with their future selves. Second, increasing the perception of instability of their relational identity over time makes people less psychologically connected to their future selves and more impatient in terms of monetary rewards.



# BETTING AGAINST YOURSELF FOR WEIGHT-LOSS: A Theoretical and Experimental Investigation

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*"I ain't got the time,  
And if my daddy thinks I'm fine,  
He's tried to make me go to rehab,  
I won't go, go, go."*

- Amy Winehouse, *Rehab*

## 1. Introduction

Managing obesity has become an important public health issue in developed countries. Since 1980, worldwide obesity has tripled: half of OECD countries count half of their population as overweight or obese, increasing public health cost induced by obesity related chronic diseases such as type-2 diabetes, higher blood pressure and higher cholesterol level (Devaux and Sassi, 2011). Excess weight and obesity are a major risk factor for global deaths: on average, an obese person has a smaller life expectancy of around 8-10 life years less than a normal-weight individual (WHO, 2000). Given the economic impact and the shortened life expectancy associated to excess weight, designing effective incentives for intentional weight-loss may be supported by public health agencies, as diminished weight and body fat have important beneficial effects on health for overweight and obese individuals.

However, most attempts to change eating behaviours often end in failure because individuals may display time inconsistent preferences: they fail to value long-term benefits of weight-loss

in the future as they value in a disproportionate way immediate gratification from not changing their behaviours. If time inconsistency is one of the sources of individuals' difficulty in achieving a long-term goal, public policies could encourage the implementation of commitment devices to promote healthier choices that match with long-run preferences of individuals. Based on voluntary enrolment, commitment devices are potential powerful alternatives for public health intervention as they would allow to help people to stick to their long-term preferences while ensuring consumers' freedom in their individual choices. Such devices could be more politically supported than nutritional taxes to tackle the obesity epidemics as it would ensure consumer sovereignty (Etilé et al., 2013).<sup>1</sup>

While humanity has always used commitment devices (sometimes unconsciously) in many forms,<sup>2</sup> little is known about the psychological mechanisms at stake of enrollments into commitment devices especially when the difficulty of the goals to be achieved are not chosen by individuals themselves. The existing literature has indeed focused on self-selection into commitment devices with unique goals (e.g. losing one pound per week in John et al. (2011); 6 months smoking cessation in Giné, Karlan and Zinman (2010)). Proposed commitment devices may thus be not always reflective of individuals preferences and this may partly explain why commitment devices display low uptake rates (see Giné, Karlan and Zinman, 2010). As a result, the fact that the goal is unique does not allow to investigate how people chose their commitments with respect to their preferences since few people actually enrol into these contracts. However, this is an important aspect to be addressed since many commitment schemes impose a unique goal for a whole targeted population.

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1. In particular, by altering the structure of relative prices and making junk-food more expensive, nutritional taxes aims at helping the consumers to make the choice that they would have done if they were time consistent. However, such a behavioural intervention implicitly assumes that the public decision maker considers that such a time consistent choice is to necessarily favour health rather than immediate pleasures. This might not always be true, and hence the implementation of such a tax can have welfare reducing effect.

2. Bryan, Karlan and Nelson (2010) list several ad hoc behaviour that can be construed as commitment devices such as "cutting up one's credit cards, only taking a fixed amount of cash when heading out to party for a night, buying junk food in small packages rather than buying in bulk, not keeping alcohol in the house, brushing one's teeth earlier in the evening to avoid late night snacking" ...

In particular, the current paper analyses the behavioural micro foundations of the choice of self-imposed penalties as commitments devices when goals are exogenous. Using a theoretical model and an experimental design, I study present-biased individuals' willingness to reduce their remunerations when they fail to reach goals with varying difficulty levels. In the theoretical model, a sophisticated quasi-hyperbolic agent must exert a high but costly effort to receive a larger benefit in the future. She thinks that exerting a high effort is optimal ex-ante but when the effort must be done, she will prefer to procrastinate. To fight her time inconsistency, she can decide a level of penalty to reach an exogenous goal. I test this model in an experimental set-up in which participants are assigned to an exogenous weight-loss goal to reach in one month and they can use a self-inflicted penalty commitment device to help them to reach their objective. In addition, individual time preferences are also measured through psychometric scales and monetary choices.

The theoretical model shows that a sophisticated quasi-hyperbolic agent is willing to restrict her own future behaviour with a financial penalty when present-bias is sufficiently severe, that is, when there is an intra-personal conflict between the individual's selves at two different points in time on the optimal effort to exert. When the individual is proposed the commitment device, she sets an expensive penalty to herself when the goal is likely to be achieved even by exerting a low effort. This counter intuitive result stems from the fact that the change in effort has little effect on the likelihood of goal success. The easiness of the goal must thus be compensated by an increase in the monetary threat. More generally, the penalty level corresponds to a U-shape function of the goal, where the minimal penalty is given by the goal for which the change in effort will change the most the likelihood of goal success. However, there are limits to self-regulation since the individual opts-out when goals are too hard to reach, even if when she exerts high effort: the high probability of receiving a penalty outweighs the benefit the individual could derive from a high level of effort. The theoretical model also allows to investigate the general form of the penalty function with respect to the severity of the present-bias. I find that severe present biased agents must set higher penalties when they opt-in because present-bias decreases the utility of exerting a high effort. However, the goal beyond which opting-out occurs is easier. This result suggests



that commitment penalties can be efficient mechanisms for weight-loss only when present-bias is moderate since severely present-biased individuals will prefer to opt-out.

I consider several extensions which account for behavioural biases. First, I analyse the effect of loss aversion in the model (Tversky and Kahneman, 1992, Köszegi and Rabin, 2006, Kahneman and Tversky, 2013). I assume that the individual gives less weight to benefits falling below the goal. The addition of this additional parameter in the model makes that individuals with a moderate present-bias are less likely to use a commitment device because it reduces both the intrapersonal conflict and the goal threshold beyond which opting-out occurs. I also investigate the impact of partial naiveté in the model. It accounts for a systematic underestimation of one's own time inconsistency (O'Donoghue and Rabin, 2001, DellaVigna and Malmendier, 2004). Overconfidence of one's own time consistency makes that the individual may not use self-imposed penalties since she might be unaware of her intrapersonal conflict. If she is aware of her time inconsistency, she thinks she must use lower self-imposed penalties and she will opt-out for harder goals. However, she will systematically underestimate the efficient penalty level of commitment because of her overconfidence in her present-bias. This leads to a substantial reducing in welfare: she does commit, but she does not exert effort. This model, together with these additional behavioural parameters, has important public policy implications. It shows that few individuals might be actually willing to use commitments devices when they are loss averse. In addition, commitments can be inefficient to induce behavioural changes when people are partially naive about their own present-bias.

I conduct an experimental study to test two main theoretical predictions of this model regarding the shape of the self-imposed penalty as function of the goal and the determinants of opting-out. First, I test whether the commitment function describes a U-shape with respect to the goal. Second, I test whether elicited time preferences are good predictors of commitment opting-out. 44 participants were invited to participate in an experiment involving a commitment penalty choice in a one-month weight-loss task. Participants were given the opportunity to set themselves a penalty up to fifteen euros for the completion of a weight-loss task with varying difficulties from one to three kilograms: they could decide how much they would like to lose at the end of the month

if they failed to reach a goal being randomly chosen for them. To investigate whether monetary present-bias can be a good predictor of commitment demand, I measure time preferences using the Convex time budget methodology from [Andreoni and Sprenger \(2010\)](#). Psychometric measures of time orientation were also collected not only to investigate whether psychometric scales are predictive of commitment demand, but also to examine the convergent validity of elicited time preferences through convex time budget. I first find that self-inflicted penalty is linearly decreasing with respect to the goal. However, this declining pattern is actually due to commitment opting-out when weight-loss goals are too hard. Since the variation in self-inflicted penalties are due to opting-out, we further investigate whether elicited time preferences will affect its probability. I find no significant relationship between monetary present-bias—measured using the convex time budget—and the probability to opt-out. Yet, trait-impulsiveness and the consideration for immediate consequences does predict that individuals are more likely to opt-out when goals are hard which is a result that is consistent with the theoretical model.

The contribution to the literature is threefold. First, this paper contributes to the goal-setting literature by examining how individuals help themselves to achieve exogenous goals. Most of this theoretical literature indeed focuses either on the effect of goal setting on performance ([Heath, Larrick and Wu, 1999](#), [Armantier and Boly, 2011](#)) or on how people determine their goals to mitigate time inconsistency ([Bénabou and Tirole, 2002](#), [Hsiaw, 2013](#), [Koch and Nafziger, 2011](#)). My theoretical section proposes hence a re-adaptation of goal setting models to study the choice of financial commitments when goals are given, which is often the case in commitment contracts proposed in the real world (see [John et al., 2011](#), [Giné, Karlan and Zinman, 2010](#)). This theoretical investigation would explain why commitments devices displays low take-up rates and would predict how people determine their penalty for goals they strive to pursue.

Second, my paper bridges the gap between the economics and the psychological literature by focusing on counteractive self-control in a micro-economic framework whereby quasi-hyperbolic discounting, loss aversion and partial naiveté are key ingredients influencing commitment choices.

In particular, there is no study in my knowledge investigating simultaneously the impact of goal difficulty and present-bias on commitment demand in both a theoretical and an empirical perspective.

Finally, this paper is a contribution to the experimental literature on time preferences and commitment devices by proposing a novel laboratory experiment in which I attempt to link time inconsistency behaviours—estimated through a variety of techniques from experimental economics to psychometrics—with a decision to engage in a commitment device to lose weight. This experiment not only examine commitment demand for weight-loss in an experimental set-up, it also allows to examine the predictive validity of time preferences measured through the convex time budget method on commitment demand. Three important results are found for this investigation. First, no evidence of significant relationship between monetary discounting and choices of commitments is found. Second, validated psychometric scales predict commitment demand. Third, no association is found between monetary discounting and psychometric scales. These three results, taken together, hence cast some doubts on the relevance of measuring monetary discounting to understand counteractive behaviours and tend to favour the use of simpler questionnaire to identify time preferences in real-world behaviours.

The remainder of the paper is organized as follows: Section 2 presents the existing and relevant literature on time inconsistency and commitments devices; Section 3 presents the model of choice of monetary commitment and its subsequent extensions; Section 4 presents the design of the experimental study; Section 5 presents the descriptive statistics and the results of the experiment; Section 6 concludes and discusses potential policy implications.

## **2. Literature Review**

One way of analysing weight-control behaviour is to consider individual decision making as the result of intertemporal utility maximization: individuals make the choice to lose weight only if the weight-loss benefit (being healthier, reaching an ideal weight) exceeds the immediate cost of

effort to maintain diet restrictions or to increase physical activity. If an agent is time consistent—that is, if she prefers  $A$  to  $B$  today, she should prefer  $A$  to  $B$  tomorrow as well—the actual effort to lose weight or not is consistent with her initial plans.

However, a large literature has documented the existence of a gap between long-run intention and short-run actions. This literature presents evidence that people do not have time-consistent preferences (Strotz, 1955, Thaler, 1981, Benzion, Rapoport and Yagil, 1989, Chapman, 1996). This inconsistency in behaviour results from a disproportionate under-evaluation of future utilities compared to immediate utility generating a disagreement between the decision maker's selves about which action should be taken. A number of studies have found that individuals may exhibit preferences reversals when the trade-offs that they face consist in choices between sooner and smaller rewards and later and larger rewards (Kirby and Herrnstein, 1995, Ainslie and Herrnstein, 1981).<sup>3</sup> The standard model of discounting utility proposed by Samuelson (1937) fails to account for such preference reversals that are important from a theoretical and empirical standpoint. To accommodate for time inconsistency, Phelps and Pollak (1968) introduce the quasi-hyperbolic discounting utility model where the discount factor is

$$D(k) = \begin{cases} 1 & \text{if } k = 0 \\ \beta\delta^k & \text{if } k > 0 \end{cases} \quad (\text{I.1})$$

in which  $\beta \leq 1$  accounts for a preference for immediate gratification. This formulation assumes a declining discount rate between the current period and every future periods but a constant discount rate thereafter. This model is highly tractable and captures important empirical findings such as the preference reversal phenomenon described above. (Laibson, 1997, Loewenstein and Prelec, 1992, Thaler, 1981).

Quasi-hyperbolic discounting models can be particularly suited for studying weight management as the discrepancy between weight-loss intentions and actual eating and exercise behaviour

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3. For instance, one may prefer 110 euros in 31 days over 100 euros in 30 days, but also 100 euros now over 110 tomorrow. This example highlights the fact that the smaller and sooner reward becomes more salient when it occurs immediately. (Thaler, 1981)

can be understood as time inconsistent decisions (Huston and Finke, 2003, DellaVigna and Malmendier, 2006, Read and Van Leeuwen, 1998). Dieters may experience hardship in maintaining a diet over the long term due to the immediate and over-valued satisfaction associated with consuming encountered fattening product. From a theoretical perspective, quasi-hyperbolic discounting could account for these types of inconsistent intentions to take preventive actions since temptation generally occurs sooner. The reason why people make resolutions to diet and exercise but later fail to follow their resolutions can be captured by the present-bias parameter  $\beta$  of the quasi-hyperbolic model.

In particular, this discounting function allows to consider at least two types of agents who take actions by anticipating their future behaviours. These agents can be either naive or sophisticated about their time inconsistency (O'Donoghue and Rabin, 1999). While a naive agent believes that she is time consistent when she is not, a sophisticated agent, in contrast, knows perfectly her level of present bias and she can undertake strategies to overcome her self-control problems. Partially sophisticated agents (or partially naive agents) corresponds to types in between these two extremes behaviours: they know that they are present-biased but systematically underestimate the value of their bias.<sup>4</sup>

If individuals are at least partially sophisticated, they can voluntarily plan to shield themselves from their own future deviations of their optimal plan. They can use commitment devices which are defined as arrangement made by an agent to himself that will restrict her future choices by making tempting options more expensive to protect their long-run goals from short-run temptations (Bryan, Karlan and Nelson, 2010). There is much evidence that people actually use engage-

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4. It is implicitly assumed that these agents backwardly induct. In other words, they determine their optimal actions by anticipating what they will do in the future in a given situation. It is not clear, at least experimentally, that people actually do backward induction. In addition to naiveté and sophistication, resolute and myopic types—who do not backwardly induct—can be considered in both their theoretical and experimental aspects. A resolute agent sticks to the decision that yields the highest utility from an ex-ante perspective. In contrast, a myopic agent simply ignores the multiple-stage decision and maximizes her utility in a short-sighted perspective without taking into account that her preferences will change over time. In an experimental study examining dynamic behaviours, Hey and Lotito (2009) find that the majority of subjects are either naive or resolute and few are sophisticated. In a different experimental setup, Hey and Panaccione (2011) find that the majority of subjects are resolute and few are either sophisticated, naive or myopic.

ment devices both in laboratory experiments and in the field (Augenblick, Niederle and Sprenger, 2015, Sadoff, Samek and Sprenger, 2015, Giné, Karlan and Zinman, 2010).

One form of commitment device, that is studied in this paper, can be self-imposed penalties for failing to reach a given objective. For instance, Giné, Karlan and Zinman (2010) propose a saving account for smoking cessation in which people deposit funds for six months after which they take a urine test for nicotine and cotinine: if they pass, their money is returned; otherwise, their money is forfeited to charity. People thus saved an amount of their choice for the sole purpose of quitting smoking. The authors showed that the 11% of individuals who used their commitment device had a 3 percentage point increase in the probability of quitting smoking. Although this result highlights the existence of a demand for commitment and its moderate efficiency, it leaves several theoretical and empirical questions open, some of which are addressed in this study.

First, since smoking cessation had to be carried out for the same length of time for every individual, this does not question the effect of the difficulty of the goal. In particular, it may be that shorter or extended periods of goal smoking cessation would have a different impact on commitment demand and self-imposed penalty levels. Trope and Fishbach (2000) studied the effect of goals on commitment choice by examining penalties imposed on oneself as part of a medical examination requiring avoiding sugar intake for a certain period of time. Subjects were assigned to two treatments in which the duration of abstinence from sugar intake was either six hours or three days for the medical test to be effective. In both treatments, subjects chose their self-inflicted penalty if they could not avoid sugary food for their assigned period of time. On average, those required to fast for 6 hours set a penalty of \$1.49, and those required to fast for 3 days set a penalty of \$3.86. However, this study does not test what would be the effect of hard goals on commitment demand. In particular, if the individual accounts for the fact that harder goals reduce the likelihood of goal success, she should prefer at some goal to opt-out from the commitment mechanism.

Second, although individuals chose how much to commit to a long-term goal, the explanation of the heterogeneity in their choices of commitment is not addressed. In particular, the individual variation in self-inflicted penalty levels can be explained theoretically by the heterogeneity in in-

dividual's (in)capacity to delay gratification. As such, it might be relevant to have an experimental instrument which capture a general element of inter-temporal preferences. Using monetary discounting to measure time preferences, several papers showed that monetary present-bias is significantly correlated with commitment devices take-up (Ashraf, Karlan and Yin, 2006, Augenblick, Niederle and Sprenger, 2015). More specifically, John (2016) showed that when individuals are offered a regular instalment commitment savings product for which they decide the savings plan and the penalty for themselves, sophisticated present-biased individuals—categorized as such using a monetary discounting elicitation procedure—set high self-inflicted penalties.

However, the measurement of time preferences with monetary rewards is subject to a heated debate. Experimental research had relied on series of monetary binary choices between sooner and smaller payments and larger and lower payments (Coller and Williams, 1999). Assuming linearity of the utility function, indifferences between sooner and later prospects provide individual estimates of discounting parameters. Given monetary choices and health choices share similarities in the decision's nature and in the intertemporal biases, a growing and recent literature found that present-bias elicited in the monetary domain correlates with the inability to take preventive behaviour linked to health, savings, or gambling outcomes (Borghans and Golsteyn, 2006, Ikeda, Kang and Ohtake, 2010, Chabris et al., 2008, Chapman, 1996). The underlying assumption is that, regardless of context or domain, intertemporal behaviours are driven by a global inclination to delay gratification (see Loewenstein, Read and Baumeister, 2003, p.399).

The predictive validity of monetary choices in experimental set-ups is challenged by the considerations of the many theoretical confounds potentially leading to poor estimates of discounting parameters. In particular, by assuming linearity of the utility function when it is actually concave, researchers end up with overestimated elicited discount rates. In order to carefully control for utility curvature, two competing estimation strategies are proposed in the literature. First, Andersen et al. (2008) rely on the joint elicitation of risk attitudes and time preferences assuming that the shape of utility function can be characterized in the risk domain. Participants have to make

a series of binary choices beyond payments at two different dates and another series of choices on risky prospects. This method is called the double multiple price list (DMPL). Controlling for utility concavity, the authors found significantly lower discount rates than those found in previous studies. Second, the Convex Time Budget (CTB) proposed by [Andreoni and Sprenger \(2010\)](#) is a procedure that measures in a single instrument both discounting parameters and utility curvature. In contrast to binary choices between two payments at different points in time, subjects allocate some budget at two dates allowing them to choose an interior solution that could not be chosen in the binary choice procedure. Interior solutions not only provide evidence that subjects have concave utility functions but provides more precise discounting parameters.

Beyond the methodological disagreements generated by these two different estimation strategies, both recognize that evidence of present-bias, at least for monetary rewards, is moderate, if not in-existent. Using the DMPL, [Andersen et al. \(2008\)](#) found evidence of declining discount rates captured by an hyperbolic specification but “the quantitative magnitude of the decline is much smaller when one allows for concave utility functions” ([Andersen et al., 2008](#), p.607). As for the CTB, [Andreoni and Sprenger \(2010\)](#) found no evidence of hyperbolic discounting behaviour. The authors argue that previous evidence of present-bias in monetary choices might actually be either “an artifact of differential risk or transactions costs over sooner and later payments” ([Andreoni and Sprenger, 2010](#), p. 3,335).

One question arising from this literature review resulting from this methodological debate is whether previous evidence of the predictive validity of time preferences still holds when carefully controlling for utility curvature. The current paper hence tests whether elicited time preferences using the CTB is in any way predictive of commitment demand and also examines whether time preferences using that method are correlated with validated psychometric scales measuring time orientations such as the consideration for future consequences (CFC-14)<sup>5</sup> and the Barratt Impul-

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5. In particular, the CFC attempts to determine whether individuals act more in terms of the immediate consequences (for the short-term satisfaction of their desires or needs) of their actions or in terms of their long-term consequences (e.g. obtaining or avoiding something, such as working diligently while in school to achieve the desired job, or favouring a healthy lifestyle to avoid later health complications). [Strathman et al. \(1994\)](#) explain that this motivational construct would make it possible to capture the tendency of individuals to distance themselves from the present moment to orient themselves towards the future, with the aim of achieving desired objectives. The CFC has allowed



siveness scales (BIS-11).<sup>6</sup> These constructs have been widely mentioned in the literature to be associated with behaviours involving time ranging from financial decisions to health outcomes.

### 3. Model of Commitment Choice

#### 3.1. Setting

I consider a three-period model of inter-temporal choice  $t \in \{0, 1, 2\}$  in which an agent suffers from self-control problems. The agent exerts a costly effort to receive a larger benefit in the next period. I focus on the case in which the agent thinks that exerting an effort is optimal at period 0 but when the effort has to be actually done, she will prefer to shirk. I denote Self- $t$  as the incarnation of the individual at period  $t$ .

**The Task** The individual has to complete a task by choosing the level of effort to exert. Self-1 can either exert a low effort  $\underline{e}$  or a high effort  $\bar{e}$ . The high effort is more costly than the low effort so that the cost function  $c(e)$  is :

$$c(e) = \begin{cases} c > 0 & \text{if } e = \bar{e} \\ 0 & \text{if } e = \underline{e} \end{cases} \quad (\text{I.2})$$

The benefit  $b$  is a random variable that is conditional on the exerted effort according to the distribution  $F(\cdot|e)$  with  $b \in [\underline{b}; \bar{b}]$  where  $\underline{b} \geq 0$ . The higher the benefit, the more likely the high exerted effort. In order to capture this relationship between effort and benefit, the following assumption

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to identify interesting results. First, individuals who take more into consideration future consequences rather than immediate consequences of their actions reported using less tobacco and alcohol and exercising more frequently. Second, [Joireman et al. \(2008\)](#) suggest that individuals who take more into consideration immediate consequences increase the likelihood to fail at self-control.

6. the Barratt Impulsiveness Scale 11 (BIS-11) measures impulsiveness being defined as the predisposition to react quickly and unplanned in response to an internal or external stimulus, without consideration of the possible consequences these reactions might have for oneself or others ([Patton, Stanford and Barratt, 1995](#)). The relevance of the concept of impulsiveness as a potential determinant of several behaviours has given rise to numerous studies, both in the field of personality and in clinical psychology. More specifically, a meta-analysis of 51 studies on the relationship between impulsivity and obesity concludes that impulsivity is a significant variable in the obesity explanatory equation ([Schag et al., 2013](#)).

is made:

**Assumption 1 (The Monotone Likelihood Ratio Property)**

$$\text{For all } (b; b') \in [\underline{b}; \bar{b}]^2 \text{ such that } b < b', \quad \frac{f(b|\bar{e})}{f(b|\underline{e})} < \frac{f(b'|\bar{e})}{f(b'|\underline{e})} \quad (\text{I.3})$$

with  $f$  the probability density of the distribution  $F$ . This assumption ensures that obtaining a large benefit  $b' > b$  is more likely when a high effort  $\bar{e}$  is exerted.<sup>7</sup> Distribution functions that satisfy the MLRP have a number of well-behaved stochastic properties, such as first-order stochastic dominance (FOSD) and hazard ratios dominance (HRD).

**Timing** In the initial setting, Self-0 can only determine what would be her preferred level of effort implemented by Self-1. Self-1 can either exert a low or a high level of effort. At date  $t = 2$ , the agent experiences the realization of the benefit  $b$  given the exerted effort.

**Quasi-Hyperbolic Discounting** I analyze the behaviour of a time inconsistent individual using the framework of quasi-hyperbolic discounting (Phelps and Pollak, 1968, Laibson, 1997) positing that from the perspective of date  $t$ , period  $t + s$  is discounted by  $\beta\delta^s$  where  $\beta \in [0, 1]$ . The parameter  $\beta$  captures the extent to which the individual overemphasizes immediate streams of utility as compared to delayed streams of utility. The smaller the  $\beta$ , the higher the present-bias. Without loss of generality, I will assume throughout the paper that the standard exponential discount factor  $\delta$  is equal to one.<sup>8</sup> In contrast, a present-bias parameter equal to one would correspond to the extreme case wherein utilities of Self-0 and Self-1 are identical. Given this framework, the expected utilities

7. More specifically, the order ensures that the two distributions of low and high effort only cross once. There exists a unique  $\tilde{b}$  such that for every  $b < \tilde{b}$ , the ratio  $\frac{f(b|\bar{e})}{f(b|\underline{e})}$  is smaller than 1. When  $b = \tilde{b}$ , the ratio  $\frac{f(b|\bar{e})}{f(b|\underline{e})}$  is equal to 1 (i.e.  $\tilde{b}$  is the crossing point) and for every  $\tilde{b}$ , we have  $\frac{f(b|\bar{e})}{f(b|\underline{e})}$  larger than 1.

8. Koch and Nafziger (2011) normalize  $\delta = 1$  for simplicity.

of Self-0 and Self-1 are the following :

$$U_0(e) = \beta \left[ -c(e) + \mathbb{E}[b|e] \right] \quad (\text{I.4})$$

$$U_1(e) = -c(e) + \beta \mathbb{E}[b|e] \quad (\text{I.5})$$

### 3.2. The Intra-personal Conflict

I focus on the case in which the individual suffers from self-control problem. This corresponds to the situation in which Self-0 would want to implement a high effort but Self-1 prefers to shirk. The two underlying conditions that must be met to be in such a situation are given by comparing Self-0's and Self-1's utilities according to their preferred level of effort.

Self-0 prefers the high effort rather than the low one if and only if :

$$\Delta U_0 \equiv U_0(\bar{e}) - U_0(\underline{e}) = \beta \left( -c + \Delta \mathbb{E}[b] \right) \geq 0 \quad (\text{I.6})$$

where  $\Delta \mathbb{E}[b] = \mathbb{E}[b|\bar{e}] - \mathbb{E}[b|\underline{e}] > 0$  is defined as the marginal benefit expected from changing the level of effort from low to high.<sup>9</sup> Self-0 prefers a high effort if and only if the marginal benefit of such high effort is larger than the associated cost.

As Self-1 incurs the immediate cost of the effort, the valuation of the expected benefit is lower relative to the cost because of the present-bias parameter. In this situation, Self-1 prefers to shirk (*i.e.*, exert a low effort) if and only if :

$$\Delta U_1 \equiv U_1(\bar{e}) - U_1(\underline{e}) = -c + \beta \Delta \mathbb{E}[b] < 0 \quad (\text{I.7})$$

There exists an intra-personal conflict if inequalities I.6 and I.7 are simultaneously satisfied, that is, when Self-0 prefers  $\bar{e}$  but Self-1 prefers  $\underline{e}$ . This conflict is solely due to the distortion of the instantaneous utilities induced by the present-bias parameter. The higher the present-bias or the

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9. The fact that the difference of expected benefit is positive is the result of assumption 1 that implies that a high effort stochastically dominates a low effort in terms of benefit.

smaller the  $\beta$ , the larger the intra-personal conflict between the two selves. These two conditions allow to define a level of present-bias beyond which the individual has problem of self-control.

**Assumption 2 (The Intra Personal Conflict)** *The individual faces a self-control problem (i.e. Self-0 prefers a high effort but Self-1 shirk) when present-bias is sufficiently large:*

$$\beta < \beta_{SC} \leq 1 \quad (\text{I.8})$$

where  $\beta_{SC} \equiv \frac{c}{\Delta \mathbb{E}[b]}$

Assumption 2 requires present-bias to be lower than the ratio between the cost of effort and the difference in benefit due to the change in level of effort.<sup>10</sup>

### 3.3. Choice of Commitment

In the following, Self-0 is allowed to use a financial penalty as a commitment device to motivate Self-1 to exert a high effort when an exogenous goal  $b_g$  to reach is given. If the individual adopts the commitment device, she decides at  $t = 0$  the level of monetary penalty  $m$  she will incur at  $t = 2$  if the benefit resulting from Self-1 effort is below the goal  $b_g$ .

Allowing the individual to restrict her own future choices with a penalty yields the following utilities for Self-0 and Self-1:

$$U_0^m(e, m) = \beta \left[ -c(e) + \mathbb{E}[b|e] - mF(b_g|e) \right] \quad (\text{I.9})$$

$$U_1^m(e, m) = -c(e) + \beta \left[ \mathbb{E}[b|e] - mF(b_g|e) \right] \quad (\text{I.10})$$

where  $F(b_g|e)$  is the probability of having a benefit  $b$  which is below the goal  $b_g$  conditional on the exerted effort. Thus,  $mF(b_g|e)$  can be interpreted as the expected penalty of falling short of the goal when the effort  $e$  is exerted.

10. The ratio  $\frac{c}{\Delta \mathbb{E}[b]}$  can be interpreted as the gross return of the effort.

Given that Self-0 knows that Self-1 will shirk, the problem of Self-0 is now to choose the penalty level that maximizes her expected utility under the constraint that Self-1 will prefer to exert a high effort if the penalty is implemented.

$$\begin{cases} \max_{m \in \mathbb{R}^+} & U_0^m(e, m) \\ \text{s.t} & U_1^m(\bar{e}, m) \geq U_1^m(\underline{e}, m) \end{cases} \quad (\text{I.11})$$

The problem of Self-0 can be solved by backward induction.<sup>11</sup> First, one need to determine the penalty level  $m$  for which the incentive constraint defined above is binding, that is, the penalty level which will motivate Self-1 to exert a high effort. If Self-0 wants to use a commitment device, she would set at least the level of penalty that is incentive compatible. However, due to the financial risk introduced by the commitment device—that is, the probability that Self-0 will receive the penalty because the realized benefit was too low—the presence of intra-personal conflict does not necessarily guarantee that Self-0 will actually opt-in to the penalty mechanism. In particular, the optimal penalty scheme that Self-0 implements should make her better-off when the penalty is implemented and when Self-1 exerts a high effort compared to the situation in which no penalty is implemented and in which Self-1 shirks.

### 3.4. Findings

#### The Impact of the Goal on Commitment Choice

This section solves the maximization problem of Self-0 by determining the optimal level of penalty that Self-0 should set given the incentive constraint. As previously mentioned, one need first to determine the penalty level that Self-0 should implement if she wants to motivate Self-1 to exert a high effort before examining whether Self-0 would actually opts in for the commitment

11. As mentioned in the literature review, the resolution of the model using backward induction restricts the analysis to the investigation of naive and partially sophisticated types of agents who take into account that their preferences might change over time. More specifically, this model does not investigate the behaviour of resolute agents who manage to impose their first-period preferences for their future selves without having to use commitment devices. It does not investigate either the behaviours of myopic agents who only maximize their current utility without taking into account their future selves may deviate from their preferred action.

device. Lemma 1 below characterizes the level of motivational penalty that should be set in order to motivate Self-1 a high effort and how this level is dependent on the goal.

**Lemma 1 (The Motivational Penalty)** *Let a goal  $b_g$  in  $[\underline{b}, \bar{b}]$ , then under assumptions 1 and 2, the penalty  $\hat{m}$  that motivates Self-1 to exert a high effort  $\bar{e}$  verifies:*

$$\hat{m}(b_g, \beta) = \frac{\Delta U_1}{\beta(F(b_g|\bar{e}) - F(b_g|\underline{e}))} > 0$$

with  $\hat{m}$ , a U-shaped function of  $b_g$ .

*(Proof in Appendix)*

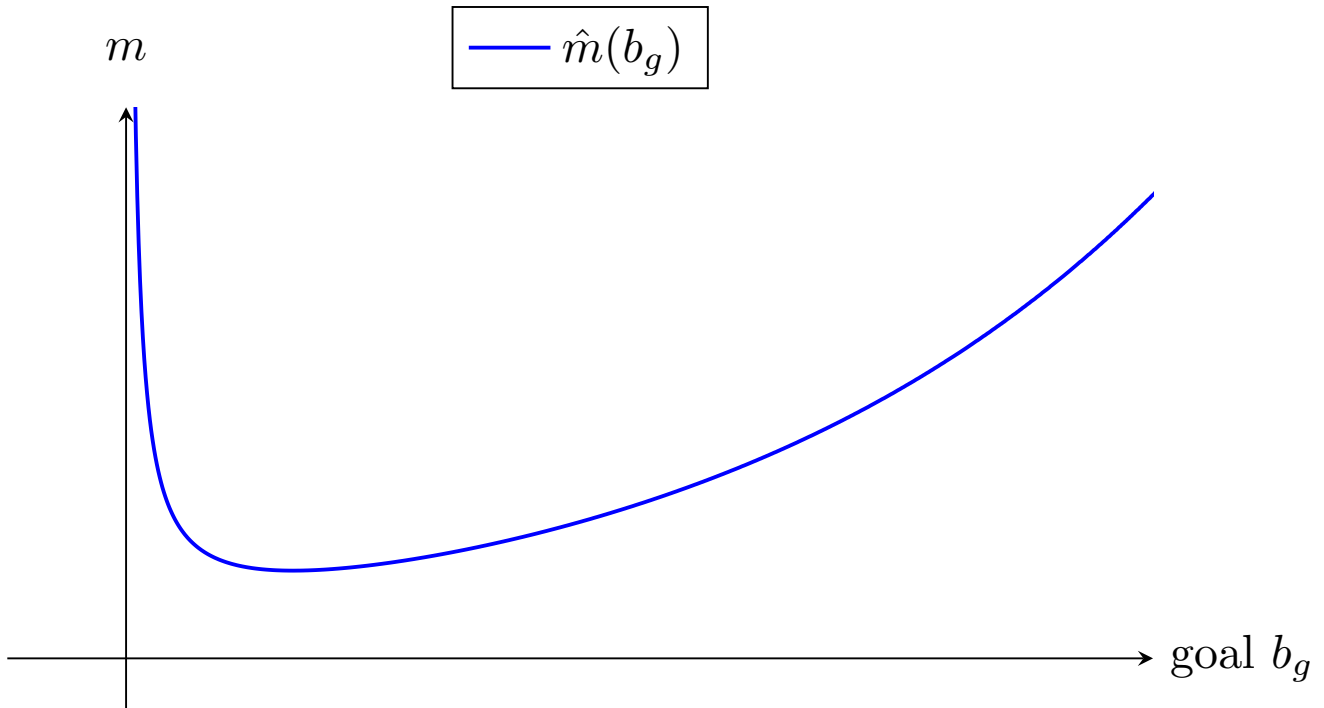
Figure I.1 illustrates the motivational penalty for high effort with respect to the goal under assumption 1 and definition 2. In order to motivate Self-1 to exert a high effort, Self-0 should implement a positive penalty.<sup>12</sup> This amount corresponds to a weighted compensation of Self-1's loss in utility resulting from the change in effort level  $\Delta U_1$ . This utility loss is weighted by the inverse of the present-bias parameter and by the inverse of the difference between the cumulative distribution of the high and low effort. This difference in cumulative distribution represents the change in the likelihood of falling short of the goal induced by a change in the effort level : the larger the difference, the higher the expected marginal return to exert a high effort rather than a low one. Consequently, there exists a goal  $\tilde{b}$  such that  $\tilde{b} = \frac{f(\tilde{b}|\bar{e})}{f(\tilde{b}|\underline{e})}$  for which the penalty that motivates Self-1 to exert a high effort is the lowest. This lowest penalty is associated to the goal for which a change in effort will affect the most the likelihood of success.

Because the difference between the two cumulative distributions of  $b_g$  is at the denominator, the motivational penalty tends to  $+\infty$  when the goal  $b_g$  tends to the lowest and upper bond. This is because the change in effort will have little influence on the likelihood of receiving the penalty at those two extreme bonds. In particular, when goals are "easy",<sup>13</sup> the motivational penalty should be very large to compensate the dis-utility of exerting an effort given that this effort exertion has

12.  $\Delta U_1$  is negative because of equation I.7 and  $F(b_g|\bar{e}) - F(b_g|\underline{e})$  is negative because of assumption 1 which implies first order stochastic dominance.

13. "Easy" goals are defined as goals  $b_g$  close to the lower bond  $\underline{b}$ .

Figure I.1: The minimal penalty set by Self-0 to motivate Self-1 to exert a high effort



**Note:** This graph illustrates the minimal penalty that would motivate Self-1 to exert a high effort with respect to the goal  $b^*$  of equation I.12 if assumption 1 is satisfied and if definition 2 holds. For illustration purposes, this graph has been drawn by using exponential distributions for the low and high effort with  $\lambda_e = 3$  and  $\lambda_{\bar{e}} = 0.5$ .

little influence on the likelihood of receiving the penalty. Conversely, when goals are "difficult",<sup>14</sup> the motivational penalty to exert a high effort should also be large to compensate the disutility of exerting a high effort given that the high effort will have little effect in reducing the high probability of falling short of the goal.

Note that Self-0 will never choose a penalty that is higher than  $\hat{m}$  since Self-0's utility  $U_0^m(m|\bar{e})$  is a decreasing function of  $m$ . If Self-0 choose to incentivize Self-1's actions, she will be better-off by choosing the lowest incentive compatible penalty. In contrast, any penalty level  $m$  below  $\hat{m}$  only induces Self-1 to exert a low effort.<sup>15</sup>

14. "Difficult" goals are defined as goals  $b_g$  tends to the upper bound  $\bar{b}$ .

15. If it would have been possible to implement a penalty motivating Self-1 to exert a low effort, given that  $U_0^m(m|\underline{e})$  is a decreasing function of  $m$ , the penalty that motivates Self-1 to exert a low effort should be set to zero.

However, whether the penalty is set or not depends on the relative gain in utility that Self-0 would have resulting from using a commitment device. As Self-1 will always implement a high effort given the penalty  $\hat{m}$ , Self-0 decides whether or not to adopt the penalty scheme for the goal  $b_g$  knowing that using this commitment device is risky for herself. It may be the case that Self-0 will prefer to opt-out of this commitment mechanism as it is likely that the goal might not be achieved even though Self-1 has exerted the right level of effort. In order to quantify the risk involved in the use of a commitment device, one need to define  $P(b_g) \equiv \hat{m}(b_g)F(b_g|\bar{e})$  which is the expected penalty that the individual faces when she uses the penalty  $\hat{m}$ .

**Lemma 2 (The Expected Penalty)** *Let a goal  $b_g \in [\underline{b}, \bar{b}]$ . Under assumptions 1 and 2, the expected penalty  $P$  that the individual faces when she uses the optimal penalty scheme is monotonously increasing in the difficulty of the goal.*

*In addition, the limits of  $P$  when the goal tends to  $\underline{b}$ , or  $\bar{b}$  are 0, and  $+\infty$  respectively.*

*(Proof in Appendix)*

Figure I.2 displays an illustration of the expected penalty as function of the goal. The increasing pattern of the expected penalty with respect to the goal shows that even though the penalty amount is very large for "easy" goals, the expected penalty is negligible as the probability of goal failure is low. The "going all-in" strategy when the goal is "easy" is optimal from the view point of Self-0 since it forces Self-1 to exert a high effort for a very low risk.

The expected penalty increases when the goal becomes harder since both the penalty level and the likelihood of goal failure increase. Hence, it may be not optimal from the viewpoint of Self-0 to use a commitment device when the goal is too hard. This leads to the main following proposition of the theoretical model:

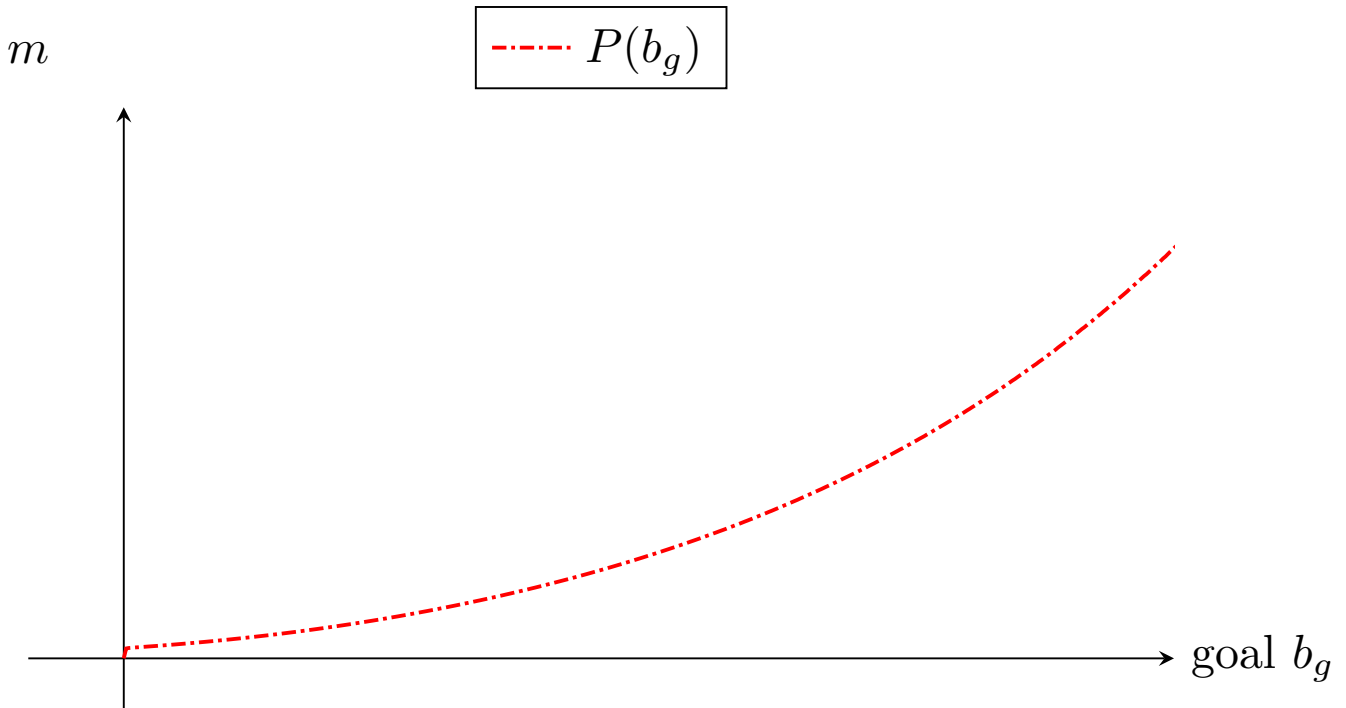
**Proposition 1 (The Optimal Commitment Penalty)** *Let a goal  $b_g \in [\underline{b}, \bar{b}]$ . Under assumptions 1 and 2, Self-0 implements a penalty  $\hat{m}(b_g, \beta)$  and Self-1 exerts a high effort if  $\Delta U_0 > \beta P(b_g, \beta)$ .*

*Otherwise, Self-0 does not implement a penalty and Self-0 exerts a low effort.*

*(Proof in appendix)*



Figure I.2: The expected penalty as function of the goal



**Note:** This graph illustrates the expected penalty  $P(b_g)$  as function of the goal. A higher goal implies a higher expected penalty with  $\lim_{b_g \rightarrow \bar{b}} = +\infty$ . For illustration purposes, this graph has been drawn by using exponential distributions for the low and high effort with  $\lambda_e = 3$  and  $\lambda_{\bar{e}} = 0.5$ .

Figure I.3 displays an illustration of the optimal self-imposed penalty described in proposition 1. As long as the difference in Self-0's utility resulting from a change in the effort level is higher than the discounted expected penalty, Self-0 will set the penalty  $\hat{m}$ . Recall that  $P(b_g)$  is monotonically increasing with respect to the goal  $b_g$ . Consequently, there exists a unique goal threshold beyond which Self-0 prefers to opt-out of the mechanism. This first proposition shows that commitments are not adopted when goals are too difficult.<sup>16</sup>

In terms of mechanism design, this section shows that if the goal associated with the commitment device is set exogenously by a third-party, the goal should be set at a moderate level for two reasons: first, there exists a goal for which the penalty set is minimal—and hence not costly for the

16. Note that this proposition can easily be extended to a more general case in which there is no intra personal conflict: even though Self-1 prefers a high effort as well, Self-0 can set a commitment device but the motivational penalty will be equal to zero.

individual—leading to an actual effort exertion. Second, if the goal is too hard, people will prefer to opt out.

### **The Impact of Present-Bias on Commitment Choice**

This subsection provides an analysis on how present-bias might affect penalty setting. More specifically, we investigate how present-bias affects the level of penalty and the goal threshold for which the individual opts-out.

**Proposition 2** *Under assumption 1 and definition 2, whereas highly present-biased individuals need higher penalties to exert a high effort for any goals, they opt-out of the commitment mechanism for easier goals.*

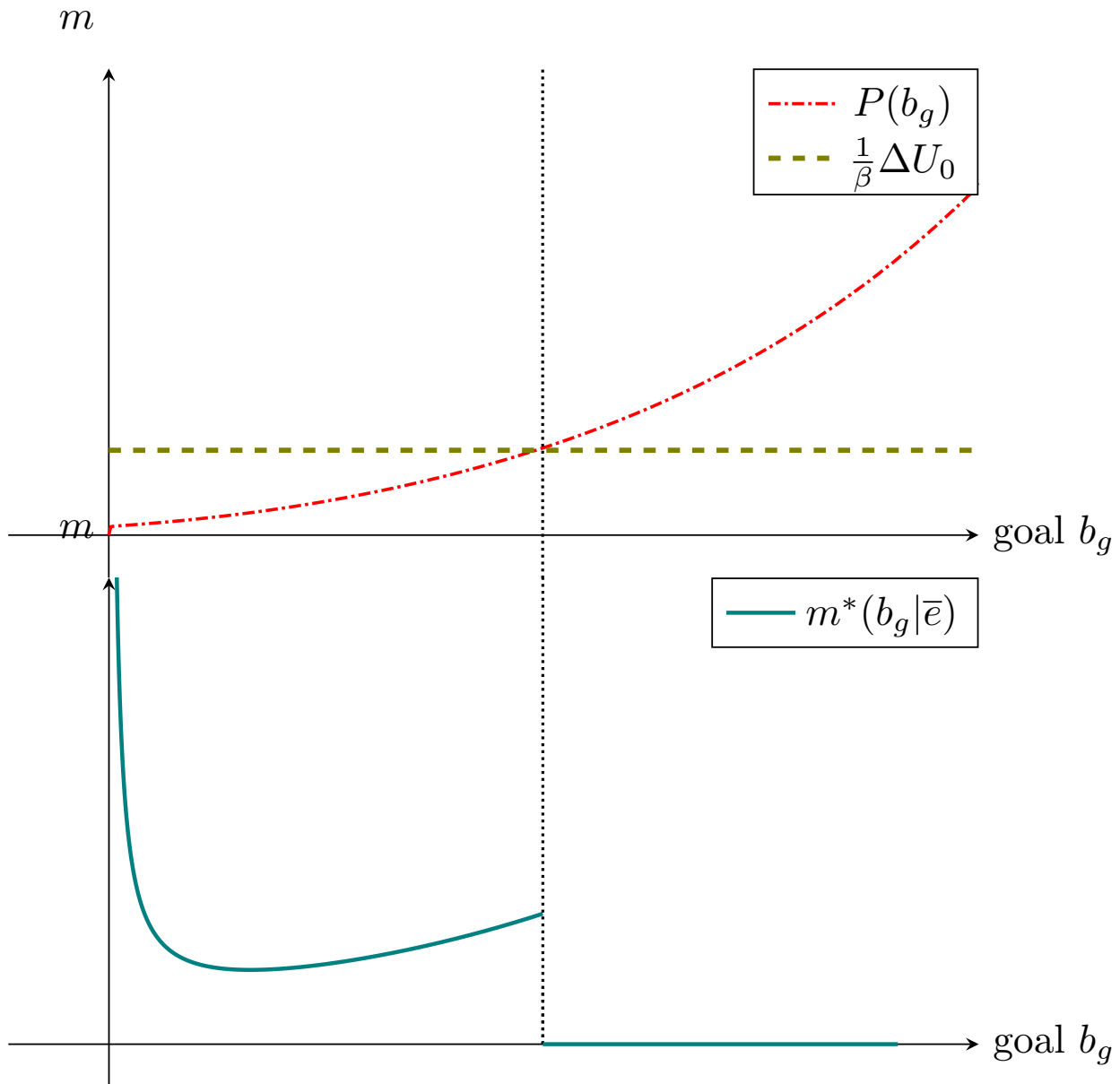
*(Proof in Appendix)*

Higher present-biased individuals need higher penalties to regulate their behaviour because the discounted cost of effort is larger from the viewpoint of Self-1. However, as present-bias increases the level penalty, the expected risk associated is also higher. Subsequently, the threshold goal for which the individual opts-out is lower meaning that highly present-biased individuals valued less commitment devices for easier goals.

This has important policy making implications for commitment devices designs. When present bias is too severe, individuals prefer not to commit since penalties that should be set to overcome time inconsistent behaviours must be very large.

The following section proposes extensions to the model presented above to take into account different psychological biases—more notably loss aversion and partial sophistication—that could affect the main results in the shape of the penalty function and the determinants of opting-out.

Figure I.3: The optimal Penalty Scheme as Function of the Goal



**Note:** This figure illustrates the optimal level of penalty that Self-0 as the result of the maximization process. In the first graph, I plotted the expected penalty function and the discounted difference of utility of Self-0. Proposition 1 shows that when  $\frac{1}{\beta}\Delta U_0$  is smaller than  $P(b_g)$ , the individual opts-out of the commitment device. The graph below displays the optimal level of penalty given this rule. When the individual opts-in, she sets  $\hat{m}(b_g)$ , otherwise, she sets 0. For illustration purposes, this graph has been drawn by using exponential distributions for the low and high effort with  $\lambda_e = 3$  and  $\lambda_{\bar{e}} = 0.5$ .

### 3.5. Extensions

#### Loss Aversion

In the previous section, I implicitly assumed that, without penalties, goals have no effect on the resolution of the intra-personal conflict. However, goals by themselves may be relevant to overcome time inconsistent behaviours as they could serve as reference points for individuals in a manner that is consistent with the value function of Prospect Theory (Kahneman and Tversky, 2013, Tversky and Kahneman, 1992, Kőszegi and Rabin, 2006). In particular, individuals can value differently benefits falling below or above the goal. This section presents the consequences of that additional behavioural mechanism on the previous framework. The new set-up is similar to the one described in the preceding section except that the individual will experience a psychological cost of falling short of the goal. In the new setting, the utilities of Self-0 and Self-1 are as follows:

$$U_0(e) = \beta \left[ -c(e) + \int_{\underline{b}}^{b_g} \lambda b f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \right] \quad (\text{I.12})$$

$$U_1(e) = -c(e) + \beta \left[ \int_{\underline{b}}^{b_g} \lambda b f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \right] \quad (\text{I.13})$$

where  $\lambda \leq 1$  is the loss aversion parameter accounting for an under-evaluation of any benefit that falls below the goal  $b_g$ .

The addition of loss aversion makes that the goal can influence Self-1's level of effort without penalties. First, for "easy" goals that can be achieved with low effort, the model remains unchanged as loss aversion has little influence on penalty levels. Assuming a high degree of loss aversion, there exists a goal interval for which both Self-0 and Self-1 will prefer to exert a high effort as the likelihood of goal success increases substantially when a high effort is exerted. Since Self-0 knows that there is no intra-personal conflict, she will not use the commitment device. However, when

goals become too hard, low effort will be preferred for both selves since the return of the effort will be negative for Self-0 and Self-1. The addition of the loss aversion parameter also mitigates the intra personal conflict but, this time, it is at the expense of the long-term objective.

By focusing only on situations wherein there is an intra-personal conflict, the utilities of Self-0 and Self-1 when they can use the commitment device are:

$$U_0(m, e) = \beta \left[ -c(e) + \mathbb{E}[b|e] - \lambda \mathbb{E}[m|e] + (\lambda - 1)\phi(b_g|e) \right] \quad (\text{I.14})$$

$$U_1(m, e) = -c(e) + \beta \left[ \mathbb{E}[b|e] - \lambda \mathbb{E}[m|e] + (\lambda - 1)\phi(b_g|e) \right] \quad (\text{I.15})$$

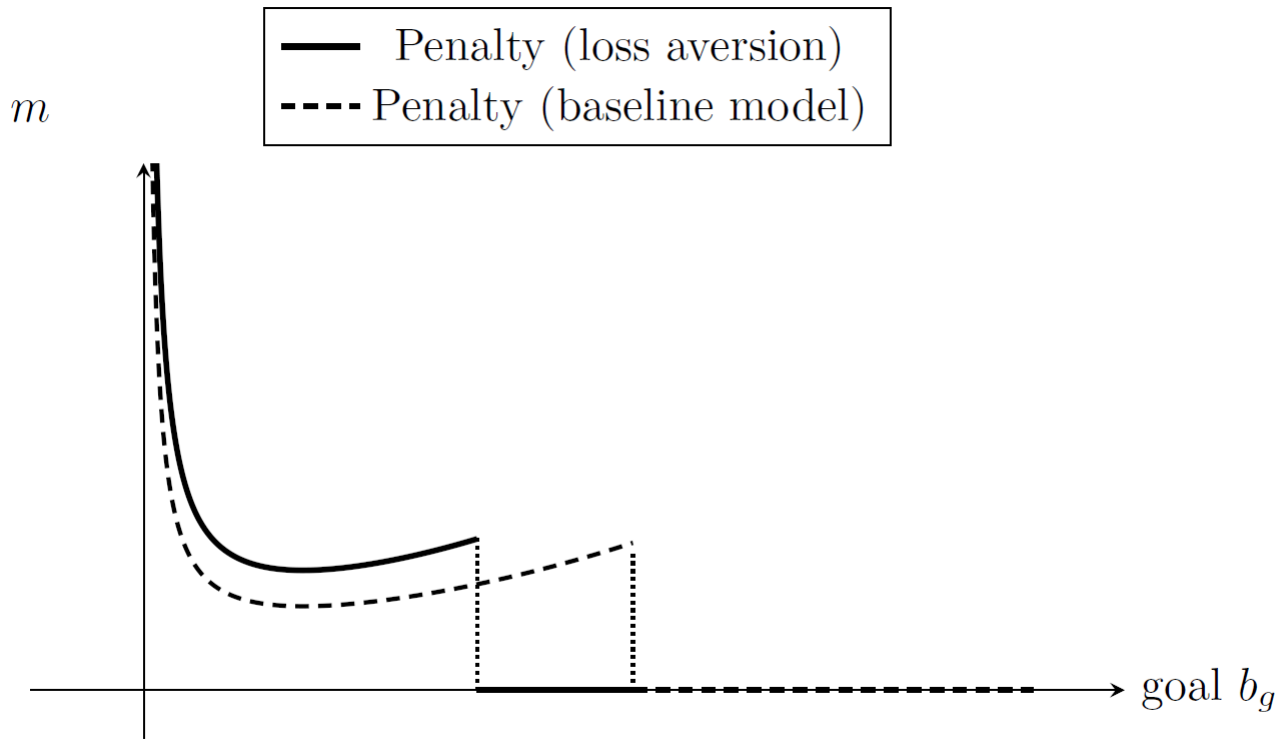
where  $\phi(b_g|e) = b_g F(b_g|e) - \int_{\underline{b}}^{b_g} F(b|e) db$ .

Results of the optimal penalty are detailed in appendix and are illustrated in Figure I.4. When loss aversion is taken into account in the model, the level of penalty should be greater to motivate Self-1 to exert the effort. This increase of the motivational penalty due to loss aversion will also increase the expected penalty that Self-0 will face when she commits. As a result, Self-0 will prefer to opt-out for easier goals.

### Partial Naiveté

In this section, I also propose an extension of the model by including partial naiveté. In this model, the individual knows she has a present-bias but she underestimates its magnitude (O'Donoghue and Rabin, 2001, DellaVigna and Malmendier, 2004). Formally speaking, partially naive individuals think erroneously that their level of present-bias is  $\tilde{\beta}$  with  $\tilde{\beta} \in [\beta, 1]$ . The difference between the perceived and the actual present-bias ( $\beta - \tilde{\beta}$ ) reflects the overconfidence about future self-control. In the extreme case, if  $\tilde{\beta} = \beta$ , the individual is perfectly sophisticated, that is, she knows she is time inconsistent, and she knows perfectly her degree of time inconsistency. This extreme case corresponds in fact to the main framework developed in this paper. In contrast, if  $\tilde{\beta} = 1$ , then the agent is perfectly naïve as she thinks erroneously that she has no present-bias while she has.

Figure I.4: Loss aversion in Commitments



**Note:** This graph illustrates the optimal level of penalty that Self-0 should set to Self-1. The bold line represents the optimal penalty level in the original model. The dashed line represents the optimal penalty level that takes into account loss aversion in the model. The optimal penalty scheme in the presence of loss aversion is higher when individuals opt-in and the threshold for opting-out is lower.

The addition of partial naiveté will not affect the intrapersonal conflict *per se* but it will affect Self-0 perception on whether there is an intrapersonal conflict. In particular, Self-0 thinks that Self-1's utility function is:

$$\tilde{U}_1(m, e) = -c(e) + \tilde{\beta} \left[ \mathbb{E}[b|e] - \mathbb{E}[m|e] \right] \quad (\text{I.16})$$

When there is actually an intrapersonal conflict, two cases arise due to Self-0's wrong perception of Self-1's utility. More formally, these situations can be expressed by the following conditions:

- **Case 1:** if  $\beta < \beta_{SC} < \tilde{\beta}$ , Self-0 thinks Self-1 wants to exert a high effort while Self-1 prefers to

shirk.

- **Case 2:** if  $\beta < \tilde{\beta} < \beta_{SC}$ , Self-0 knows that Self-1 wants to shirk

In Case 1, since Self-0 erroneously believes that Self-1 wants to exert a high effort, she will not implement the commitment device. However, In Case 2, Self-0 knows that Self-1 wants to shirk. Hence she might want to implement the commitment device. Results of the optimal penalty of Case 2 are detailed in the appendix and are illustrated in Figure 1.5. The wrong perception of Self-0 on Self-1's utility function will induce a systematic underestimation of the penalty that Self-0 should set to Self-1: the commitment device will be always too weak to motivate Self-1 to make an effort. In such a situation wherein the individual underestimates her present-bias, commitment devices are always detrimental to individuals as their plans to regulate their behaviour are systematically inefficient.<sup>17</sup> In addition to the inefficiency of the commitment device, the systematic underestimation of the penalty that Self-0 should set will also imply that she underestimates the risk involved in the commitment device. Hence, she will prefer to opt-out for harder goals compared to the situation in which her perception of utility's Self-1 is accurate.

This result has crucial implications for present-biased individuals who do not know precisely their degree of present-bias. First, the incorrect recalling of present-bias would induce some people to erroneously think that they are time consistent while they are not. Second, individuals in such a model are systematically worse off when they use commitment devices as they would always procrastinate to the task they are assigned to, even when they face a penalty.<sup>18</sup>

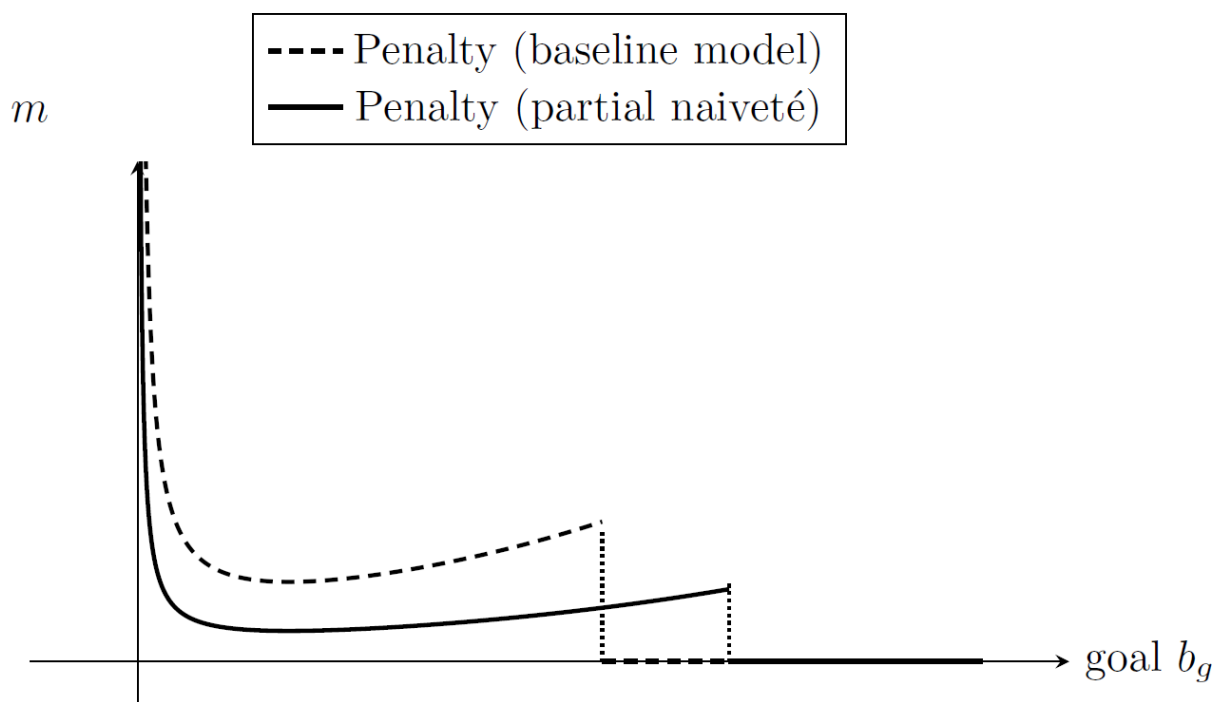
## 4. Experimental Design

This section presents an experimental study aiming to test two predictions of the model. First, it is tested whether self-inflicted penalties can be characterized by a quadratic function of goal dif-

17. It does not necessarily mean that they will always fail to reach their objective since the benefit is stochastic. However, it means that Self-1 will systematically exert a low effort.

18. As shown by DellaVigna and Malmendier (2004), monopolistic firms can exploit consumer's overconfidence to design contracts that would always end up in a failure, extracting therefore consumers' surplus.

Figure I.5: Loss aversion in Commitments



**Note:** This graph illustrates the penalty level that Self-0 set to Self-1. The bold line represents the optimal penalty level in the original model. The dashed line represents the actual penalty level that Self-0 set when she is partially naive. The penalty scheme in the presence of partial naiveté is lower when individuals opt-in and the threshold for opting-out is higher. However, The individual always underestimates her own time inconsistency, hence the penalty that the partial naive individual set is not optimal since the amount will not motivate Self-1 to exert a high effort.

difficulty. Second, I test whether present-bias elicited through monetary choices and psychometric scales can characterize self-inflicted penalties. This hypotheses testing relies on an experiment of commitment device choice for a weight-loss task with varying difficulty.

## Recruitment

Participants have been recruited from the pool of subjects of the Laboratoire d'Economie Experimentale de Paris (LEEP). Subjects that were recruited have a body mass index (BMI) between 25 and 35, have declared to be in good health and consider themselves to be above their ideal



weight.<sup>19</sup> One of my main challenge in the recruitment process was to avoid as much as possible selection bias consisting in recruiting only subjects that were already looking for an external device to lose weight. This selection bias would have induced an overestimation of commitment take-up rates as we would have departed from a more representative population of overweight individuals saying they have weight issues.<sup>20</sup> Subsequently, in order to participate to this experiment, subjects were required to first answer to an on line questionnaire asking for various information relevant for the inclusion mentioned above and also non-relevant information for the experiment.<sup>21</sup> The questionnaire was built in such a way that participants would not know precisely the nature of the experiment. When they were eligible to participate to the experiment, an invitation to a one month experiment—more precisely, two experimental sessions spaced one month apart occurring during mornings—was sent.<sup>22</sup>

Weight and height were assessed individually in a private room in which a weight scale and a height scale were installed. Subjects were asked to scale themselves wearing pants and light T-shirts.<sup>23</sup> Once the weigh-in has been performed, they were invited to wait in the computer room next door.

## The Penalty Scheme

Subjects were informed in the computer room that the purpose of the study was designed to shed light on the effect of monetary incentives on weight-loss goal setting. Participants were given

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19. In particular, the age inclusion criteria was 18 up to 55 years old. Exclusion criteria are conditions that would make participation unsafe (eg. consumption of >5 alcoholic drinks per day, myocardial infarction or stroke, metastatic cancer, diabetes, currently pregnant or breastfeeding). We choose people whose BMI was in between 25 and 35 to ensure that we end up with a homogeneous population as regards to a standardized weight measure and to ensure that all participants could safely lose at maximum three kilograms over a one month intervention.

20. Typically, we would have ended up with a very motivated population that would be familiar with such devices.

21. More specifically, they are asked their age, their self-assessed health, their weight and height and their potential willingness to lose weight along with other non-related weight-loss information. I also asked subjects about their quality of sleep, their use of social media, their educational achievement, if they own a Paypal or Amazon account

22. This was followed by an on line consent document informing them that some weight and height measures will be performed prior to the experimental session. Individuals had to agree on these terms to be invited to the experiment.

23. It was stressed that they should try to wear the same clothes for the forthcoming experiment to avoid systematic measurement error due to their clothing.

the opportunity to commit to weight-loss goals of varying difficulty with a self-inflicted penalty between 0 to 15 euros corresponding to their show-up fee of the second experiment. I used the strategy method to elicit the self-inflicted penalty they were willing to use in order to reach various goals from 1 to 3 kilograms, increasing by a 0.5 kg increment.<sup>24</sup> This method is incentive compatible as a random goal was selected at the end of the first session determining how much they should lose for the second experiment under their self-incurred penalty. Subjects were also told that they could opt-out by choosing the value of 0 euros for any goal. The penalty would not be implemented if they met or exceeded the assigned weight loss goal.

## Measuring Present-Bias

In the first session, time preferences were elicited using Andreoni Kuhn and Sprenger's methodology (Convex time budget). Subjects had to allocate a budget of 20 euros at two different dates between a "sooner smaller" (SS) amount and a "later larger" (LL) amount. In each decision, I change the interest rate and the dates of the "sooner" and the "later" payment. Only six options per decision are proposed to subjects for the allocation to simplify the task. These six options represent different convex allocations between the SS and the LL reward. Table I.B.1 summarizes the parameters of the intertemporal choice task of the experiment. each cluster of seven choice corresponds to a fixed starting date  $t$  and delay  $k$  whereby I only change the interest rate parameters  $1 + r$  that can take the value 1, 1.11, 1.18, 1.25, 1.43, 1.82 or 2.22. The budget to be allocated is always equal to 20 for all decisions and the maximum LL reward is always fixed to 20. However, the maximum SS reward decreases with the interest rate. Details on the estimation methodology are provided in the appendix.

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24. We also asked whether people wanted to use a commitment device for goals for 0 and 0.5kg. However, these goals are difficult to exploit as a large majority of subjects used self-inflicted penalties of either 0 or 15 euros.

## Psychometric Scales of Time Orientation

I also measure time perspective using psychometric scales such as the Barratt impulsiveness scale (BIS-11) and the questionnaire of considerations for future consequences (CFC-14).

The French CFC-14 (Camus, Berjot and Ernst-Vintila, 2014) is composed of 14 items on which participants had to rate each item on a Likert scale ranging from 1 (*the statement is extremely uncharacteristic of me*) to 7 (*the statement is extremely characteristic of me*). Recent research favors to distinguish two subscales of 7 items each, one tapping consideration of immediate consequences,<sup>25</sup> the other tapping consideration of future consequences.<sup>26</sup>

The French BIS-11 (Rousselle and Vigneau, 2016) is composed of 30 items. For each item, subjects must answer using a four-point frequency scale: *rarely or never*; *occasionally*; *often*; *almost always*; or *always*. The items in the questionnaire can be grouped into three types of impulsivity, each type also consisting in two subscales: nonplanning impulsiveness (self-control and cognitive complexity) refers to an absence of future planning ; motor impulsiveness (motor and perseverance) refers to a tendency to act without thinking ; and attentional impulsiveness (attention and cognitive instability) refers to the tendency to make quick decisions.

Finally, I use an ultra-short measure for impulsiveness and patience that are extensively used in large-scales surveys (Vischer et al., 2013). Participants have to rate their degree of impulsiveness and patience on a 10-point Likert scale.

### 4.1. Descriptive Statistics

#### Socio-demographic Characteristics

44 individuals participated in this experiment (30 females, mean age=37.47). Their initial average BMI was 28.44 (sd=2.37). Participants self-reported that they would like to lose 5.88kg on average to be at their ideal weight. 7 individuals did not come during the second session of the

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25. Examples of items are "*I only act to satisfy immediate concerns, figuring the future will take care of itself*" and "*My behaviour is only influenced by the immediate outcomes of my actions*"

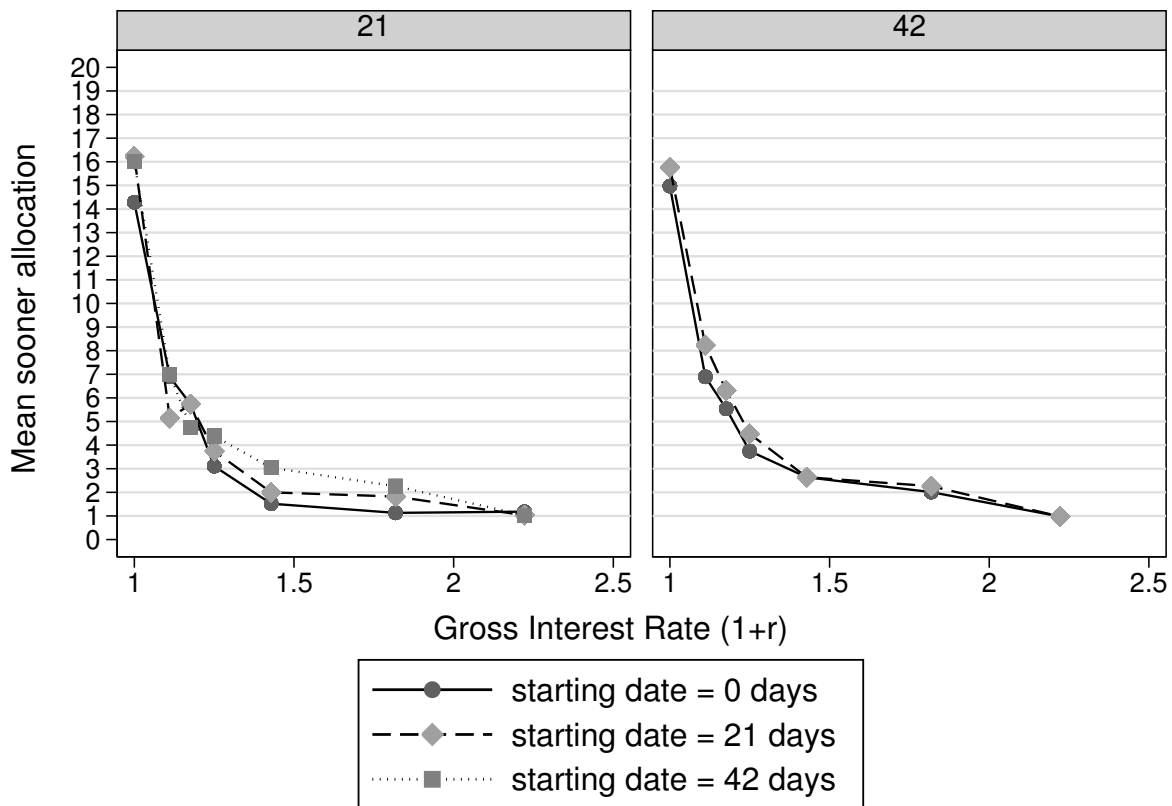
26. Examples of items are "*I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes*" and "*when I make a decision, I think about how it might affect me in the future*".

experiment. As a result, 37 individuals answered the CFC-14 and the Likert-Scale.

**Elicitation of Time Preferences**

Figure I.6 represents the mean allocation of earlier money against the gross interest rate  $(1 + r)$  of each CTB decision. I plot separate points for the three starting dates  $t$  ( $t=0, 21, 42$  days), and separate graphs for the two delays  $k$  ( $k=21, 42$ ).

Figure I.6: Mean Sooner allocation



Graphs by delay ( $k=21$  or  $k=42$ )

**Note:** This figure plots the mean sooner allocation against the gross interest rate,  $(1 + r)$ , of each CTB decision. We plot separate points for the three experimental values of the sooner date  $t$  ( $t = 0, 21, 42$  days) and separate graphs for the three experimental values of delays  $k$  ( $k = 21$  or  $42$  days).

At each delay, the mean amount allocated to the sooner payment declines monotonically with the interest rate which is consistent with discounting behaviour. The average earlier payment is

constant across starting dates suggesting that participants are on average time consistent in the domain of money.<sup>27</sup>

The main estimation of the structural model of quasi-hyperbolic discounting is reported in Table I.1. It provides aggregate estimates of the curvature of the utility function  $\alpha$ , present-bias  $\beta$  and the exponential discount factor  $\delta$  using non linear least squares estimation (NLS).<sup>28</sup> The elicited discount factor  $\delta$  equals 0.997 which is significantly different from 1 ( $p < 0.00$ ). On average, participants exhibit a relatively high impatience preferring outcomes at the sooner date.<sup>29</sup> Aggregate curvature is estimated at  $\hat{\alpha} = 0.899$  ( $se = 0.015$ ) significantly different from 0 ( $p < 0.00$ ). No evidence for present-bias is found at the aggregate level as I cannot reject the hypothesis that  $\beta = 1$  ( $\chi^2$ -test,  $p = 0.3695$ ).

Table I.1: Aggregate Utility Parameter Estimates

	Sooner Choice (NLS)
Present-Bias: $\beta$	1.011*** (0.014)
Daily Discount Factor: $\delta$	0.997*** (0.000)
CRRA Curvature: $\alpha$	0.899*** (0.015)
Clusters	35
Obs	1225

**Note:** This table presents the estimates of aggregate preferences parameters resulting on the CTB decisions using the demand function I.21. Standard errors clustered at the individual level are displayed in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Time preferences can also be estimated at the individual level. Table I.2 presents the elicited values of the time preferences and curvatures parameters. Although aggregate results suggest that

27. *De visu* evidence for present bias or hyperbolic discounting at the aggregate level would have been observed in the graph if a difference in the mean level of sooner allocation comparing starting date  $t = 0$  and  $t = 21, 42$  was noticeable.

28. Standard errors are clustered at the individual level.

29. Such a discount factor can be expressed as a discount rate using the formula  $r = \delta^{-365} - 1$  that yields a discount rate of  $r = 1.724$ .

Table I.2: Individual Discounting, Present Bias and Curvature Parameter Estimates

	N	Median	5th Percentile	95th percentile	Min	Max
Present-Bias: $\hat{\beta}$	35	1.00	0.78	1.62	0.77	1.95
Daily Discount Factor: $\hat{\delta}$	35	1.00	0.98	1.01	0.97	1.01
CRRRA Curvature: $\hat{\alpha}$	35	0.92	0.42	1.00	-.14	1.00

**Note:** This table represents the descriptive statistics of the time discounting parameters  $\hat{\beta}$ ,  $\hat{\delta}$  and  $\hat{\alpha}$  estimated at the individual level. I used the CTB elicitation techniques with a quasi-hyperbolic and CRRRA specification.

individuals appear time consistent, the distribution of the present-bias parameter display individual heterogeneity. 22 individuals have an estimated present-bias that is significantly smaller than one. However, 13 individuals can be categorized as future-biased as their estimated present-bias parameters are larger than unity. Although this results are difficult to reconcile with the theoretical model, this heterogeneity in present-bias is exploited to attempt to explain the variability in the self-inflicted penalty choices.

A convergent validity of the intertemporal preference measures is also performed using the psychometric scales in which I study correlations between the elicited model parameters and the psychometric measures described above that are supposed to measure the same theoretical construct. Results and a detailed discussion is provided in the appendix. Overall, I find that the CTB estimates are poorly correlated with the psychometric scales which casts some doubt on the ability of the elicited parameters of discounting to predict field behaviours. Nevertheless, psychometric scales are still relevant to determine whether present-biased (measured through impulsiveness and consideration for immediate consequences) are good predictors of commitment device choices.

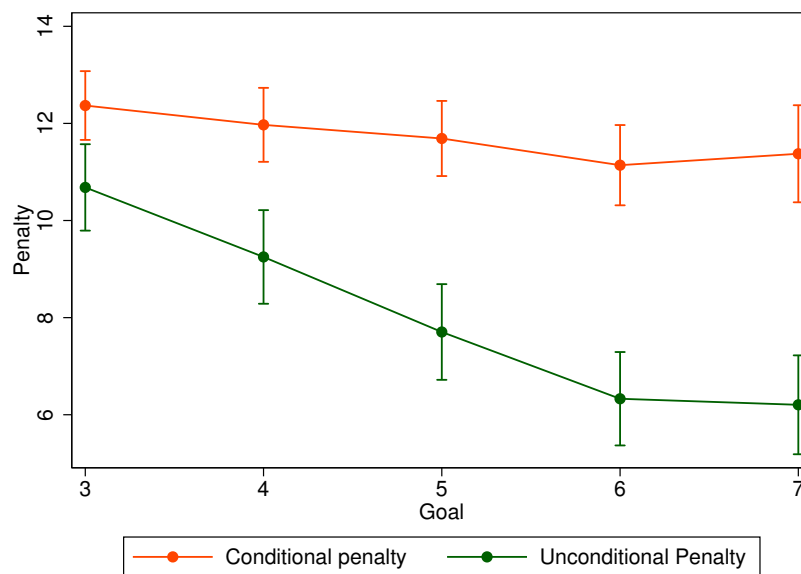
## 4.2. The Penalty Function

### The Impact of Goals on Self-Inflicted Penalty

Figure I.7 plots the average level of self-inflicted penalty set by participants on the completion of weight-loss goals ranging from 1 to 3 kilograms. The decreasing line at the bottom of the figure is the unconditional penalty line corresponding to the average penalty for which null-penalties

are taken into account. Self-inflicted penalty is decreasing with goal difficulty and converges to six euros for harder goals. However, this decreasing relationship between penalties and goals may result from opting-out as the difficulty of the goal increases. Indeed, when penalties of zero—which are interpreted here as opting-out observations—are not taken into account, the average level of penalty tends to be constant over goal difficulty. As most of the variability of the self-imposed penalty is driven by opting-out, it suggests that the relevant outcome to be examined in this sample is not the self-imposed penalty itself but opting-out of the commitment device.

Figure I.7: Mean Penalty as Function of Goals



**Note:** This graph represents the average penalty set by participants for the weight-loss task as function of the weight-loss goal from 1 kilogram to 3 kilograms. Conditional penalty corresponds to the average penalty level after removing penalties that equals 0. Unconditional penalty corresponds to the average penalty that takes into account the zeros. Bars represent the 95% confidence interval.

Still, the relationship between self-imposed penalty and goals is examined more carefully with OLS regressions to test whether goal difficulty has an effect on self-inflicted penalty. Table I.3 displays the results of two OLS specifications—a linear and a quadratic specification of goal difficulty on penalty—on the whole sample in column (1) and (2), and on the sample excluding zero level

penalties in column (3) and (4).<sup>30</sup> When zero level penalties are included, the goal is significantly correlated with the penalty level on both specifications. No significant correlation is found for the goal squared suggesting that the the decreasing relationship between penalty and goal may be linear. But again, if we exclude opting-out, the coefficient associated to the difficulty of the goal is not significant anymore. This relationship (or lack thereof) between penalty and goal provides another strand of evidence that variation in self-inflicted penalty is mainly influenced by opting-out for hard goals.

Table I.3: Penalty Size and Goals

VARIABLES	(1) Penalty (including opt-out)	(2) Penalty (including opt-out)	(3) Penalty (excluding opt-out)	(4) Penalty (excluding opt-out)
<i>Goal</i>	-1.19*** (0.35)	-3.18** (1.52)	-0.29 (0.32)	-0.98 (1.46)
<i>Goal</i> <sup>2</sup>		0.12 (0.15)		0.06 (0.15)
Constant	13.97*** (1.87)	18.55*** (3.41)	13.16*** (1.59)	14.60*** (3.19)
Observations	220	220	150	150

**Note:** This table represents OLS regressions of penalty choice on the goal and its quadratics on two samples. Column (1) and (2) are regressions for observations with 0 included. Column (3) and (4) are regressions excluding the non participation (where the penalty is set to 0) Bootstrapped and individual clustered standard errors are displayed in parentheses and \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

### Predicting the Probability to Opt-out through Time Orientations Measures

Since self-inflicted penalty appears relatively constant with respect to the goal when opting-out taken into account, a remaining question at this stage is whether present-bias—elicited through monetary discounting and psychometric scales—predicts the probability to opt-out of the commitment device. Several probit regressions are performed to estimate the marginal effects of a particular present-bias measure on the probability to opt-out. Bootstrapping methods were employed

30. Bootstrapping methods are employed for both sets of regressions in order to estimate the standard errors that have been clustered by subjects.



to estimate standard errors. Some other scales measuring future orientation are also reported as falsification tests since it is unlikely—based on my theoretical model—that future orientation play a significant role in the probability to opt-out.<sup>31</sup>

Figure I.8 displays the marginal effect of the scores for the CFC scale on the probability of opting-out at a given level of difficulty. Consistent with the theoretical model, participants who are present-oriented are more likely to opt-out when goals are hard. A one unit increase of the immediate subscale score is associated with 12% increase of the probability of opting-out when the goal is 2.5 kilograms, and a 13% increase when the goal is 3 kilograms. These results are significant at the 5% level. No significant effect of the score the future subscale is found for any goal difficulty providing by contrast evidence of the relevance of the consideration for immediate subscale to understand commitment opting-out.

Figure I.9 presents the marginal effects of scores of patience and impulsivity measured through Likert scales on the probability to opt-out. Participants who considered themselves as impulsive are more likely to opt-out when the goal is 3 kilograms. More specifically, a one unit increase of the impulsivity score is associated with a 5% increase of the probability to opt-out, which is consistent with the previous result found with the CFC subscale. No significant marginal effect is found for patience, measured on a 10-point Likert scale which is consistent with our theoretical prediction.

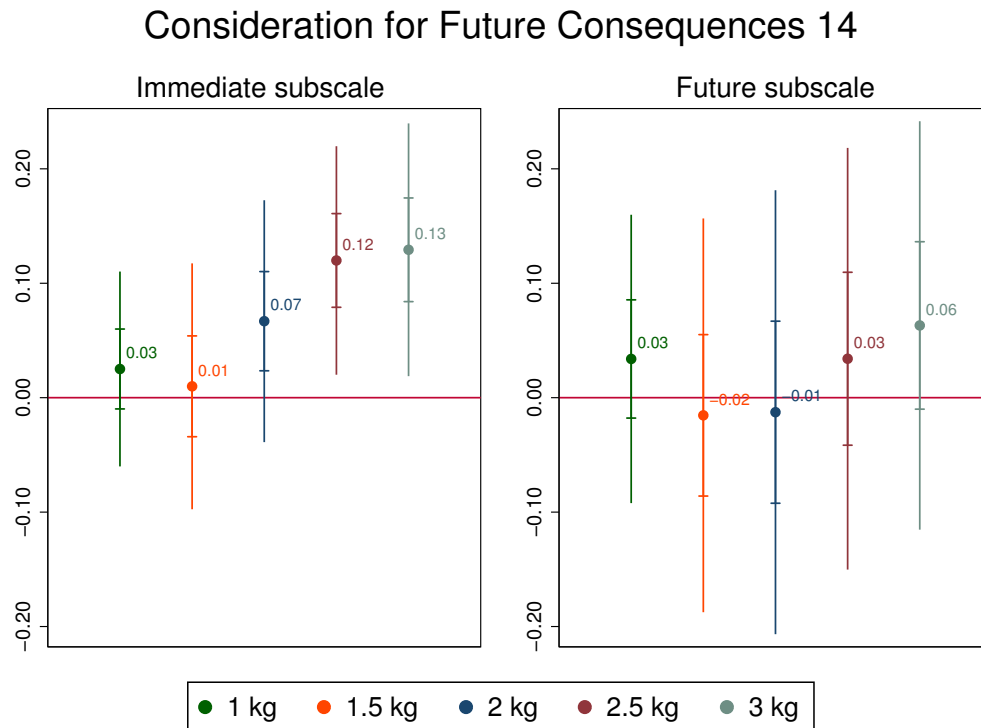
The same set of regression is performed for the different subscales of the BIS-11 in Figure I.10. The only significant marginal effect that is found is on the nonplanning subscale. A one unit increase of the score of the tolerance for cognitive complexity is associated with a 4% decrease of opting-out suggesting that self-inflicted penalty might be a complex mechanism to overcome time inconsistent behaviours.

Finally, the effect of present bias from the CTB method is investigated in Figure I.11, although there are some reasons to suspect that the elicited parameters time preferences may not be appropriate to study commitment choices given the poor convergent validity of the parameters. Indeed, no significant marginal effect is found for the parameters of present-bias and discount factor,

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31. For instance, I use patience-trait which is measured with the Likert scale, the subscale of consideration for future consequences, and the discount factor from the CTB method.

Figure I.8: Marginal effects of CFC scores on the probability of opting-out



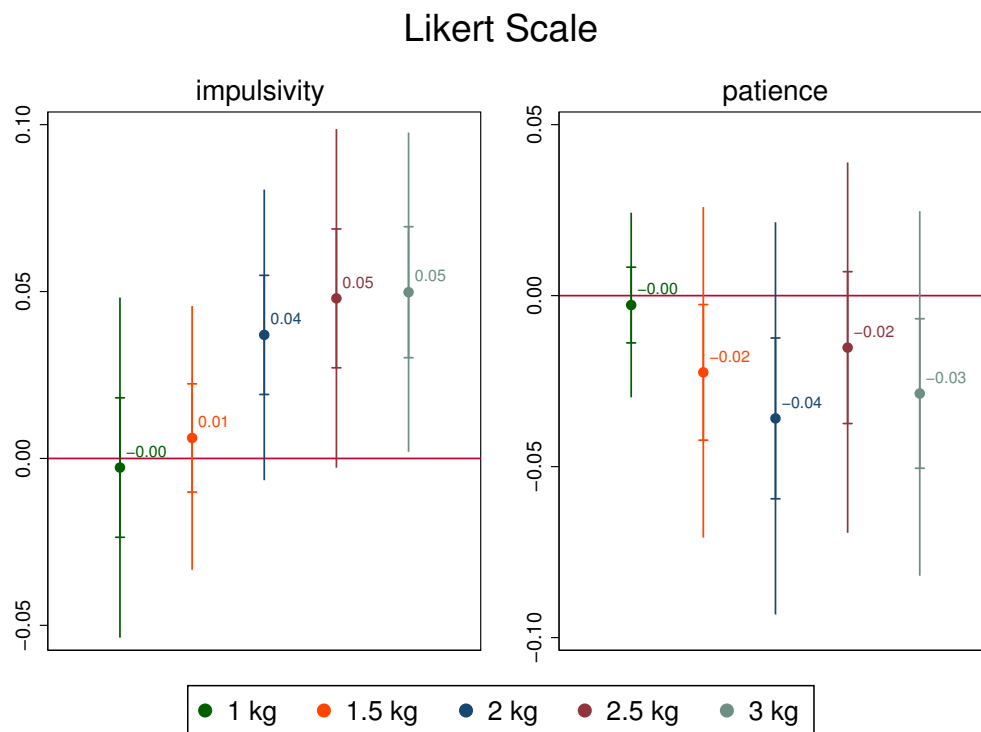
**Note:** This figure presents the marginal effects from the probit regression of the probability of opting-out at different goal levels on the consideration for future consequences (CFC-14) scores. Subscales of the CFC-14 consists in the consideration for immediate consequences (immediate subscale) and the consideration for future subscale (future subscale). Bootstrapping methods were employed to estimate standard errors. Vertical lines correspond to 90% confidence interval.

which confirming our doubts on the external validity of those time preferences measurements.

## 5. Conclusion

This paper investigates the psychological determinants of the willingness to accept a commitment device when the individual suffers from present-bias. While the theoretical results of the penalty function is robust to loss aversion and partial naiveté, the inclusion of these additional psychological mechanisms are important to my view. First, the addition of loss aversion in the model suggests that very specific individuals might be actually willing to use self-inflicted penal-

Figure I.9: Marginal effect of impulsivity and patience scores on the probability of opting-out

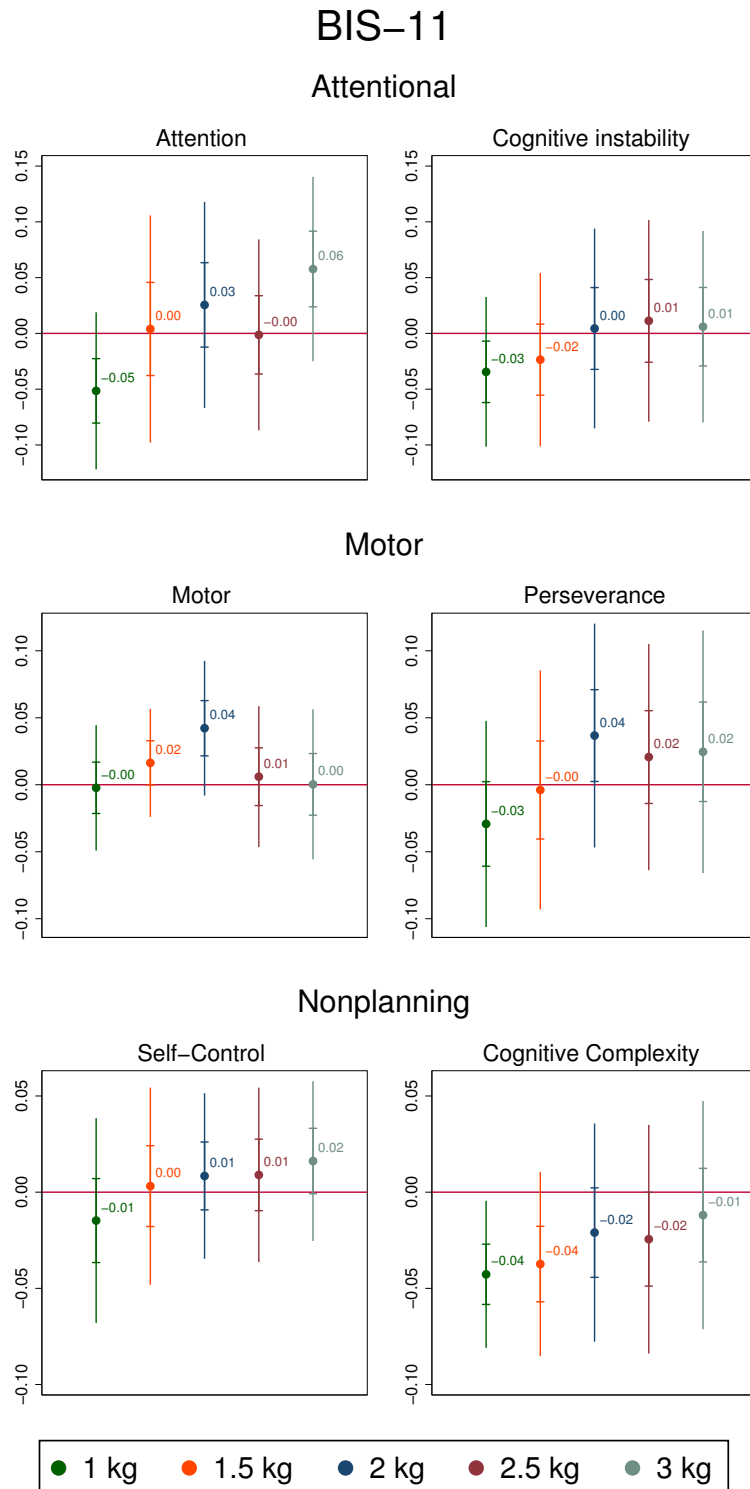


**Note:** This figure presents the marginal effects from the probit regression of the probability of opting-out at different goal levels on the scores of patience and impulsivity measured using a Likert scale. Bootstrapping methods were employed to estimate standard errors. Vertical lines correspond to 90% confidence interval.

ties as commitment devices since higher levels of present-bias are required to generate an intrapersonal conflict when agents are loss averse. In addition, individuals opt out of the mechanism if present-bias is too severe. Hence, the inclusion of loss aversion restricts dramatically the interval of present-bias individuals for which the commitment device may help them to overcome time inconsistency issues. The addition of partial naiveté in the model appears even more problematic since commitments are always welfare reducing when people underestimate their own time inconsistency.

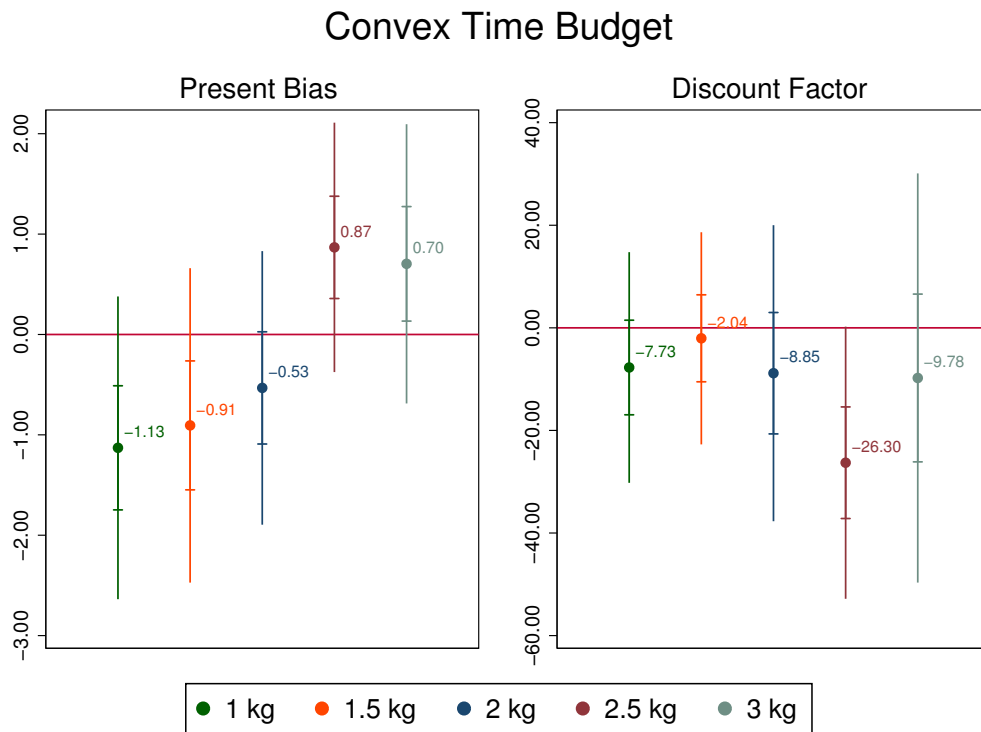
The experimental pilot attempted to provide an illustration of the problem described in the theoretical model through a weight-loss challenge. Because I needed very specific individuals to conduct my experiment, the inclusion criteria made that the resulting sample size is low. A larger sample size would have been relevant to study the relationship between time orientations through psychometric scales and commitment. Yet, the experimental pilot provides encouraging results. Although no impact of the goal was found on self-inflicted penalty because most of its variation is due to opting-out, significant relationships have been found between opting-out and present-bias when goals are difficult as it is predicted by the theoretical model.

Figure I.10: Marginal effects of BIS-11 scores on the probability of opting-out



**Note:** This figure presents the marginal effects from the probit regression of the probability of opting-out at different goal levels on the scores of the BIS-11 subscales. The subscale of the BIS are attention and cognitive instability, measuring attentional impulsiveness; motor and perseverance, measuring motor impulsiveness; and self-control and cognitive complexity, measuring nonplanning impulsiveness. Bootstrapping methods were employed to estimate standard errors. Vertical lines correspond to 90% confidence interval.

Figure I.11: Marginal effects of the CTB parameters on the probability of opting-out



**Note:** This figure presents the marginal effects from the probit regression of the probability of opting-out at different goal levels on the present-bias and discount factor elicited through the Convex time budget method. Bootstrapping methods were employed to estimate standard errors. Vertical lines correspond to 90% confidence interval.



# Appendix

## I.A. Proofs of the Model of Commitment Choice

### Proof of Lemma 1

I determine the penalty level for which the incentive constraint in equation I.11 is binding. Formally,  $\hat{m}$  is:

$$\hat{m} = \left\{ \inf m \geq 0 : U_1(\bar{e}, m) - U_1(\underline{e}, m) \geq 0 \right\}$$

Solving the inequality for a level of  $m$  yields:

$$\begin{aligned} U_1(\bar{e}, m) - U_1(\underline{e}, m) &\geq 0 \\ \Leftrightarrow -c + \beta \left[ \mathbb{E}[b|\bar{e}] - mF(b_g|\bar{e}) \right] - \beta \left[ \mathbb{E}[b|\underline{e}] - mF(b_g|\underline{e}) \right] &\geq 0 \\ \Leftrightarrow -c + \beta \Delta \mathbb{E}[b] + m\beta \left( F(b|\underline{e}) - F(b|\bar{e}) \right) &\geq 0 \\ \Leftrightarrow m \geq \frac{-c + \beta \Delta \mathbb{E}[b]}{\beta \left( F(b|\underline{e}) - F(b|\bar{e}) \right)} &\equiv \hat{m}(b_g, \beta) \end{aligned}$$

$\hat{m}$  can be derived with respect to the goal  $b_g$  in  $[\underline{b}, \bar{b}]$

$$\frac{\partial \hat{m}}{\partial b_g} = \frac{\left( -c + \beta \Delta E(b|e) \right)}{\beta \left( F(b_g|\bar{e}) - F(b_g|\underline{e}) \right)^2} \left( f(b_g|\bar{e}) - f(b_g|\underline{e}) \right)$$

$-c + \beta \Delta E(b|e) < 0$  and  $\beta \left( F(b_g|\bar{e}) - F(b_g|\underline{e}) \right)^2$  is positive. Therefore, the sign of  $m_{min}$  depends on  $f(b_g|\bar{e}) - f(b_g|\underline{e})$ , that is the relative position of the ratio  $\frac{f(b_g|\bar{e})}{f(b_g|\underline{e})}$  compared to 1.

From assumption 1, we know that there exists a unique  $b^*$  such that for all  $b_g < b^* \frac{f(b_g|\bar{e})}{f(b_g|\underline{e})} < 1$  and for all  $b_g > b^* \frac{f(b_g|\bar{e})}{f(b_g|\underline{e})} > 1$ . Therefore, for all  $b_g < b^*$ ,  $\hat{m}(b_g)$  is strictly decreasing in  $b_g$  and for all  $b_g > b^*$   $\hat{m}(b_g)$  is strictly increasing in  $b_g$  and  $\hat{m}(b^*)$  is the minimal penalty level for any goal.



## Proof of Lemma 2

We want to show that  $\frac{\partial P(b_g)}{\partial b_g} > 0$  when  $P(b_g)$  is the expected penalty:

$$\begin{aligned} P(b_g) &= \hat{m}F(b_g|\bar{e}) \\ &= \frac{-c + \beta\Delta E(b|e)}{\beta(F(b_g|\bar{e}) - F(b_g|\underline{e}))} F(b_g|\bar{e}) \end{aligned}$$

Straightforward calculations show:

$$\Rightarrow \frac{\partial P(b_g)}{\partial b_g} = \frac{-c + \beta\Delta E(b|e)}{\beta} \frac{f(b_g|\bar{e})(F(b_g|\bar{e}) - F(b_g|\underline{e})) - F(b_g|\bar{e})(f(b_g|\bar{e}) - f(b_g|\underline{e}))}{(F(b_g|\bar{e}) - F(b_g|\underline{e}))^2}$$

We know that  $\frac{-c + \beta\Delta E(b|e)}{\beta} < 0$  because of equation I.7. Therefore, the sign of the derivative of the expected penalty depends solely on the sign of  $f(b_g|\bar{e})(F(b_g|\bar{e}) - F(b_g|\underline{e})) - F(b_g|\bar{e})(f(b_g|\bar{e}) - f(b_g|\underline{e}))$ .

The derivative of  $P(b_g)$  is positive if and only if:

$$\begin{aligned} f(b_g|\bar{e})(F(b_g|\bar{e}) - F(b_g|\underline{e})) - (f(b_g|\bar{e}) - f(b_g|\underline{e}))F(b_g|\bar{e}) &< 0 \\ f(b_g|\bar{e})(F(b_g|\bar{e}) - F(b_g|\underline{e}) - f(b_g|\bar{e})) + f(b_g|\underline{e})F(b_g|\bar{e}) &< 0 \\ -f(b_g|\bar{e})F(b_g|\underline{e}) + f(b_g|\underline{e})F(b_g|\bar{e}) &< 0 \\ f(b_g|\underline{e})F(b_g|\bar{e}) &< f(b_g|\bar{e})F(b_g|\underline{e}) \\ \frac{f(b_g|\underline{e})}{F(b_g|\underline{e})} &< \frac{f(b_g|\bar{e})}{F(b_g|\bar{e})} \quad (\text{RHRD}) \end{aligned}$$

The ratio  $\frac{f(b_g|\underline{e})}{F(b_g|\underline{e})}$  is called the reverse hazard rate function corresponding to the probability of observing a benefit in a neighborhood of  $b_g$ , conditional on the outcome being no more than  $b_g$ .

The reverse hazard rate function is implied by the MLRP condition 1, therefore:

$$\frac{\partial P(b_g)}{\partial b_g} > 0 \quad \text{for all } b_g \in [\underline{b}; \bar{b}] \quad (\text{I.17})$$

### Proof for Proposition 1

Self-0 will implement the penalty if and only if her utility of implementing the penalty  $\hat{m}$  and having a high effort exerted exceeds her utility from not implementing the penalty and having a low effort exerted. More formally:

$$\begin{aligned} U_0^m(\hat{m}) &> U_0^m(0) \\ \beta \left[ -c + \mathbb{E}[b|\bar{e}] - P(b_g, \beta) \right] &> \beta \mathbb{E}[b|\underline{e}] \\ \Delta U_0 &> \beta P(b_g, \beta) \end{aligned}$$

$\Delta U_0$  is a positive constant term. Under lemma 2, the function  $P(b_g, \beta)$  is continuous and monotonously increasing in  $b_g$  in  $[\underline{b}, \bar{b}]$ . In addition, its limits when  $b$  tends to  $\underline{b}$  or  $\bar{b}$  are 0 and  $+\infty$  respectively. Hence, we can use the intermediate value theorem stating that there exists a unique threshold  $b^{optout}$  such as, the individual will commit for goals  $b < b^{optout}$

## Proof for proposition 2

$$\begin{aligned}
\frac{\partial \hat{m}}{\partial \beta} &= \frac{\Delta E(b|e)\beta(F(b|\bar{e}) - F(b|\underline{e})) + c(F(b|\bar{e}) - F(b|\underline{e})) - (F(b|\bar{e}) - F(b|\underline{e}))\beta\Delta E(b|e)}{\left(\beta(F(b|\bar{e}) - F(b|\underline{e}))\right)^2} \\
&= \frac{(F(b|\bar{e}) - F(b|\underline{e}))c}{\left(\beta(F(b|\bar{e}) - F(b|\underline{e}))\right)^2} \\
&= \frac{c}{\beta^2(F(b|\bar{e}) - F(b|\underline{e}))} < 0
\end{aligned}$$

Furthermore, the opting-out goal threshold  $\tilde{b}$  is given by the following equation:

$$\begin{aligned}
1 - \frac{F(b_g|\underline{e})}{F(b_g|\bar{e})} &= \frac{\Delta U_1(e)}{\Delta U_0(e)} \\
1 - \frac{F(b_g|\underline{e})}{F(b_g|\bar{e})} &= \frac{-c + \beta\Delta E(b|e)}{\beta(-c + \Delta E(b|e))}
\end{aligned}$$

Since the derivative of the right-hand side of the equation with respect to  $\beta$  is :

$$\frac{\partial}{\partial \beta} \frac{\Delta U_1(e)}{\Delta U_0(e)} = \frac{-c(c + \Delta E(b|e))}{\beta^2(-c + \Delta E(b|e))^2} < 0$$

Thus, when  $\beta$  increases, the right hand side of the equation decreases. Therefore, the threshold  $\tilde{b}$  must be lower as  $\beta$  increases.

## Loss Aversion

In the previous section, I consider a problem of goal setting with the help of an external commitment assuming that the goal by itself serves no role in the setting of the analysis. The goal may however serves as a reference point for the individual who do not attribute the same values to outcomes above or below the reference point. The setup is similar to the one described in the

preceding section except that the individual will experience a psychological cost of falling short of the goal represented by the loss aversion parameter  $\lambda \leq 1$ .

Let  $g(\cdot)$  be the new benefit function that depends on the goal. In the new setting, every benefit below  $b^*$  is underweighted by  $\lambda$  in the utility as follows:

$$g(e, b_g) = \lambda \int_{\underline{b}}^{b^*} b f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \quad (\text{I.18})$$

$$= E(b|e) + (\lambda - 1)\phi(b_g|e) \quad (\text{I.19})$$

where (I.19) uses integration by part and  $\phi(b_g|e) = b_g F(b_g|e) - \int_{\underline{b}}^{b_g} F(b|e) db$

I use this formulation as the benefit function can be re-expressed with the previous expected benefit independently of the loss aversion parameter. When  $\lambda = 1$  (ie. when there is no loss aversion), the benefit function is identical to the one presented in the previous section. The smaller  $\lambda$ , the higher the loss aversion. At this stage, comparative statics are helpful to give meaning of the impact of loss aversion on the model. Taking the benefit function at the lower bound of the distribution—*i.e.*, when the goal is  $\underline{b}$ —yields:

$$g(e, \underline{b}) = E(b|e)$$

meaning that the benefit when the goal is the easiest is identical to the benefit in the model without loss aversion. Conversely, taking the benefit function at the upper bound—*i.e.* when the goal is high—yields:

$$g(e, \bar{b}) = \lambda E(b|e)$$

which is the expectation of the benefit under-weighted by the loss aversion parameter as, for sure, the benefit will be below the goal.

Let's focus on the variation of the benefit function with respect to the goal. We have:

$$g(e, b_g) = \lambda \int_{\underline{b}}^{b_g} b f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db$$

Let  $h(b) = b f(b|e) \forall b \in [\underline{b}, \bar{b}]$ . Let's assume  $H$  is the primitive of  $h$ . Then:

$$\begin{aligned} g(e, b_g) &= \lambda [H(b_g^* | e) - H(\bar{b})] + [H(\bar{b}|e) - H(\underline{b}|e)] \\ &= (\lambda - 1)H(b_g | e) + H(\bar{b}) - H(\underline{b}|e) \end{aligned}$$

Taking the derivative of  $g$  with respect to  $b_g$  yields:

$$\begin{aligned} \frac{\partial g(e, b_g)}{\partial b_g} &= (\lambda - 1)h(b_g) \\ &= (\lambda - 1)b_g f(b_g) < 0 \end{aligned}$$

which is always negative.

In contrast to what was found previously the benefit function  $g()$  is function of the goal  $b_g$ : the higher the goal, the lower the benefit, as the effect of loss aversion will be more severe. This result suggests that the self-control problem could be mitigated without a commitment device as the difference between utilities of Self-0 and Self-1 when there is loss aversion is smaller.

Accounting for the new benefit function, utilities of Self-0 and Self-1 in the model are :

$$U_0(e, b_g) = \beta \left[ -c(e) + E(b|e) + (\lambda - 1)\phi(b_g|e) \right]$$

$$U_1(e, b_g) = -c(e) + \beta \left[ E(b|e) + (\lambda - 1)\phi(b_g|e) \right]$$

In the same way as in the original setup, we look at the two conditions generating a self-control problem.

Self-0 would prefer the high effort if and only if:

$$\begin{aligned}
 & U_0(\bar{e}, b_g) > U_0(\underline{e}, b_g) \\
 \Leftrightarrow & \beta \left[ -c + E(b|\bar{e}) + (\lambda - 1)\phi(b^*|\bar{e}) \right] > \beta \left[ E(b|\underline{e}) + (\lambda - 1)\phi(b_g|\underline{e}) \right] \\
 \Leftrightarrow & \beta \left[ -c + \Delta E(b|e) + (\lambda - 1)\Delta\phi(b_g|e) \right] > 0
 \end{aligned}$$

Including the loss aversion parameter into the model displays interesting results as the threshold used to determine whether Self-0 would like to exert a high effort is now function of the goal  $b^*$ . In order to fully determine the effect of the loss aversion parameter, I need to analyze the variations of  $\Delta\phi(b_g|e) = b^* \Delta F(b_g|e) - \int_{\underline{b}}^{b_g} \Delta F(b|e) db$

Using assumption (1), we know that for the easiest goal  $\underline{b}$ :

$$\begin{aligned}
 \Delta\phi(\underline{b}|e) &= \left( \underline{b} \left( F(\underline{b}|\bar{e}) - F(\underline{b}|\underline{e}) \right) - \int_{\underline{b}}^{\underline{b}} F(b|\bar{e}) - F(b|\underline{e}) db \right) \\
 &= 0
 \end{aligned}$$

and the hardest goal:

$$\begin{aligned}
 \Delta\phi(\bar{b}|e) &= \bar{b} \left( F(\bar{b}|\bar{e}) - F(\bar{b}|\underline{e}) \right) - \int_{\underline{b}}^{\bar{b}} F(b|\bar{e}) - F(b|\underline{e}) db \\
 &= - \left[ F(b|\bar{e}) - F(b|\underline{e}) \right]_{\underline{b}}^{\bar{b}} + \int_{\underline{b}}^{\bar{b}} b f(b|\bar{e}) - f(b|\underline{e}) db \\
 &= \Delta E(b|e) > 0
 \end{aligned}$$

Furthermore:

$$\begin{aligned}\frac{\partial \Delta \phi(b_g | e)}{\partial db_g} &= b_g \left( F(b_g | \underline{e}) - F(b_g | \bar{e}) \right) - \int_{\underline{b}}^{b_g} \left( F(b | \underline{e}) - F(b | \bar{e}) \right) db \\ &= b_g \left( f(b^* | \bar{e}) - f(b_g | \underline{e}) \right)\end{aligned}$$

We know that  $b_g$  is positive. Therefore, the sign of the derivative of  $\Delta \phi(e, b^*)$  depends solely on the sign of  $f(b_g | \bar{e}) - f(b_g | \underline{e})$ . Using assumption (1), we know that there exists a unique value  $B$  such that:

- For every  $b_g < B$ ,  $\frac{\partial \Delta \phi(b_g | e)}{\partial db_g} < 0$  hence  $\Rightarrow U_0(e, b_g)$  is increasing for all  $b_g \in [\underline{b}, B]$
- For  $b_g = B$ ,  $\frac{\partial \Delta \phi(b_g | e)}{\partial db_g} = 0$ , hence  $U_0(e, b_g)$  is maximum in  $b_g = B$
- For every  $b_g > B$ ,  $\frac{\partial \Delta \phi(b_g | e)}{\partial db_g} > 0$  hence  $U_0(b_g | e)$  is decreasing for all  $b_g \in [B; \bar{b}]$

For the easiest goal, Self-0 wants the high effort if  $-c + \Delta E(b | e) > 0$  which similar to the previous section. As the goal gets harder, Self-0 utility increases up to the goal  $b_g = B$  and then this value decreases to reach the asymptotic value  $-c + \lambda \Delta E(b | e)$  which is lower in the situation where there is no loss aversion. Moreover, this term can also be negative depending on the level of loss aversion. When the term becomes negative, there is no intra-personal conflict anymore as both Self-0 and Self-1 prefers the low effort.

Self-1 would prefer to shirk (exert the low effort) if and only if :

$$\begin{aligned}U_1(\bar{e}, b_g) &< U_1(\underline{e}, b_g) \\ -c + \beta \left( \Delta E(b | \bar{e}) + (1 - \lambda) \phi(b_g | \bar{e}) \right) &< -c + \beta \left( \Delta E(b | \underline{e}) + (1 - \lambda) \phi(b_g | \underline{e}) \right) \\ -c + \beta \left[ \Delta E(b | e) + (1 - \lambda) \Delta \phi(b_g | e) \right] &< 0\end{aligned}$$

Contrary to the previous section, the addition of the loss aversion parameter makes that the threshold associated with the Self-0 and Self-1 willingness to exert a high effort are concave function of the target. Consequently, there is a three main differences in the first setup of the model.

First, for an easy goal, the model remains unchanged as the loss aversion does not affect to a large extent utilities for goals that would be succeeded easily.

As the goal gets harder, the loss aversion will increase the differential in utilities of both Self-0 and Self-1 so that there exists a value  $\lambda_{SC}$  of  $\lambda$  for which every  $\lambda < \lambda_{SC}$ , there is no interpersonal conflict as the differential of utilities of Self-0 and Self-1 are both positive. Beyond a certain goal, loss aversion reduces utilities of Self-0 and Self-1 up to a point where both differential in utilities are negative. Consequently, there is no more problem of interpersonal conflict in the sense that Self-0 also prefers to shirk.

Using the financial self-penalty, the utilities are:

$$\begin{aligned} U_0(m, e) &= \beta \left( -c(e) + \lambda \int_{\underline{b}}^{b_g} (b - m) f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \right) \\ &= \beta \left[ -c(e) + E(b|e) - \lambda m F(b_g|e) + (\lambda - 1) \phi(b_g|e) \right] \end{aligned}$$

$$\begin{aligned} U_1(m, e) &= -c(e) + \beta \left( \lambda \int_{\underline{b}}^{b_g} (b - m) f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \right) \\ &= -c(e) + \beta \left[ E(b|e) - \lambda m F(b_g|e) + (\lambda - 1) \phi(b^*|e) \right] \end{aligned}$$

**The incentive constraint** Self-1 prefers the high effort to the low effort conditional on the self-penalty if and only if :

$$\begin{aligned} -c + \beta \left( \lambda \int_{\underline{b}}^{b_g} (b - m) f(b|\bar{e}) db + \int_{b_g}^{\bar{b}} b f(b|\bar{e}) db \right) &> -\beta \left( \lambda \int_{\underline{b}}^{b_g} (b - m) f(b|e) db + \int_{b_g}^{\bar{b}} b f(b|e) db \right) \\ m &> \frac{-c + \beta \Delta E(b|e) + \beta(\lambda - 1) \left( b_g \Delta F(b_g|e) - \int_{\underline{b}}^{b_g} \Delta F(b|e) db \right)}{\beta \lambda \Delta F(b_g|e)} \\ m &> \frac{\Delta U_1(\beta) + \beta(\lambda - 1) \Delta \phi(b_g|e)}{\beta \lambda \Delta F(b_g|e)} \equiv m_{min}(\beta, \lambda, b_g) \end{aligned}$$



The minimal incentive constraint is analogous to the first case despite the additional term  $\beta(\lambda - 1)\Delta\phi(b_g|e)$  that convexify the function to a greater extent. As compared to the initial case, when the goal is very easy or very hard, the financial incentive motivating Self-1 to provide a high effort is higher since the degree of loss aversion will decrease to a larger extent the utility of Self-1 at the two extreme bounds.

**The participation Constraint** Self-0 wants to implement the penalty to get the high effort if and only if:

$$\begin{aligned}
 & U_0(m_{min}; \bar{e}) > U_0(0, \underline{e}) \\
 & \beta \left[ -c + E(b|e) - \lambda m_{min} F(b_g|\bar{e}) + (\lambda - 1) \left( b_g F(b_g|\bar{e}) - \int_{\underline{b}}^{b_g} F(b|\bar{e}) db \right) \right] > \\
 & \beta \left[ E(b|\underline{e}) + (\lambda - 1) b_g F(b_g|\underline{e}) - \int_{\underline{b}}^{b_g} F(b|\underline{e}) db \right] \\
 & \frac{\Delta U_1 + \beta(\lambda - 1)\Delta\phi(b_g|e)}{\Delta U_0 + \beta(\lambda - 1)\Delta\phi(b_g|e)} > 1 - \frac{F(b_g|\underline{e})}{F(b_g|\bar{e})}
 \end{aligned}$$

The result of the addition of the loss aversion parameter in the model provides two changes: first, the financial penalty set by Self-0 is higher for easy goals. Second, Self-0 don't set penalties for a lower threshold of hard goals as compared to the original model with loss aversion. Qualitatively speaking, the addition of the loss aversion parameter do not change fundamentally the main results.

## Partial Naiveté

The overconfidence in self-control won't affect Self-0 preferences as he knows his own level of present-bias:

$$\Delta U_0 \equiv \beta(-c + \Delta E(b|e)) \geq 0$$

However, Self-0 thinks that Self-1 prefers the low effort compared to the high effort if and only if:

$$-c + \tilde{\beta}\Delta E(b|\bar{e}) < \tilde{\beta}\Delta E(b|e)$$

$$\Delta\tilde{U}_1 \equiv -c + \tilde{\beta}\Delta E(b|e) < 0$$

Because  $\beta < \tilde{\beta}$ , we have  $\Delta U_1(e) < \Delta\tilde{U}_1(e)$ . In this new setting, three cases arise:

- **Case 1:**  $\beta_{SC} < \beta < \tilde{\beta}$  There is no intra-personal conflict. Hence, Self-0 does not use commitment devices.
- **Case 2:**  $\beta < \beta_{SC} < \tilde{\beta}$  There is an intra-personal conflict but Self-0 believes there isn't. Hence, Self-0 does not use commitment devices either.
- **Case 3:**  $\beta < \tilde{\beta} < \beta_{SC}$  There is an intra-personal conflict and Self-0 knows there is. Hence, Self-0 will use a commitment device.

The two following sub-sections focus on case 3.

**The incentive constraint** In the case 3 where  $\beta < \tilde{\beta} < \beta_{SC}$ , Self-0 may want to implement a commitment device to motivate Self-1 to exert a high effort. However, Self-0 has wrong beliefs on Self-1 present-bias. More specifically, Self-0 thinks erroneously that Self-1 will prefer a high effort under the penalty constraint if and only if :

$$\tilde{U}_1(\bar{e}, m) > \tilde{U}_1(e, m)$$

$$\Leftrightarrow m > \frac{\Delta\tilde{U}_1(e)}{\tilde{\beta}\Delta F(b_g|e)} \equiv \tilde{m}_{min}$$

with  $\tilde{m}_{min}(b^*) < m_{min}(b^*)$  Hence, Self-0's underestimation of Self-1's present-bias makes that he will underestimate the level of penalty that will make Self-1 exert a high effort. Consequently, the penalty setting is detrimental for both selves since Self-1 will systematically exert a low effort with the financial penalty.

**The participation constraint** Self-0 will take the penalty if and only if :

$$\frac{\Delta \tilde{U}_1(e)}{\Delta U_0(e)} > \left(1 - \frac{F(b_g|e)}{F(b_g|\bar{e})}\right)$$

We know that  $\frac{\Delta \tilde{U}_1(e)}{\Delta U_0(e)} > \frac{\Delta U_1(e)}{\Delta U_0(e)}$ . Consequently, the goal threshold for which Self-0 will use a financial penalty is harder than the threshold in the initial case. Self-0 takes commitments for harder goals as compared to the situation in which self-naiveté does not affect Self-0 beliefs about Self-1 present-bias.

## I.B. Experimental Material

Such choices allow us to estimate parameters of a standard utility maximization assuming a quasi-hyperbolic discounting with constant relative risk aversion (CRRA) with respect to the budget constraint:

$$U(x_t, x_{t+k}) = x_t^\alpha + \beta^{1\{t=0\}} \delta x_{t+k}^\alpha \quad \text{s.t.} \quad x_t + P x_{t+k} = R \quad (\text{I.20})$$

where  $\delta$  is the per-period discount factor that captures long-run exponential discounting,  $\beta$  is the present bias, and  $\alpha$  is the curvature parameter of the utility function ie. the intertemporal substitution. The one period discount factor between the present and the future is  $\beta\delta$ , while the one period discount factor between two future periods is  $\delta$ . Present bias is associated with  $\beta < 1$  and  $\beta = 1$  corresponds to the case of standard exponential discounting. From I.20, we can define a demand function whereby we will estimate a non-linear regression equation based upon:

$$x_t = \frac{20(\beta^{t_0} \delta^k P)^{\frac{1}{\alpha-1}}}{1 + P(\beta^{t_0} \delta^k P)^{\frac{1}{\alpha-1}}} \quad (\text{I.21})$$

To address the question of incentive compatibility of this task, we use Paypal and Amazon account to pay participants. More specifically, one decision out the 32 decisions was chosen randomly

by the computer. This decision determines the payments that will be sent either on Paypal or Amazon at the two dates of the decision. We use these web-based payments to facilitate the logistic implementation of the experiment and to equalize the transaction costs for the two dates chosen in the decision. In addition, participants were given the card with the experimenter's name and phone number in case of missing payments to ensure the credibility of payments.

Table I.B.1: Intertemporal experimental parameters

t (Starting Date)	k (Delay)	Budget	SS	LL	$(1+r)$
0	21	20	20	20	1,00
0	21	20	18	20	1,11
0	21	20	17	20	1,18
0	21	20	16	20	1,25
0	21	20	14	20	1,43
0	21	20	11	20	1,82
0	21	20	9	20	2,22
0	42	20	20	20	1,00
0	42	20	18	20	1,11
0	42	20	17	20	1,18
0	42	20	16	20	1,25
0	42	20	14	20	1,43
0	42	20	11	20	1,82
0	42	20	9	20	2,22
42	21	20	20	20	1,00
42	21	20	18	20	1,11
42	21	20	17	20	1,18
42	21	20	16	20	1,25
42	21	20	14	20	1,43
42	21	20	11	20	1,82
42	21	20	9	20	2,22
21	21	20	20	20	1,00
21	21	20	18	20	1,11
21	21	20	17	20	1,18
21	21	20	16	20	1,25
21	21	20	14	20	1,43
21	21	20	11	20	1,82
21	21	20	9	20	2,22
21	42	20	20	20	1,00
21	42	20	18	20	1,11
21	42	20	17	20	1,18
21	42	20	16	20	1,25
21	42	20	14	20	1,43
21	42	20	11	20	1,82
21	42	20	9	20	2,22

**Notes:** Table 1 summarizes the parameters of the intertemporal choice portion of the experiment.  $t$  is the date in days of the sooner reward.  $k$  corresponds to the delay in days after the starting date to get the later reward. The budget is the amount that has to be allocated to the sooner and the later date. SS and LL are the maximum amount that it is possible to allocate to the sooner date and the later date respectively.  $(1+r)$  corresponds to the daily interest factor.

## I.C. Correlations between Time Discounting and Temporal Perspective Scales

I investigate whether the measure of present-bias found using the Convex Time Budget is correlated with the other measures of temporal perspective elicited with the psychometric scales. Results are displayed in Table I.C.1 of the correlation matrix .

The psychometric scales display a good convergent validity. The CFC-14 sub-scale of consideration for immediate consequences is positively correlated with impulsiveness measured by the 10-points Likert scale. It also displays positive and significant correlations with the BIS-11 2nd order scales of motor impulsiveness ("*acting quickly*")—corresponding to the sub-scales of motor and perseverance—and nonplanning impulsiveness ("*not enjoying mental challenges*")—corresponding to the sub-scales of Self-control and cognitive complexity. To a lower extent, the immediate sub-scale is negatively correlated—although only significant at most at the 10% level—to attentional impulsiveness ("*focusing on current tasks*"). The CFC-14 sub-scale of consideration for future consequences is positively related to the measure of patience being measured using the 10-points Likert scale. Individuals who have an unstable lifestyle—that is, individuals that score high on the sub scale of perseverance—have a lower consideration for future consequences.

Correlations found between present-bias and the different sub-scales go in the opposite direction of what we would have expected. Namely, we would have expected that present-biased individuals—that is, individual whose estimated value of  $\beta$  is low—would have a higher score on the immediate sub-scale and on the Barratt impulsiveness subscales. Here, present bias is negatively and significantly correlated with the score of impulsiveness of the 10-point Likert scale, the BIS-11 sub-scales of cognitive instability , self-control, and cognitive complexity, and also with the sub-scale of the CFC-14 on the consideration of immediate consequences. Interestingly, the BIS-11 sub-scale of attention—corresponding to the predisposition to focus on current tasks—is negatively correlated with present-bias. Given the good convergent validity properties of psychometric scales, this correlation results suggest that the elicited present-bias may be inappropriate

for assessing behaviours in the field. In addition to be poorly correlated with the psychometric scales, present-bias might come from the fact that people did not concentrate during the task of allocation between sooner and later reward. This hypothesis is corroborated with the positive correlation between present-bias and the propensity to be inattentive measured with the BIS-11 attention sub-scale. In addition, I find that the discount factor is poorly correlated with the psychometric scales and patience evaluated through a Likert-scale.

Potential explanations of the poor convergent validity of individual discounting parameters can be provided. First, because of the low sample size, the estimation of time preferences parameters may be imprecise as the CTB method requires a non-linear regression model to obtain estimates. Second, the allocation of money between a sooner date and a later date in the laboratory can be the result of a different cognitive process than making intertemporal choices outside the laboratory or in a specific domain. Third, it is also likely that the CTB task was too complicated for the subjects. This critique is addressed by [Harrison, Lau and Rutström \(2013\)](#). They argue that the CTB method requires, for a valid estimated time preferences parameters, to rely on the cognitive abilities of subjects to comprehend abstract problems. Thus, if the task was found to be complicated for subjects, it might have lead subjects to choose corner solutions that are conceptually simpler. We do indeed find that, as in the original paper from [Andreoni and Sprenger \(2010\)](#), around 63.76% of observed choices are corner solutions. The high prevalence of corner solution can be problematic from a theoretical and an econometric perspective. First, [Chakraborty et al. \(2017\)](#) point out the theoretical issue that wealth monotonicity— $c_t$  and  $c_{t+k}$  are weakly increasing in wealth—is frequently violated by subjects who chose corner solutions. Such a violation cannot allow to rationalize behaviour with a monotone utility function. The second problem arising from the high prevalence of corner solutions is an econometric specification issue. The non-linear least squares regression used to estimate discounting parameters would perform a poor job at identifying discount rate and present-bias if their true value would lie outside of the range generated by the restricted experimental values of the task (see [Harrison, Lau and Rutström, 2013](#), p. 15).

Table I.C.1: Correlation matrix of time preferences

	(CTB)	(CTB)	(Likert)	(Likert)	(BIS-11)	(BIS-11)	(BIS-11)	(BIS-11)	(BIS-11)	(BIS-11)	(BIS-11)	(BIS-11)	(CFC-14)
	$\hat{\beta}$	$\hat{\delta}$	Impulsive	Patience	Attention	Cognitive Instability	Motor	Persevere	Self-Control	Cognitive Complexity	Immediate Sub-Scale		
(CTB) $\hat{\beta}$	1.00												
(CTB) $\hat{\delta}$	<b>-0.44</b> (0.00)	1.00											
(Likert) Impulsive	<b>0.18</b> (0.01)	-0.12 (0.08)	1.00										
(Likert) Patience	0.02 (0.81)	-0.10 (0.15)	<b>-0.48</b> (0.00)	1.00									
(BIS-11) Attention	<b>-0.23</b> (0.00)	<b>0.18</b> (0.01)	<b>0.18</b> (0.00)	<b>-0.26</b> (0.00)	1.00								
(BIS-11) Cognitive instability	<b>0.31</b> (0.00)	-0.10 (0.12)	<b>0.16</b> (0.01)	<b>0.13</b> (0.03)	<b>0.21</b> (0.00)	1.00							
(BIS-11) Motor	-0.097 (0.13)	0.09 (0.17)	<b>0.31</b> (0.00)	<b>-0.28</b> (0.00)	<b>0.24</b> (0.00)	<b>0.22</b> (0.00)	1.00						
(BIS-11) Persevere	0.10 (0.13)	0.06 (0.32)	<b>0.10</b> (0.10)	<b>-0.12</b> (0.05)	<b>0.189</b> (0.00)	<b>0.15</b> (0.01)	<b>0.19</b> (0.00)	1.00					
(BIS-11) Self-Control	<b>0.13</b> (0.05)	-0.02 (0.77)	0.06 (0.35)	<b>-0.16</b> (0.01)	<b>0.57</b> (0.00)	0.06 (0.32)	<b>0.45</b> (0.00)	<b>0.26</b> (0.00)	1.00				
(BIS-11) Cognitive Complexity	<b>0.17</b> (0.01)	<b>0.17</b> (0.05)	0.06 (0.36)	<b>-0.17</b> (0.01)	0.10 (0.06)	0.02 (0.67)	<b>0.40</b> (0.00)	<b>0.47</b> (0.00)	<b>0.43</b> (0.00)	1.00			
(CFC-14) Immediate Sub-Scale	<b>0.43</b> (0.00)	-0.05 (0.49)	<b>0.11</b> (0.08)	<b>-0.28</b> (0.00)	<b>-0.12</b> (0.05)	-0.09 (0.15)	<b>0.24</b> (0.00)	<b>0.44</b> (0.00)	<b>0.10</b> (0.09)	<b>0.45</b> (0.00)	1.00		
(CFC-14) Future Sub-Scale	0.08 (0.24)	-0.02 (0.71)	0.08 (0.22)	<b>0.11</b> (0.08)	0.07 (0.23)	<b>0.32</b> (0.00)	<b>0.16</b> (0.01)	<b>-0.36</b> (0.00)	-0.01 (0.88)	<b>-0.34</b> (0.00)	-0.09 (0.13)		

**Note:** This table represents the correlation matrix of the different measures used to elicit time perspective of individuals. More specifically, we used the elicited present-bias measure  $\hat{\beta}$  from the CTB method (note that a higher  $\hat{\beta}$  means that the individual is more time consistent), impulsivity using the 10-point Likert scale, the six subscales from the BIS-11 and the two subscales of the CFC-14. Significant correlations at 10% are displayed in bold. p-values are in parentheses.





# SELF-CONTROL, FATIGUE AND BODY WEIGHT

## Evidence from Transitions to Night Shifts

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*This chapter is a joint work with Fabrice Étilé.*

*“Le travail c’est la santé,  
Rien faire c’est la conserver,  
Les prisonniers du boulot,  
N’font pas de vieux os.”*

-Henri Salvador *Le travail, c’est la santé!*

### 1. Introduction

Evening and night work shifts tend to become more prevalent on the labor market (*Eurostat*). Between 15% and 20% of American and European workers now experience regular or irregular night work. There are firmly established evidence that night work has a negative impact on the health and well-being of workers. A survey by [Costa \(1996\)](#) enumerates four types of impairments that have been associated with night shifts: (i) disturbance in the normal circadian rhythms and sleep/wake cycles, (ii) loss of efficiency at work and increasing risks of accidents; (iii) difficulties in maintaining usual relationships at the family and social levels, with negative consequences on marriage, care for children and social bonds; (iv) a wide range of health disorders, ranging from disturbances of eating habits to gastrointestinal diseases and psychological functioning. Evening

and night work may also have specific adverse effects on women health and well-being by disturbing hormonal and reproductive functions, and depreciating their role in the family. While evening and night work might be associated to gains for firms and consumers, such health and well-being effects point to the existence of potential negative externalities that are important to consider in the design of labour market regulations.

In this perspective, this paper examines whether the conjunction of impulsiveness and irregular evening and night shifts generating stress, fatigue and anxiety increases the likelihood of unhealthy behaviors such as weight gain, bad diet habits and less exercises.

Following [Baumeister et al. \(1998\)](#), [Baumeister, Vohs and Tice \(2007\)](#), self-control can be defined as a stock that is used by individuals to resist temptations that are specific to their environment. Self-control has two main characteristics. First, it is a limited resource that is depleted by repeated exertions ([Baumeister, Vohs and Tice, 2007](#)). Second, self-control is heterogeneously distributed across individuals. In a well-known experiment, [Mischel, Ebbesen and Raskoff Zeiss \(1972\)](#) study children abilities to delay gratification in the form of an increased reward in Marshmallow. Not only did they observe substantial differences in children temptation resistance but they also showed that this ability is positively correlated to future life outcomes such as SAT scores, obesity and alcohol and drug consumption ([Shoda, Mischel and Peake, 1990](#)).

Evening and night works are likely to deplete the stock of self-control by generating fatigue, and potentially stress and anxiety. Night, evening and day works are also likely to be associated to different consumption environments, in terms of food supply for instance. In addition, the impact of specific work and environmental conditions on self-control is likely to be heterogeneous, as individuals differ in their impulsiveness.<sup>1</sup> In our set-up, heterogeneity in impulsiveness can be interpreted in terms of individual differences in the marginal cost of using cognitive resources to achieve a given level of self-control. As a consequence, the impact of night work on health and

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1. Impulsiveness is a personality trait defined as a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individuals or to others. There is good evidence that impulsiveness is associated with many psychiatric disorders: eating disorders, obsessive-compulsive disorders, attention deficit disorder of childhood, psychoactive substance abuse disorders, antisocial personality disorders, borderline personality disorders, impulse control disorders. ([Moeller et al., 2001](#))

health behaviors is likely to be larger for more impulsive individuals.

To test this prediction, we use a large sample of individuals from the German Socio-Economic Panel, which is a representative longitudinal survey of the German population. We exploit the 2007-2014 waves, which include objective and subjective indicators on health behaviors, work conditions and personality traits. We estimate the moderating role of impulsiveness in the effect of evening and night work on the body mass index, the propensity to perform a health-conscious diet and the frequency of physical exercises. Our empirical strategy relies on individual fixed-effects regression analysis to control for unobservable time-variant heterogeneity such as invariant personality traits or genetic predispositions.

We find positive cross-sectional correlations between evening and night work and health behaviors, but fixed-effect regressions do not show any average effect of evening or night work on BMI and dieting propensity. However, evening and night work performed several times a week (i.e. evening and night rotating shifts) have a significant impact on BMI and dieting for impulsive individuals. The cross-sectional correlations are thus likely to result from some self-selection on fixed unobservable characteristics that are controlled for in fixed effect regressions. Surprisingly, fixed (daily) evening or night works have no effect on health behaviors. Hence, it is not evening and night work per se that increase the risk of adopting unhealthy behaviors, but the fact of having evening or night shifts sometimes in the week. This is consistent with the idea that individuals may have difficulties to replete their self-control resources when they have irregular time schedule. In such a situation, being impulsive is likely to lead to more frequent lack of self-control.

The contribution of this paper is twofold. First, we add to previous evidence of the consequences of night and evening work. Empirical evidence from epidemiological studies are mainly obtained from cross-sectional correlations. Here, we estimate the health effects of transitioning to evening and night work after controlling for time-invariant unobservable characteristics. In addition, we examine how these effects differ across individuals who differ by their impulsiveness.

Contrary to previous findings from the literature, we only find a detrimental effect of evening and night work for irregular schedules. Part of the cross-sectional correlations are explained by self-selection into evening or night work on fixed unobserved characteristics.

Second, we extend the existing literature in experimental economics on self-regulation by providing field evidence on how the behavioural consequences of impulsiveness vary with the environment and external constraints, such as atypical working hours. A number of experimental studies have shown that self-control resources can be depleted by fatigue and cognitive exhaustion. For instance, [Shiv and Fedorikhin \(1999\)](#) studied participants' food choices between a healthy snack (fruit salad) and an unhealthy snack (a chocolate bar) after a memorizing task that varies in difficulty across subjects. The chocolate bar was chosen more often when the memorizing task was difficult (i.e. when subjects' self-control resources were reduced) as compared to when the memorizing task was easy. Yet, this effect is significant in impulsive consumers only, whereby impulsiveness is measured through a psychometric scale. We here obtain very similar result but out of the laboratory, exploiting the fact that changes in work schedules may impact self-control resources, and differently so depending on impulsiveness.

The remainder of the paper is organized as follows: Section 2 presents the existing and relevant literature on night shifts and self-control Section 3 presents our model of self-control in food choice and working activity; Section 4 presents the database and descriptive statistics; Section 5 presents the main empirical results and provides robustness checks; Section 6 concludes and discusses potential policy implications.

## **2. Fatigue & Self-Control: the Strength Model**

An extensive literature in psychology and economics has evidenced the role of self-control (or lack of) in the self-regulation of eating and weight control behaviours (see inter alia [Bandura, 2005](#), [Will Crescioni et al., 2011](#), [De Ridder et al., 2012](#), [Bénard et al., 2017](#), [Zhang and Rashad, 2008](#), [Ikeda, Kang and Ohtake, 2010](#)). Exerting self-control requires cognitive efforts that consume psychological resources ([Baumeister, Vohs and Tice, 2007](#), [Muraven and Baumeister, 2000](#), [Muraven,](#)

Tice and Baumeister, 1998).<sup>2</sup> Self-control can therefore be construed as an activity that is produced from cognitive resources that are available in limited amount over a time period. These resources are affected by a number of physiological and psychological factors. Resting, sleeping, having holidays and times without self-control requirements are a few means of replenishing cognitive resources. The anxiety produced by interpersonal conflicts, ruminative thoughts cluttering the available working memory, or merely physical fatigue deplete the cognitive resources available for self-control (Wegner, 1994, Boon et al., 2002). Individual ability to produce self-control is heterogeneous and malleable. Individuals with impulsive personality will tend to produce less self-control from a given level of resources. But they can also be trained to produce more self-control despite their impulsiveness, like a muscle becoming stronger with regular and appropriate physical exercise. (Muraven, Baumeister and Tice, 1999). We now incorporate some of these insights in a standard economic decision model.

Individuals are assumed to derive utility from the consumption of two commodities  $Z_u$  and  $Z_h$ , and health  $H$ .  $Z_u$  is an aggregate commodity of health activities, while  $Z_h$  represents unhealthy activities. Health is derived from these commodities according to the production function  $H = h(Z_u, Z_h)$ . Hence, without loss of generality, the utility function  $U$  of the individual can be written in a compact form  $U^*$  such that:

$$U(Z_u, Z_h, H) = U^*(Z_u, Z_h). \quad (\text{II.1})$$

Drawing from Borghans et al. (2008), self-control is modelled as a ‘task’ that enters in the production of utility by shifting the individual ability at producing commodities from market goods. More precisely, we specify the following production function for commodities:

$$\begin{aligned} Z_u &= (1 - S(\beta, e)) x_u \\ Z_h &= (1 + S(\beta, e)) x_h. \end{aligned} \quad (\text{II.2})$$

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2. Baumeister, Vohs and Tice (2007) mention the following cognitive processes: controlling thoughts, managing emotions, overcoming unwanted impulses, fixing attention, guiding behavior, making many choices.

In these production functions,  $S$  is the self-control exerted during consumption and leisure-time activities,  $x_u$  and  $x_h$  are market aggregates of unhealthy and healthy products respectively. The price of  $x_h$  is  $p_h$ , while the price of  $x_u$  is normalized to 1. The variable  $e$  is the level of cognitive resources available for exerting self-control, while  $\beta$  is a measure of individual trait-impulsiveness: the higher is  $\beta$ , the more prone to impulsiveness is the individual. We assume that  $\frac{\partial S}{\partial e} > 0$ ,  $\frac{\partial S}{\partial \beta} < 0$ , so that less impulsive individuals or individuals with more resources have more self-control and can produce more of the healthy commodity  $Z_h$  from a given level of market good  $x_h$ . We may think here of individuals purchasing a subscription to a fitness center and being more or less able to attend regularly, depending on whether they are tired or not, whether they procrastinate etc. On the contrary, individuals with more self-control will benefit less from purchasing unhealthy goods. For instance, they will feel shameful and guilty if they indulge on sugary products, reducing thereby the utility of eating such foods. Impulsiveness and cognitive resources can be complement in the production of self-control ( $\frac{\partial^2 S}{\partial e \partial \beta} > 0$ ), so that more impulsive individuals will gain more self-control from a marginal unit of cognitive resources. They can also be substitute.

We then consider individuals who are active on the labour market. They earn an income  $y$ , which is a function of their effort at work and their impulsiveness, so that

$$y = Y(e_w, \beta). \quad (\text{II.3})$$

More efforts and being less impulsive yields higher earnings, so that  $\frac{\partial Y}{\partial e} \geq 0$ ,  $\frac{\partial Y}{\partial \beta} \leq 0$ . Note that we can accommodate here for the case of unemployed individuals living on some social benefits. We abstract from modelling labor-market choices: we will deal with the issue of self-selection (choice of  $e_w$ ) in the empirical section.

We simply close the model by assuming that efforts exerted at work result in less cognitive resources available for regulating behaviors, so that we have the normalized self-control constraint

$$e + e_w = 1 \quad (\text{II.4})$$

Given their work situation, individuals allocate their budget according the following maximization program

$$\begin{aligned} & \max_{\{x_u, x_h\}} U^*(Z_u, Z_h) & (II.5) \\ \text{s.t} & \quad p_h x_h + x_u = y \\ \text{and} & \quad (II.2), (II.3), (II.4) \end{aligned}$$

We use equation (II.2) to replace  $x_u$  and  $x_h$  with  $Z_u$  and  $Z_h$  in the budget function. Then, self-control in healthy activities result in a lower *full* price for these activities ( $\frac{p_h}{1+S}$ ) as compared to the market price of healthy goods  $p_h$ , while self-control in unhealthy activities rises the price of unhealthy market goods. This appears in the marginal rate of substitution between  $Z_u$  and  $Z_h$ , which writes

$$MRS_{Z_u/Z_h} = p_h \frac{1-S}{1+S}. \quad (II.6)$$

What is the impact of a change in on-the-job efforts? Since  $\frac{dMRS_{Z_u/Z_h}}{de_w} = p_h \frac{2\frac{\partial S}{\partial e}}{(1+S)^2} > 0$ , an increase in on-the-job efforts generate a substitution effect. When individuals need to exhaust more of their cognitive resources at work, then the price of healthy activities increases relatively to the price of unhealthy activities, because they have less resources to devote to self-control during consumption and leisure time. However, an increase in efforts at work will also have a positive income effect on consumption (provided that commodities  $Z_u$  and  $Z_h$  are normal). Hence, adding the price and income effects, the sign of  $\frac{dZ_h}{de_w}$  is undetermined, while we are almost certain that  $\frac{dZ_u}{de_w} > 0$ .<sup>3</sup> For instance, we may well imagine someone moving from unemployment to a night shift job, and using her additional earnings to subscribe to a sport club. The overall impact of  $e_w$  on health will eventually depend on the shape of the production function  $h(Z_u, Z_h)$ . Assuming reasonably that there are no returns to scale, we can write  $H = h^*\left(\frac{Z_u}{Z_h}\right)$ , so that less resources for self-control out of work will deteriorate health, because individuals substitute  $Z_u$  for

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3. This prediction will not hold only if the healthy and unhealthy activities have very large and negative cross-price elasticities, i.e. the individual dramatically reduces  $Z_u$  when the full price of  $Z_h$  increases.



$Z_h (dZ_u/dZ_h > 0)$ .<sup>4</sup>

More impulsive individuals are less efficient in the production of self-control. Hence, they face a lower relative price of unhealthy activities ( $\frac{dMRS_{Z_u/Z_h}}{d\beta} > 0$ ) and they earn less. As they earn less, they will for sure spend less on healthy activities, but the eventual impact on unhealthy activities is ambiguous: it depends on the relative magnitude of price and the income effects. An increase in impulsiveness is anyway associated with an higher relative consumption of unhealthy activities, so that with no returns to scale in health production, more impulsiveness is associated to worse health.

What is the interaction effect between impulsiveness and on-the-job efforts? The cross-derivative of the MRS,  $\frac{d^2 MRS_{Z_u/Z_h}}{d\beta de_w}$ , is positive whenever cognitive resources and trait-impulsiveness are complement or weak substitutes in the production of self-control.<sup>5</sup> In this case, facing an increase in on-the-job demand for cognitive resources, more impulsive individuals will be more likely to substitute unhealthy activities for healthy activities. Under no returns to scale in health production, they should endure larger health losses. If efforts and impulsiveness are substitutes in work ( $\frac{\partial^2 Y}{\partial e \partial \beta} < 0$ ), then an increase in  $e_w$  will be associated to lower earnings for more impulsive individuals. In this case, the associated income effect will generate a lower increase in spending on unhealthy activities for impulsive individuals, but it is also more likely to generate a decrease in healthy activities for these individuals.

We test these implications of the model by estimating the impact of transitions to evening work and night shifts on three variables. We will use the Body Mass Index (BMI) as a summary measure of health, and two variables measuring individual commitment to healthy activities: following a health-conscious diet, and having regular physical activity. We work under the assumption that transitions to evening and night work are likely to increase the on-the-job demand for cognitive resources ( $e_w$  increases). Hence, we have the two following testable predictions:

4. The no-returns to scale assumption is reasonable in our context, if we think of  $H$  as being body weight,  $Z_u$  being the calories in, and  $Z_h$  being the calories out. In this case, the energy balance principle implies that body weight does not change when the calories in and out are multiplied by the same factor.

5. The cross-derivatives equals  $2p_h \left[ \frac{\frac{\partial^2 S}{\partial e \partial \beta}}{(1+S)^2} - 2 \frac{\frac{\partial S}{\partial e} \frac{\partial S}{\partial \beta}}{(1+S)^3} \right]$ , which is positive only if  $\frac{\partial^2 S}{\partial e \partial \beta} > 2 \frac{\frac{\partial S}{\partial e} \frac{\partial S}{\partial \beta}}{(1+S)}$ .

### Transitions to night shift and evening work...

1. ...produce a deterioration in health, i.e. an increase in BMI, which is larger for more impulsive individuals.
2. ...reduce the level of healthy activities, and more so for more impulsive individuals, but only if they are not associated to large income effects.

We have derived these predictions from the most simple and intuitive cases.<sup>6</sup> It is worth noting that we expect the sign of the cross-partial effects of impulsiveness and transitions on health to be negative, because we have assumed that impulsiveness and cognitive resources are complement or weak substitutes in the production of self-control ( $\frac{\partial^2 S}{\partial e \partial \beta} > 0$ ). If they are strong substitutes, i.e. if more impulsive individuals are much less able to convert cognitive efforts into effective self-control, then the more impulsive individuals will be marginally less affected by transitions to evening and night works. If, in addition, there are large and positive income effects, their health may deteriorate less. The theoretical framework shows eventually that the impact of transitions to night shift and evening work is modulated by impulsiveness depending on two types of factors: preferences over healthy and unhealthy activities (the size of own-price, cross-price and income elasticities); how impulsiveness and efforts interact to produce self-control.

To test our predictions, we exploit a panel survey of individuals, for whom job transitions are precisely observed, and impulsiveness is self-reported. The next section presents the data and the methods. We discuss the key statistical issue: individual self-selection into job position depends partly on their fixed traits, such as impulsiveness.

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6. The theoretical analysis could of course have additional layers of complexity by assuming that self-control in healthy activities is different from self-control in unhealthy activities, or by considering specific cases such as more impulsive individuals being more productive in specific night jobs, or preferences producing very large income effects etc. Developing a richer framework is out of the scope of the current paper.

### 3. Data and Methods

We use the German Socio-Economic Panel Survey (GSOEP), which is a representative longitudinal survey of the resident adult population in Germany. The first yearly wave of the survey was conducted in 1984. At each wave, the GSOEP collects information on individual characteristics, household wealth, and general work conditions. Specific questionnaire modules are implemented at some waves to include more information on topics of interest such as personality traits, atypical working hours and health aspects. In this study, we use only waves between 2007 and 2014, where self-reported measures of impulsiveness are available. We exploit individual transitions between work schedules to identify their health effects independently from fixed individual heterogeneity.

#### 3.1. Data: Sample Selection

The analysis includes every individual that is active in the labour market and aged under 60 years old.<sup>7</sup> Dropping respondents with missing values, extreme BMI values or BMI variations, and without work schedule transitions over the period of interest yields a sample of 31,077 individual-year observations for 13,790 individuals from 2007 to 2014.<sup>8</sup> We keep only individuals with work transitions as fixed-effect regressions are identified from this population subgroup.<sup>9</sup> The estimation sample may not represent the general population aged under 60 years old that are observed during the period from 2007 to 2014. Table II.B.1 in Appendix compares descriptive statistics between the original and the estimation samples. The estimation sample is older, has a higher household annual income and has larger annual working hours. This sample selectivity implies that our

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7. In particular, unemployed people are not excluded from the analysis. Comparing estimations results with and without this population show indeed that excluding the unemployed (2,113 individual-years) has no impact on our results, as will be shown later in the discussion section.

8. Regarding the missing values, one may worry that the estimation sample may be self-selected due to missing answers on the impulsiveness questions: there are only 91 missing values on the impulsiveness trait at waves 2008 and 2013. We have tested whether these missing values are correlated with sociodemographic characteristics: age and age squared, gender, marital status, level of education, state of residence, employment and number of individuals in the household and household income. The estimated correlations were all non significant showing that our results are not affected by missing values on the impulsiveness measure

9. Throughout the analysis, the estimation subsample is the one used in the first fixed-effect regression with BMI as the dependent variable.

results will reflect the health and behavioural outcomes of those individuals who are truly at risk of work schedule transitions.

## 3.2. Data: Key Variables

### Health Behaviors

We here focus on health behaviors using questions that were included in the 2008, 2010, 2012 and 2014 waves only.

Our first dependent variable is the Body Mass Index (BMI), which is defined as the ratio of weight in kilograms over the square of height in meters.<sup>10</sup> The Body Mass Index is a good indicator of decisions regarding food, alcohol and physical activity. An individual gain weight either because she does engage himself regularly into physical exercise or because she eats more food than she would need for meeting her physical requirements. As body weight variations are roughly determined by the difference between calorie intake and calorie expenditure, overweight and obesity are mainly the results of unhealthy behaviour.

We drop individuals that are in the 1st and 99th quantile of the BMI distribution, or display weight variations larger than 40 kilograms and height variations of 10 centimeters as there variations are very unlikely for an adult. Figure II.A.1 shows the distribution of BMI. The average BMI is 25.97, the minimum BMI is 17.72 and the maximum is 39.90. The distribution is right-skewed, with a skewness of 0.65. The average female BMI is 25.13, significantly lower than average male BMI (26.41).

We also use as dependent variables answers to questions indicating the extent to which individuals follow a health-conscious diet and how often they engage in sport and exercise activities.

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10. The BMI is a commonly used and validated measure of fatness among adults. Although there exist other indicator to determine body composition providing more accurate fat estimates, BMI is widely used to characterize fatness in large-scale epidemiological studies because it is based on self-reported height and weight. Although self-reported body sizes are prone to non-random measurement errors - weight being under-estimated and height being over-estimated (see [Burkhauser and Cawley \(2008\)](#)) -, these should not affect our longitudinal analyses of changes in BMI provided that the relationship between observed and actual BMI remains stable, and that these measurement errors are not correlated with work schedule transitions

These questions and their possible answers are worded as follows:

*To what extent do you follow a health-conscious diet:*

Not at all, Not so much, Much, Very much ?

*Please indicate how often you take part in sports:*

At least once per week, At least once per month, Seldom or Never?

Figure II.A.1 represents the distributions of these diet and exercise variables in the whole sample. The diet variable attracts more central answers than the exercise question, suggesting that healthy eating is a widely shared concern, while having a sport or exercise practice is more polarised.

### **Frequency of Evening and Night Work**

We are interested in transitions between work schedules with or without evenings and nights. These transitions are measured by using two questions in the survey related to evening and night work. These questions were asked at waves 2007, 2009, 2011 and 2013. The wording of the questions is the following:

*Do you sometimes have to work in the evenings (after 7:00 PM) or nights (after 10:00 PM)? If so, how often:*

Never, Occasional, Several times a week, Every day?

It is worth mentioning that the original answers for this question were: *Never; Less often, as needed; Once a week (changing shifts); Several times a week and Everyday*. We merged the answers *Once a week* and *Less often* into the broader "Occasional" category, that appears above. This category is thus meant to indicate any work pattern that includes infrequent evening or night shifts. As unemployed respondents did not answer the work schedule question (the survey's conditional branching had them skip employment-related items), we chose to include them in our "Never" category. From the four response categories, we construct four indicators of the frequency of

evening and night work. We can then analyse the transitions between different types of work schedule implying more or less evening or night work.

Tables II.A.1 and II.A.2 present transition probability matrices to and from schedules involving evening work and night work separately in the estimation sample. Overall, these transition tables show that there are enough transitions between work schedules to perform fixed-effects analysis. It also suggests that the estimates will mainly reflect the effects of exits into atypical working hours: each two years, 85.02% of people who never worked during evening (respectively 91.75% for night work) remained daytime workers at the following wave. Although people working during evening and night have great chances of becoming daytime worker in the next two years as evidenced by the probabilities in the first column of Tables II.A.1 and II.A.2, daytime workers are very unlikely to becoming evening or night workers as evidenced by the first row of the tables: for instance, the probability of transitioning from never working at night to working several times a week is 1.09% only.

Figure II.A.2 proposes a graphical representation of the bivariate distribution of evening and night work patterns, with the size of the squares proportional to the frequency of answers for a particular couple of responses. As large weights are found below the diagonal, evening work is more frequent than night work. We observe large squares on the diagonal, which indicate that evening work and night work frequencies are highly correlated to each other. Most night workers also declare to be also evening workers. The raw correlation between evening work and night work is 0.528 ( $p < 0.01$ ). To avoid multicollinearity issues, we will not use both variables simultaneously in the regressions. It would otherwise be difficult to assess their relative importance in explaining the variance of the dependent variable.

### **Impulsiveness**

We use a simple and ultra-short survey measure, which characterizes individual impulsiveness on a 11-point scale. The wording of the impulsiveness question, translated from German is:

*How would you describe yourself: Do you generally think things over for a long time before acting in other words, are you not impulsive at all? Or do you generally act without thinking things over for long time in other words, are you very impulsive?*

Please tick a box on the scale, where the value 0 means: "not at all impulsive" and the value 10 means: "very impulsive". You can use the values in between to make your estimate.

This scale measures impulsiveness as a personality trait, and captures specifically the cognitive aspects of impulsiveness.<sup>11</sup> As impulsiveness is measured at waves 2008 and 2013 only, we make the underlying hypothesis that impulsiveness is a stable personality trait over time and that the within-variability of the measure is mostly attributable to random measurement errors. That impulsiveness is a stable measure across time has already been showed in [Meier and Sprenger \(2010\)](#). We take either the 2008 value or the 2013 value, or the mean of both responses when available.<sup>12</sup> The scale is eventually standardized to have mean 0 and standard deviation 1 in the estimation sample. In the discussion section, we discuss the potential impact of work transitions on impulsiveness, using the subsample of individuals who answered in 2008 and 2013.

### **Control Variables**

In all regressions, we control for a wide set of observable individual and household characteristics : age and age squared, number of years of education, logarithm of the household monthly income, marital status, number of persons and number of children in the household, the occupation of the individual (one-digit Industry code), land of residence, risk attitudes, and satisfaction with work. [Table II.A.3](#) displays some summary statistics of the estimation sample. The average individual is 43 years old, works 1,928 hours per year and earn around 45,828 per year. 48% of the sample is female and the majority is married (61%).

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11. Motor impulsiveness, also called compulsiveness, and lack of planning, are captured through other questions in psychometric studies, see the three dimensions of the Barratt Impulsiveness Scale, ([Patton, Stanford and Barratt, 1995](#))

12. We would restrict dramatically the sample size if we relied only on individuals that answered twice to the questionnaire.

### 3.3. Descriptive Statistics: Evening/Night Work and Health Behaviours

Figure II.A.4 displays the distribution of health behaviours (BMI, Following a health conscious diet, frequency of physical activities) for day workers vs. evening or night workers.<sup>13</sup> Standard t-tests and Kolmogorov-Smirnov equality of distribution tests show that evening and night workers have a higher BMI and a lower propensity to follow a health-conscious diet than day workers. Evening workers perform less physical exercises than day workers, but we cannot reject the null hypothesis that night workers exert as much physical activities as day workers.

Figure II.A.4 however raises the question of whether the difference in the distribution of health behaviors is the result of some self-selection. The workers selected into evening or night work may have some specific characteristics that make them more prone to have unhealthy behaviors. We now present a fixed effect estimation strategy that controls for self-selection on fixed characteristics into evening or night work.

### 3.4. Econometric Model

Our main objective is to identify the moderating role of impulsiveness in the relationship between evening and night work and health behaviors (BMI, health-conscious diet, sport and exercise): does the health effects of evening and night work increase with impulsiveness? Our identification strategy relies on individual fixed effect regressions, which will control for selection evening and night work based on invariant unobservable characteristics such as genetic or preference factors that might affect simultaneously labor market choices and health behaviors. In addition, we analyze the impact of work transitions between calendar years  $t - 1$  and  $t + 1$  on changes in BMI and BMI-related behaviours observed between  $t$  and  $t + 2$ .<sup>14</sup> The use of lagged variable has two advantages. Change in healthy habits - and a fortiori body weight - may be slow to operate. Taking a one year lag is thus more appropriate for observing a new equilibrium. Moreover although

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13. We conveniently use the term 'day worker' as our reference category, i.e. workers who always have daytime work schedules.

14. Evening and night work are observed in 2007, 2009, 2011 and 2013 whereas BMI and BMI-related behaviours are observed in 2008, 2010, 2012 and 2014.



we introduce fixed effects to get rid of self-selection on time invariant unobservable characteristics, we also want to avoid any reverse causality bias, whereby unhealthy behaviors (e.g. being overweight) may increase the likelihood of ending in evening or night work (e.g. through labour market discriminations for instance). By appealing to the arrow of time, we avoid problems of reverse causality running from health to work. We use the following empirical specification :

$$y_{i,t} = \beta_0(\text{imp}_i \times w_{i,t-1}) + \beta_1 w_{i,t-1} + \chi' x_{i,t} + \alpha_i + u_{i,t} \quad (\text{II.7})$$

for  $t \in \{2008, 2010, 2012, 2014\}$  where  $y_{i,t}$  denotes health related behavior of individual  $i$  at time  $t$ .  $\text{imp}_i$  is the normalized impulsiveness measure,  $w_{i,t-1}$  is the vector of evening or night work frequency of individual  $i$  at time  $t - 1$  and  $x_{i,t}$  denotes a vector of control variables for  $i$  at time  $t$ .  $\alpha_i$  is the individual fixed effect which account for unobserved explanatory variables that are time invariant and  $u_{i,t}$  is the time variant error term. In equation II.7, we do need to control for the direct effect of impulsiveness, because we treat the latter as a time-invariant personality trait. Nevertheless, we can still identify the coefficient  $\beta_0$  on the interaction between impulsiveness and evening or night work, because the latter varies over time.

## 4. Results

### 4.1. Main Results

Table II.A.4 displays the results concerning the interaction effect of impulsiveness and evening work on health behaviors. In columns (1), (3) and (5), we estimate first pooled regression models (OLS) in order to test whether evening work or night work are associated with unhealthy behaviors after controlling for observed characteristics, and to estimate the correlation between impulsiveness and health behaviors. As expected, impulsiveness is positively and significantly associated with BMI at the 1% level and is negatively associated with following a health conscious diet. However, the correlation between impulsiveness and the frequency of physical exercises is not signif-

icant. It may be due to the fact that physical exercises merely provide immediate gratifications through the pleasure of doing one's favourite activity. Performing evening work during the week (whatever the frequency) is significantly associated with unhealthy behaviours, which is in line with our descriptive statistics and earlier results from the literature. We also note that the interactions terms ( $\beta_0$  in II.7) are not significant in these pooled OLS estimations.

We now focus on fixed-effect regressions to distinguish the impact of transition to evening work from effects that could be due to self-selection. The estimates are displayed in column (2), (4) and (6) of Table II.A.4. As compared to the pooled OLS regressions, we now observe a substantially different pattern of results in terms of signs and significance. Most of the coefficients on evening work that were significant in the pooled OLS are not significant in the fixed effect specification. However, for BMI, there is a positive and significant interaction effect between impulsiveness and "Occasional evening work". Working several times a week during evenings makes individual gain more weight as well (significant at the 10% level only), and the effect is larger for more impulsive individuals. The total effect of working several times a week during evenings is somehow large as it corresponds to an average increasing in body weight of 0.49 kilograms for a 1.70 meter tall person. We find no effect of working daily during evening, whatever the level of individual impulsiveness.

Table II.A.5 displays the results for night work. The estimates change again drastically between OLS and fixed-effect models. The fixed effects estimates show no evidence of a direct impact of transitioning from fixed day work to some night work, but we do find a significant interaction effect with impulsiveness for the modality "several times a week". Transitions from day work to night work several times a week generates a +0.24 points increase in BMI by standard deviation of impulsiveness (significant at the 1% level). This corresponds to a weight gain of +0.69 kilograms for a 1.70 meter tall person. Such transitions also produce a significant decrease in the propensity to follow a healthy diet, but for the more impulsive individuals only: the direct effect is not significant, but the interaction effect show a decrease of  $-0.08$  point on a four-points likert scale for an additional one standard deviation of impulsiveness.

Interestingly, we find significant interaction effects of impulsiveness for transitions to work schedules that include some evening or night shifts (the effects being higher for night shifts as compared to evening shifts). Yet, there are no interaction effects for transitions to daily evening or night work. This is consistent with the observation that irregular work schedules are associated with higher difficulties in organizing one's life in terms of behavioral habits (sleep, food), and social and family life (Colligan and Rosa, 1989), with potentially more negative consequences for impulsive individuals. It is not evening and night work per se that deteriorate health behaviors but the irregularity of time schedule.

## 4.2. Heterogeneity

The literature has largely documented the gender differences in self-control and impulsiveness (Cross, Copping and Campbell, 2011). The upper panel of Table II.A.6 thus provide fixed-effect estimation results by sex. Impulsive females tend to be more affected by irregular work schedule including evening and night shifts than impulsive males. For females, the interaction effect of impulsiveness is substantially higher for night work, with an impact of +0.34 points of BMI per standard deviation of impulsiveness for transitions to night work several times a week (significant at the 1% level). This corresponds to an increase of around 0.98 kilogram for a 1.70 meter tall female. Impulsive males are also significantly affected by such work transitions, with an average gain of +0.22 points of BMI per standard deviation of impulsiveness. Unlike women, they tend to care less about their diet, with an estimated reduction of -0.10 point per standard deviation of impulsiveness on the four-points healthy-diet scale.

It might be the case that transitions between work schedules affect differently white and blue collars, as they are assigned to jobs with very different requirements in terms of on-the-job physical activity, and different normative constraints regarding food and body sizes. A higher weight may then just be the result of a higher muscle mass invalidating the ego-depletion argument. The fixed-effect regression results in the middle panel of Table II.A.6 suggests that the average impact of transitions to evening or night shifts might indeed be higher for blue collars, but the moderating

role of impulsiveness effects do not differ markedly between these two population groups. We even find that transitions to alternating weekly night work is associated to a stronger decrease in sport and exercise for impulsive white collars.

### 4.3. Robustness Tests

We have included the unemployed in our estimation sample. One implicit assumption underlying this choice is that unemployed individuals' daily activities are more likely to occur during daytime than during night time. Shifting to evening and night work should then produce very similar effects for the employed and for the unemployed. The lower panel of Table II.A.6 shows indeed that excluding unemployed people from the estimations do not change our main results, which validates our assumption.

As following a health conscious diet and frequency of physical activity are ordinal variables, a linear regression model may yield misleading estimates of the effect of interest. The use of linear models for these ordinal variables was however deliberate because our empirical strategy relies on estimating the sign and the significance of the interaction term between impulsiveness and evening or night work. Riedl and Geishecker (2014) provide Monte-Carlo evidence that simple linear fixed effects model performs as well as non-linear fixed-effect models for ordered responses if the relative size of parameters and significance is the main interest of the researcher. In addition, estimating marginal effects of interaction term in non-linear fixed effect models is not straightforward.<sup>15</sup> We nevertheless examine the robustness of our results to the use of non-linear models, which are a priori more adapted to the modelling of ordinal responses. To identify the interaction effect, we have trichotomized the impulsiveness variable. The baseline is made of non-impulsive individuals, those with standardized impulsiveness below minus one standard deviation. Individuals are defined as impulsive if their normalized impulsiveness score is higher than minus one

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15. As Ai and Norton (2003) points out, "the magnitude of the interaction effect in nonlinear models does not equal the marginal effect of the interaction term, can be of opposite sign (..) ". They provide a way of estimating the magnitude and standard errors of interaction effects in non-linear model, but this does not apply when there are fixed-effects. Computing marginal effects in non-linear models with fixed effects is feasible only if one is willing to assume that all individuals have the same fixed effect (Karaca-Mandic, Norton and Dowd, 2012).

standard deviation, and very impulsive if they are above one standard deviation. With such trichotomization, we can perform an "as-if" difference-in-difference estimation, whereby we compare the impact of work transitions between the three impulsiveness groups. Non-linear conditional fixed-effect models are performed for the different health behaviours we observe in our sample. For BMI, we create a variable "overweight at risk" indicating an individual whose BMI is higher than 27, and we apply a conditional fixed effects logit estimator (Chamberlain, 1979). For the diet and sport variables, we use the 'Blow-Up and Cluster' estimator proposed by Baetschmann, Staub and Winkelmann (2015), which extends the conditional fixed-effect logit to multinomial variables.<sup>16</sup>

Tables II.B.5 and II.B.6 in Appendix A display the estimation results in log odds-ratio. The log odds-ratio for the interaction effects can be interpreted as differences in log odds associated to work transitions between a (very) impulsive individual and a non-impulsive individual, who have the same observed characteristics *and* have constant average unconditional response over the period of observation (Recall that the conditional fixed-effect approach consider the probability of response conditional on the average unconditional response over the period). The results confirm our previous findings. In particular, the interaction terms between night work several times a week and impulsive or very impulsive are significant in the risky overweight and diet regressions.

## 5. Discussion

Epidemiological studies suggests that health behaviors have a mediating role in the association between evening and night work and health. They provide cross-sectional evidence of correlations between night work and smoking, alcohol consumption, sleep duration or lack of regular exercise. As an illustration, Buchvold et al. (2015) find in a sample of 2059 nurses that night shifts are significantly and positively associated with BMI. Bushnell et al. (2010) display evidence of significant

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16. The idea of this estimator strategy is to replace every observation in the sample by  $K - 1$  copies of itself ("blow-up" the sample size), and dichotomize every  $K - 1$  copy of the individual at a different cutoff point and then estimate a conditional maximum likelihood logit using the entire sample.

associations between rotating night shifts and short sleep duration, smoking, lack of exercises and obesity in repeated cross-sections of workers in chemical and coatings factories. [Nabe-Nielsen et al. \(2011\)](#) examine a sample of health care female assistant with varying work schedules. They find that fixed night work is significantly associated with higher odds of smoking relapse, lower odds of smoking cessation, and lower odds of becoming physically active over a two-year period. However, two and three shifts with night work are associated with lower odds of weight gain, while fixed evening work and two shifts without night work are not associated with changes in health behaviors. These results suggest that the health impact of evening or night work depends on their weekly frequency.

Our results show that evening and night works are not systematically detrimental to BMI, diet and exercises. Contrary to previous evidence from epidemiological studies, only irregular evening or night work has a negative effect on health behaviors, and this relationship is observed almost only in trait-impulsive individuals. In the Appendix Tables [II.B.2](#) and [II.B.3](#), we display results from additional regressions without the interaction terms between impulsiveness and work schedules. The coefficients on the work schedule variables are virtually the same and are still not significant. This confirm that the effect of transition to evening and night work is significant only for people that are trait-impulsive.

The cross-sectional empirical evidence on a relationship between evening and night work, and health, are thus partly explained by selection effects on fixed unobservable traits. Having said that, even though we have lagged right-hand side variables and fixed-effects, there may still remain some selection on time-varying unobservable characteristics. We can not test this hypothesis, due to the lack of quasi-natural shocks on the distributions of work schedules in the German labor market. Even though the Hartz reforms affected the labor market in Germany during the period of analysis, there is no institutional changes that is closely and clearly related to evening and night work.

Our results are obtained under the assumption that impulsiveness is stable personality trait. It

might be possible that impulsiveness is not a trait but a skill that would be affected by transitions to evening and night work as a consequence of changes in the exertions of self-control resources.<sup>17</sup> Since we observe impulsiveness both in 2008 and 2014 for a fraction of our estimation sample, we can estimate potential changes in impulsiveness as a function of work schedules and occupational level. Table II.B.4 in Appendix provides fixed effect estimation results of regressions of impulsiveness measured at  $t$  on evening and night work variables, and the control variables that we used on previous regressions. The results show that transitions to work schedules implying evening or night shifts do not significantly impact the level of impulsiveness of individuals after controlling for standard sociodemographic characteristics and occupational factors.

The absence of interaction effects between fixed evening or night work and trait-impulsiveness might be surprising as we would have expected a monotonously increasing impact of evening or night work on health behaviours. Our results indeed suggest that irregular work schedules induce a specific fatigue in individuals, because there are associated with atypical lifestyles. Irregular time schedules are likely to be hard to reconcile with the regularity required by biological functions, social and family life. People who have fixed evening or night work may more easily adopt adaptive strategies to cope with the peculiarities of their environment, in terms of food habits, family life and so on. On the opposite, irregular work schedules generate more stress, fatigue and anxiety, with difficulties to implement efficient coping strategies, leading individuals to compensate negative affective states with unhealthy behaviors giving them immediate gratifications.

## Conclusion

We here have used SOEP data to analyze the effects of work schedules with evening and night shifts on health behaviors. We show that the negative health impacts of evening and night shifts are mostly related to self-control issues as it affects only impulsive individuals. We also find that

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17. There is some evidence that contemporaneous self-control abilities can be affected by past exertions of self-control, see (Palma et al., 2017)

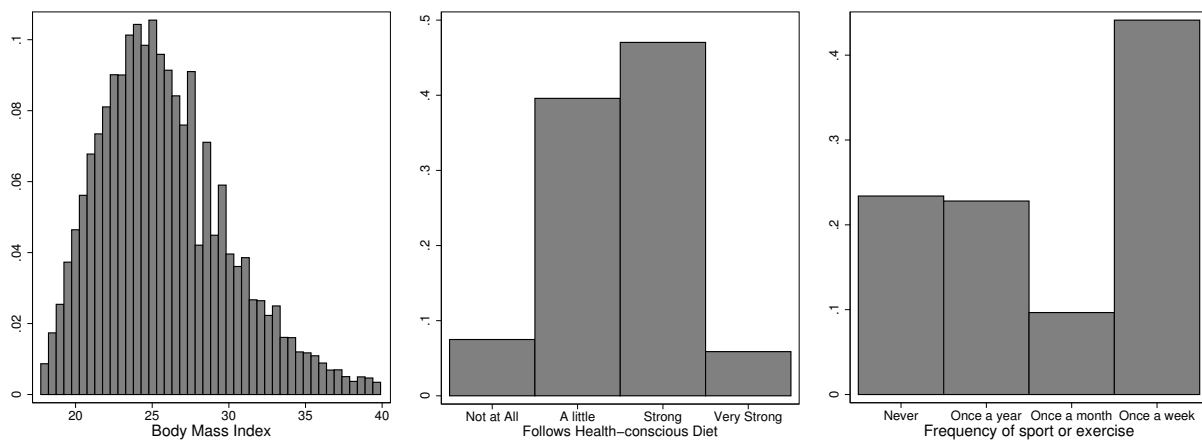
it is not evening and night work per se that causes impulsive individuals to change their behaviors, but rather the irregular schedules within a week with evening and night shifts alternating with day shifts. A likely explanation for this result is that individuals with irregular work schedules face specific stresses for organizing their social and family life, and disturbances of the circadian rhythm due to irregular wake/sleep cycles. We believe that these results are important in two ways. First, it is, to our knowledge the first paper that tries to build a bridge between epidemiological evidence, psychological literature and economic modeling. Second, the use of evening and night shifts should become a concern to public policies as it may impair some worker's health through the channel we discussed in the paper.





## II.A. Tables and Figures

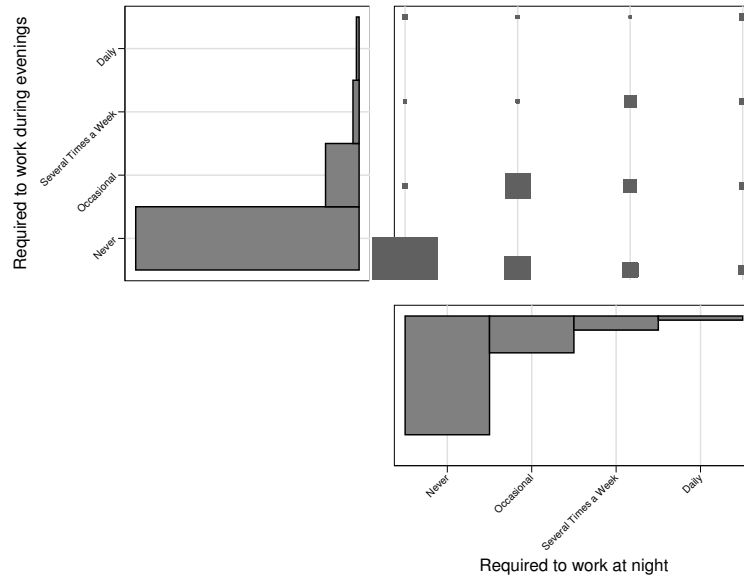
Figure II.A.1: Distributions of health behaviors



Source : The German Socio-economic Panel

**Note:** The figure displays the histograms of body mass index, adherence to a health-conscious diet, and frequency of sport and exercises in the GSOEP subsample used for the estimations. This estimation sample excludes the 1% and the 99 % quantiles on the distribution of BMI to avoid outliers in the statistical analysis.

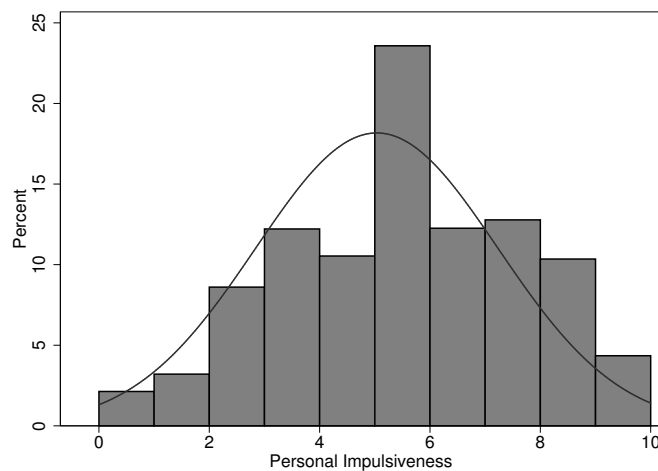
Figure II.A.2: Correlation between Night Work (upper-left) and Evening Work (lower-right)



Source: German Socioeconomic Panel (GSOEP)

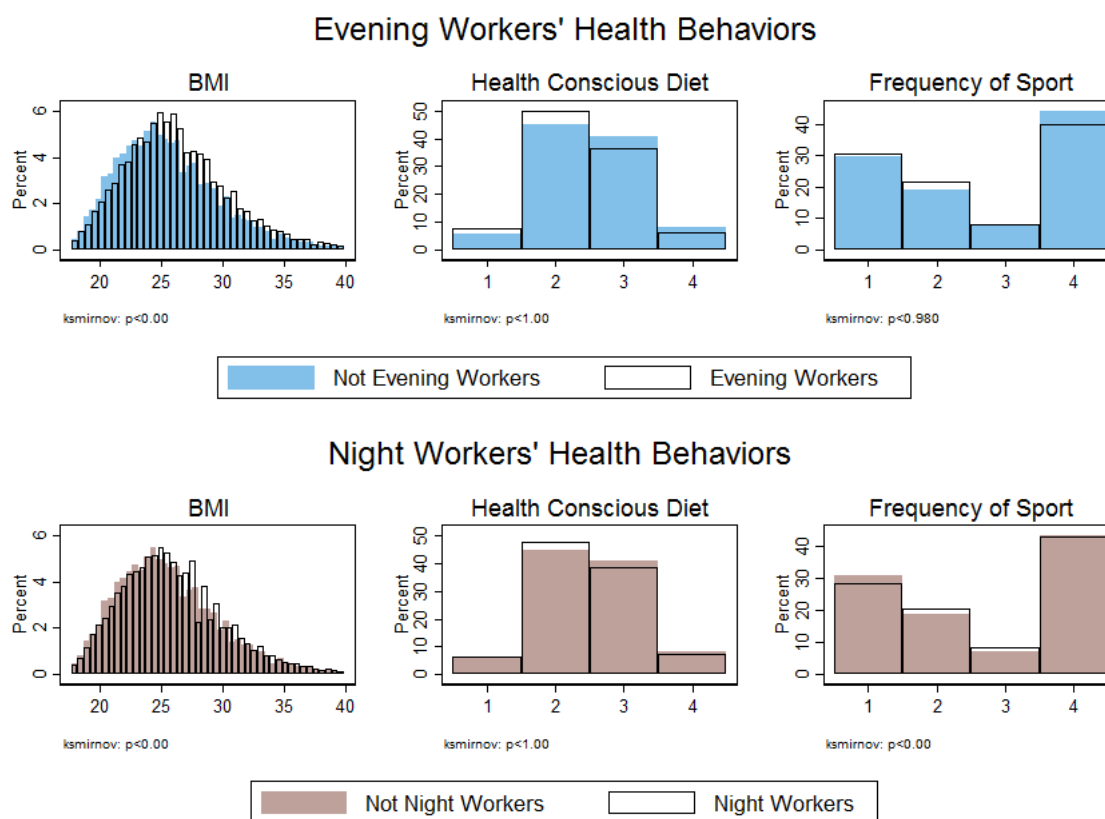
**Note:** The figure displays the histograms of frequency of night work at the top left and evening work at the bottom right. The graph at the bottom right displays the cross density of evening and night work. Larger squares correspond to higher densities. Data: GSOEP, our estimation sample.

Figure II.A.3: Impulsiveness distribution



**Note:** The figure displays the histogram of the impulsiveness trait which is measured on a 10-point likert scale. We provide a normal distribution as a comparison benchmark to put the emphasis that the trait is well distributed and does not seem to be affected by corner solutions. Data: GSOEP, our estimation sample.

Figure II.A.4: Comparisons of health behaviors



**Notes:** Our estimation sample. The figure displays the histogram of health behaviors presented above by comparing individuals that worked at least one year during evening/night work. Data: GSOEP, our estimation sample.

Table II.A.1: Transition Probabilities for Evening work

<b>Evening Work</b>		<i>t</i>			
		Never	Occasionally	Sev. Times	Daily
<i>t - 1</i>	Never	85.02	10.74	3.07	1.17
	Occasionally	27.57	57.96	12.29	2.18
	Several Times a week	16.55	24.18	48.56	10.70
	Daily	15.06	11.14	31.02	42.77
Total		62.49	23.29	10.56	3.66

**Note:** The figure displays the transition probabilities of frequencies of night work. The rows reflect the initial frequencies of night work for individuals, and the columns reflect the final frequencies. Data: GSOEP, our estimation sample.

Table II.A.2: Transition Probabilities for Night Work

<b>Night Work</b>		<i>t - 1</i>			
		Never	Occasionally	Sev. Times	Daily
<i>t</i>	Never	91.75	6.58	1.09	0.58
	Occasionally	37.33	52.60	8.05	2.03
	Several Times a week	26.97	27.53	39.04	6.46
	Daily	21.32	13.24	17.65	47.79
Total		80.53	14.25	3.63	1.60

**Note:** The figure displays the transition probabilities of frequencies of evening work. The rows reflect the initial frequencies of evening work for individuals, and the columns reflect the final frequencies. Data: GSOEP, our estimation sample.

Table II.A.3: Descriptive statistics of the sample for sociodemographic variables

	N	Mean	Std. Deviation	Min	Max
Age of Individual	31,097	43.04	10.40	19.00	59.00
Annual Household Income	31,097	47,295.17	34,331.72	160.00	1,497,595
Annual Working Hours	31,097	1,871.93	842.00	0.00	6,654
Married	31,097	60%		0	1
Widowed	31,097	1%		0	1
Divorced	31,097	10%		0	1
Separated	31,097	2%		0	1
Number of Persons in the Household	31,097	2.84	1.24	1	14
Number of Children in the Household	31,097	0.61	0.90	0	8
Female	31,097	50%		0	1
Employed	31,097	92%		0	1

**Note:** This table provides descriptive statistics of the main control variables in the regression model. The variable *married*, *widowed*, *Divorced* and *separated* are dummies variables. The means represent therefore the percentage of individuals in the sample that are in each category. Data: GSOEP, our estimation sample.

Table II.A.4: Evening Work and Impulsiveness on Health Behaviors

VARIABLES	BMI		Health Conscious Diet		Sport or Exercises	
	(1) OLS	(2) FE	(3) OLS	(4) FE	(5) OLS	(6) FE
Impulsive	<b>0.21***</b> (0.05)		<b>-0.02***</b> (0.00)		0.02 (0.01)	
Occasional evening work	<b>0.27***</b> (0.06)	0.04 (0.03)	<b>-0.04***</b> (0.01)	-0.00 (0.01)	<b>-0.05***</b> (0.01)	<b>-0.04**</b> (0.01)
Several times a week evening work	<b>0.21**</b> (0.09)	<b>0.07*</b> (0.04)	<b>-0.04***</b> (0.01)	-0.01 (0.01)	<b>-0.13***</b> (0.02)	<b>-0.10***</b> (0.02)
Daily evening work	0.14 (0.16)	-0.01 (0.06)	<b>-0.07***</b> (0.02)	-0.04 (0.02)	<b>-0.36***</b> (0.04)	<b>-0.11***</b> (0.04)
Occasional evening work × Impulsive	0.03 (0.07)	0.04 (0.03)	0.01 (0.01)	0.00 (0.01)	-0.00 (0.02)	-0.02 (0.02)
Several Times a week evening work × Impulsive	0.11 (0.10)	<b>0.10*</b> (0.05)	<b>0.03*</b> (0.01)	-0.02 (0.02)	-0.04 (0.02)	-0.00 (0.03)
Daily evening work × Impulsive	0.08 (0.17)	0.06 (0.07)	<b>0.05*</b> (0.02)	0.02 (0.03)	-0.06 (0.05)	0.01 (0.04)
Observations	31,077	31,077	31,044	31,044	32,924	32,924
Fixed Effect	No	Yes	No	Yes	No	Yes
N		13,790		13,784		13,993

**Note:** This table presents the estimations results for model (II.7), using as dependent variable BMI in column (1) and (2), following a health-conscious diet in column (3) and (4) and frequency of sport or exercises in column (5) and (6). The main independent variables corresponds to the interaction between impulsiveness and evening work. OLS stands for the analysis using a pooled Ordinary Least Squares Regression and FE stands for the analysis using Individual fixed-effects Ordinary Least Squares Regression. Standard deviations are clustered at the individual level. Estimates represent marginal effects with \*\*\* (p<0.01), \*\* (p<0.05), \* (p<0.1). Exogenous control variables include age, age squared, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes.

Table II.A.5: Night Work and Impulsiveness on Health Behaviors

VARIABLES	BMI		Health Conscious Diet		Sport or Exercises	
	(1) OLS	(2) FE	(3) OLS	(4) FE	(5) OLS	(6) FE
Impulsive	<b>0.23**</b> (0.04)		<b>-0.01*</b> (0.00)		0.01 (0.01)	
Occasional night work	<b>0.29***</b> (0.07)	<b>0.09**</b> (0.03)	<b>-0.03***</b> (0.01)	<b>-0.02*</b> (0.01)	<b>-0.08***</b> (0.02)	<b>-0.03*</b> (0.02)
Several Times a week night work	<b>0.28*</b> (0.15)	0.07 (0.07)	0.00 (0.02)	-0.00 (0.02)	<b>-0.10**</b> (0.044)	-0.05 (0.04)
Daily night work	<b>0.48*</b> (0.25)	0.07 (0.11)	<b>-0.06*</b> (0.03)	0.00 (0.04)	<b>-0.38***</b> (0.06)	-0.10 (0.07)
Occasional night work × Impulsive	0.01 (0.08)	-0.01 (0.04)	0.01 (0.01)	-0.00 (0.01)	0.02 (0.02)	<b>-0.04*</b> (0.02)
Several Times a week night work × Impulsive	0.21 (0.18)	<b>0.24***</b> (0.09)	-0.00 (0.03)	<b>-0.08**</b> (0.03)	-0.03 (0.05)	-0.06 (0.05)
Daily night work × Impulsive	-0.12 (0.26)	0.07 (0.15)	0.05 (0.04)	0.03 (0.05)	-0.02 (0.07)	0.03 (0.08)
Constant	28.08*** (0.895)	18.48*** (0.814)	0.61*** (0.144)	1.339*** (0.280)	-1.287*** (0.237)	0.49 (0.45)
Observations	30,110	30,110	30,077	30,077	31,912	31,912
Fixed Effect	No	Yes	No	Yes	No	Yes
N		13,635		13,629		13,852

**Note:** This table presents the estimations results for model (II.7), using as dependent variable BMI in column (1) and (2), following a health-conscious diet in column (3) and (4) and frequency of sport or exercises in column (5) and (6). The main independent variables corresponds to the interaction between impulsiveness and night work. OLS stands for the analysis using a pooled Ordinary Least Squares Regression and FE stands for the analysis using Individual fixed-effects Ordinary Least Squares Regression. Standard deviations are clustered at the individual level. Estimates represent marginal effects with \*\*\* (p<0.01), \*\* (p<0.05), \* (p<0.1). Exogenous control variables include age, age squared, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes.



Table II.A.6: Comparison of evening and night work interaction effects on health behaviors using different subsamples - Individual Fixed Effects Regressions

VARIABLES SUBSAMPLE	BMI		Health Conscious Diet		Sport or Exercises	
	(Males)	(Females)	(Males)	(Females)	(Males)	(Females)
Occasional evening work × Impulsive	0.04 (0.04)	0.05 (0.05)	-0.02 (0.02)	0.03 (0.01)	-0.00 (0.03)	-0.01 (0.02)
Several Times a week evening work × Impulsive	0.04 (0.07)	<b>0.20**</b> (0.08)	<b>-0.07**</b> (0.02)	0.01 (0.02)	-0.00 (0.04)	0.00 (0.04)
Daily evening work × Impulsive	0.06 (0.10)	0.09 (0.12)	-0.02 (0.04)	<b>0.09*</b> (0.05)	0.02 (0.05)	0.05 (0.07)
Occasional night work × Impulsive	0.01 (0.04)	-0.05 (0.07)	-0.00 (0.02)	0.00 (0.02)	-0.04 (0.03)	-0.06 (0.04)
Several Times a week night work × Impulsive	<b>0.22**</b> (0.11)	<b>0.34**</b> (0.16)	<b>-0.10**</b> (0.04)	-0.05 (0.05)	-0.08 (0.05)	-0.03 (0.08)
Daily night work × Impulsive	0.21 (0.17)	-0.15 (0.28)	-0.01 (0.06)	0.12 (0.09)	0.07 (0.09)	0.06 (0.12)
SUBSAMPLE	(Blue-collar)	(White-collar)	(Blue-collar)	(White-collar)	(Blue-collar)	(White-collar)
Occasional evening work × Impulsive	0.07 (0.06)	0.05 (0.05)	0.01 (0.02)	0.00 (0.01)	0.04 (0.03)	<b>-0.05*</b> (0.03)
Several Times a week evening work × Impulsive	0.12 (0.08)	<b>0.16**</b> (0.08)	-0.02 (0.03)	-0.03 (0.02)	0.03 (0.04)	-0.01 (0.04)
Daily evening work × Impulsive	0.13 (0.11)	0.04 (0.13)	0.04 (0.05)	0.01 (0.04)	0.02 (0.06)	-0.01 (0.06)
Occasional night work × Impulsive	-0.03 (0.06)	0.03 (0.06)	-0.00 (0.02)	-0.00 (0.02)	0.00 (0.03)	<b>-0.08**</b> (0.03)
Several Times a week night work × Impulsive	<b>0.26*</b> (0.13)	<b>0.33**</b> (0.13)	<b>-0.08</b> (0.05)	<b>-0.11**</b> (0.04)	-0.05 (0.06)	-0.07 (0.07)
Daily night work × Impulsive	0.05 (0.21)	0.16 (0.27)	0.09 (0.07)	0.03 (0.08)	0.11 (0.09)	-0.02 (0.1)
SUBSAMPLE	(E+U)	(E)	(E+U)	(E)	(E+U)	(E+U)
Occasional evening work × Impulsive	0.05 (0.03)	0.04 (0.03)	0.00 (0.01)	0.00 (0.01)	-0.02 (0.02)	-0.01 (0.02)
Several Times a week evening work × Impulsive	0.10* (0.05)	0.08 (0.05)	-0.02 (0.02)	-0.03 (0.02)	-0.00 (0.03)	0.00 (0.03)
Daily evening work × Impulsive	0.07 (0.07)	0.00 (0.07)	0.02 (0.03)	0.03 (0.03)	0.01 (0.04)	0.01 (0.05)
Occasional night work × Impulsive	-0.01 (0.04)	0.01 (0.04)	-0.00 (0.01)	-0.00 (0.01)	<b>-0.04*</b> (0.02)	<b>-0.04*</b> (0.02)
Several Times a week night work × Impulsive	<b>0.23**</b> (0.09)	<b>0.24***</b> (0.08)	<b>-0.07**</b> (0.03)	<b>-0.09**</b> (0.03)	-0.06 (0.05)	-0.07 (0.05)
Daily night work × Impulsive	0.08 (0.15)	0.10 (0.15)	0.04 (0.05)	0.06 (0.05)	0.03 (0.08)	-0.00 (0.09)

**Note:** This table represents the summary of the interaction effects of evening/night work and impulsiveness on health behaviors using different stratifications of the estimation sample. All results are from fixed effect regressions, specification II.7. The upper panel provides the interactions effects separately for males and females for both evening work and night work. The middle panel provides similar results for blue collar and white collar. The lower panel compares the results between the original sample (E+U: Employed + Unemployed) and a sample that includes only employed individuals (E). Standard deviations are clustered at the individual level. Estimates represent marginal effects with \*\*\* (p<0.01), \*\* (p<0.05), \* (p<0.1). Exogenous control variables include age, age squared, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes. When we exclude the unemployed, we loose 973, 972 and 1,024 individuals for BMI, adherence to a health conscious diet and frequency of sport or exercises respectively.

## II.B. Additional Results

Table II.B.1: Comparison of the descriptive statistics between the general population and the estimation sample

	Mean Original Sample	Mean Studied Subset	Difference	p-value
Age of Individual	37.25 (0.05)	43.04 (0.06)	-5.79 (0.08)	0.00
Annual Household Income	39,418.70 (140.28)	47,295.17 (194.69)	-7,876.47 (233.71)	0.00
Annual Working Hours	984.32 (5.05)	1,871.93 (4.77)	-887.61 (7.21)	0.00
Married	54% (0.00)	60% (0.00)	6% (0.00)	0.00
Widowed	1% (0.00)	1% (0.00)	0% (0.00)	0.01
Divorced	9% (0.00)	10% (0.00)	-1% (0.00)	0.01
Separated	5% (0.00)	2% (0.00)	3% (0.00)	0.00
Number of persons in the Household	3.53 (0.01)	2.84 (0.01)	0.69 (0.01)	0.00
Number of Children in the Household	1.32 (0.01)	0.61 (0.01)	0.70 (0.01)	0.00
Female	58% (0.00)	50% (0.00)	9% (0.00)	0.00
Employment Status of Individual	63% (0.00)	92% (0.00)	-30% (0.00)	0.00
<i>N</i>	43,527	31,097		

**Note:** This table displays tests of the sociodemographic difference between the sample of the representative population and the studied subsample, with p-values in the last column. The first sample corresponds to individuals whose age is below 60 in 2008, 2010, 2012 and 2014. The estimation subsample is the set of observations that allows to estimate the parameters of the first fixed-effect regression with BMI as the dependent variable. The exclusion criteria remain the same as we look for individuals below 60 interviewed at the dates described above. The table suggests that the sample we study is not representative of the population as the main characteristics of the population show a large discrepancy. Standard errors are in parenthesis

Table II.B.2: Effect of evening work on health behaviors without interaction terms - Individual fixed effect regression

VARIABLES	BMI		Health Conscious Diet		Sport or Exercises	
	(1) OLS	(2) FE	(3) OLS	(4) FE	(5) OLS	(6) FE
Occasional evening work	<b>0.28***</b> (0.06)	0.04 (0.03)	<b>-0.04***</b> (0.01)	-0.00 (0.01)	<b>-0.05***</b> (0.01)	<b>-0.04**</b> (0.01)
Several Times a week evening work	<b>0.24**</b> (0.09)	<b>0.08**</b> (0.04)	<b>-0.04***</b> (0.01)	-0.01 (0.01)	<b>-0.13***</b> (0.02)	<b>-0.10***</b> (0.02)
Daily evening work	0.17 (0.16)	-0.00 (0.06)	<b>-0.07**</b> (0.02)	-0.03 (0.02)	<b>-0.36***</b> (0.04)	<b>-0.10***</b> (0.042)
Constant	27.88*** (0.89)	18.29*** (0.78)	0.58*** (0.14)	1.28*** (0.27)	-1.46*** (0.23)	0.61 (0.43)
Observations	31,077	31,077	31,044	31,044	33,029	33,029
Fixed Effect	No	Yes	No	Yes	No	Yes
<i>N</i>		13,790		13,784		14,098

**Note:** This table represents estimates of regressions of model (II.7) using as dependent variable BMI in column (1) and (2), following a health-conscious diet in column (3) and (4) and frequency of sport or exercises in column (5) and (6). The main independent variables corresponds to evening work. OLS stands for the analysis using a pooled Ordinary Least Squares Regression and FE stands for the analysis using Individual fixed-effects Ordinary Least Squares Regression. Each regression is clustered at the individual level. Estimates represent marginal effects with \*\*\* ( $p < 0.01$ ), \*\* ( $p < 0.05$ ), \* ( $p < 0.1$ ). Exogenous control variables include age, quadratics of age, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes

Table II.B.3: Effect of night work on health behaviors without interaction effects - Individual fixed effect regression

VARIABLES	BMI		Health Conscious Diet		Sport or Exercises	
	(1) OLS	(2) FE	(3) OLS	(4) FE	(5) OLS	(6) FE
Occasional night work	<b>0.29***</b> (0.07)	<b>0.09**</b> (0.03)	<b>-0.03***</b> (0.01)	<b>-0.02*</b> (0.01)	<b>-0.08***</b> (0.02)	<b>-0.03*</b> (0.02)
Several Times a week night work	0.31** (0.15)	0.10 (0.07)	0,00 (0.02)	-0.00 (0.02)	<b>-0.11***</b> (0.04)	-0.05 (0.04)
Daily night work	<b>0.63**</b> (0.27)	0.09 (0.12)	-0.06 (0.04)	0.01 (0.04)	<b>-0.39***</b> (0.06)	-0.09 (0.07)
Constant	27.81*** (0.89)	18.43*** (0.81)	0.61*** (0.14)	1.32*** (0.28)	-1.29*** (0.23)	0.50 (0.45)
Observations	29,951	29,951	29,919	29,919	32,014	32,014
Fixed Effect	No	Yes	No	Yes	No	Yes
<i>N</i>		13,607		13,601		13,954

**Note:** This table represents estimates of regressions of model (II.7) using as dependent variable BMI in column (1) and (2), following a health-conscious diet in column (3) and (4) and frequency of sport or exercises in column (5) and (6). The main independent variables corresponds to night work. OLS stands for the analysis using a pooled Ordinary Least Squares Regression and FE stands for the analysis using Individual fixed-effects Ordinary Least Squares Regression. Each regression is clustered at the individual level. Estimates represent marginal effects with \*\*\* (p<0.01), \*\* (p<0.05), \* (p<0.1). Exogenous control variables include age, quadratics of age, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes

Table II.B.4: Effect of atypical working hours on impulsiveness - Individual Fixed Effect linear regression

VARIABLES	(1) Impulsiveness	(2) Impulsiveness
Alternating weekly evening work	-0.031 (0.068)	
Several Times a week evening work	0.0073 (0.097)	
Daily evening work	-0.103 (0.162)	
Alternating weekly night work		-0.099 (0.080)
Several Times a week night work		-0.128 (0.166)
Daily night work		0.214
<i>Observations</i>	18,136	17,597
<i>N</i>	12,926	12,697

**Note:** This table represents estimates of regressions of model with impulsiveness as dependent variable. The main independent variables corresponds to evening work in column (1) and night work in column (2). Individual fixed-effects Ordinary Least Squares Regression are used to estimate the coefficients. Each regression is clustered at the individual level. Estimates represent marginal effects with \*\*\* (p<0.01), \*\* (p<0.05), \* (p<0.1). Exogenous control variables include age, quadratics of age, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code), state of residence, number of working hours and risk attitudes

Table II.B.5: Interaction effects of night work and impulsiveness in non-linear regression models - Conditional logistic regression for overweight at risk and "blow-up and cluster" logistic regression for diet and sport

VARIABLES	clogit	BUC	BUC
	(1) Overweight at risk	(2) Diet	(3) Sport
Occasional Evening work	-0.16 (0.27)	0.15 (0.13)	-0.04 (0.13)
Several Times a Week Evening Work	-0.11 (0.45)	0.04 (0.20)	-0.23 (0.21)
Daily Evening Work	-1.39 (1.23)	<b>-0.68*</b> (0.36)	<b>-0.60*</b> (0.33)
Impulsive × Occasional Evening Work	0.49 (0.30)	-0.19 (0.14)	0.00 (0.15)
Very impulsive × Occasional Evening Work	<b>0.87**</b> (0.40)	-0.05 (0.17)	0.02 (0.19)
Impulsive × Several Times a week Evening Work	0.71 (0.49)	-0.09 (0.22)	0.11 (0.22)
Very impulsive × Several Times a week Evening Work	<b>1.29**</b> (0.60)	-0.32 (0.27)	-0.19 (0.28)
Impulsive × Daily Evening Work	1.67 (1.27)	0.59 (0.39)	0.39 (0.37)
Very impulsive × Daily Evening Work	1.41 (1.33)	0.49 (0.44)	0.63 (0.44)
Observations	3,918	18,782	31,550
N	1,212		
Fixed Effect	Yes	Yes	Yes

**Note:** \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . In the first column, the dependent variable is a dichotomous variable indicating whether an individual is overweight at risk ( $bmi > 27$ ). This BMI status refer to the NHS recommendations. Coefficients represent log of odd-ratios and are estimated by using a conditional logit model. In the second and third column, we still use the variables of the propensity of adopting a healthy diet and the frequency of sport and exercises but we use an estimator that may be better fitted for ordered modalities. We estimate coefficients associated to the different frequencies of work and their interactions using a blow-up and cluster estimator. Exogenous control variables include age, age squared, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code).

Table II.B.6: Interaction effects of night work and impulsiveness in non-linear regression models - Conditional logistic regression for overweight at risk and "blow-up and cluster" logistic regression for diet and sport

VARIABLES	clogit	BUC	BUC
	(1) Overweight at risk	(2) Diet	(3) Sport
Occasional night work	-0.29 (0.33)	0.09 (0.14)	-0.22 (0.15)
Several Times a Week night work	-1.40 (0.97)	<b>0.77**</b> (0.34)	-0.49 (0.33)
Daily night Work	-1.04 (1.33)	-0.34 (0.43)	-1.06** (0.49)
Impulsive × Occasional night work	0.48 (0.36)	-0.18 (0.16)	0.14 (0.17)
Very impulsive × Occasional night work	0.48 (0.50)	-0.13 (0.21)	-0.23 (0.22)
Impulsive × Several Times a week night work	<b>1.76*</b> (1.01)	<b>-0.89**</b> (0.37)	0.46 (0.36)
Very impulsive × Several Times a week night work	<b>2.72**</b> (1.20)	<b>-1.04**</b> (0.45)	-0.19 (0.48)
Impulsive × Daily night Work	1.12 (1.40)	0.41 (0.49)	<b>1.12**</b> (0.56)
Very impulsive × Daily night Work	1.46 (1.51)	0.48 (0.56)	0.65 (0.62)
<i>Observations</i>	3,737	17,902	30,069
<i>N</i>	1,168		
<i>Fixed Effect</i>	Yes	Yes	Yes

**Note:** \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . In the first column, the dependent variable is a dichotomous variable indicating whether an individual is overweight at risk ( $bmi > 27$ ) and coefficients are estimated by using a conditional logit model. In the second and third column, we use the same dependent variables as the one in the core of the paper but we estimate coefficients associated to the different frequencies of work and their interactions using a blow-up and cluster estimator. Estimates represent log of odd-ratios. Exogenous control variables include age, age squared, number of years of education, logarithm of the household income, marital status, number of persons and number of children in the household, the occupation of the individual (one digit industry code).

**MEASURING IDENTITY ORIENTATIONS FOR  
UNDERSTANDING PREFERENCES:  
A French Validation of the Aspects-of-Identity  
Questionnaire**

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*This chapter is a joint work with Fabrice Étilé.*

*“My name is Nobody.  
Nobody I am called by mother, father,  
and by all my comrades.”*

*-“Ulysses” in *The Odyssey* by Homer,*

## **1. Introduction**

Why does the concept of *individual* identity matter for economists? Introducing the notion of identity in economics raises questions about our understanding of the ontology of individuals, as s/he is defined in theoretical models, or observed and analysed in empirical works. Standard microeconomics is built on the implicit premise that individuals have a personal identity, as they are distinct from one another and can be re-identified over time (Davis, 1995, 2013). Individuation is required to model human beings as autonomous decision-makers with an agency power over their existence and becoming. Re-identification over time is required to analyse inter-temporal



decisions in a consequentialist perspective. Individuation and re-identification are thus logically necessary criteria for the ontological existence of individual economic agents, *i.e.* for them to be “the most basic entities (...) said to occupy the world” (Davis, 1995).<sup>1</sup>

The issues of individuation and re-identification are of practical concerns for applied economists because they point to important research questions: Are preferences stable? Why should people be held or feel morally responsible for their past actions? Why do we have self-regarding prudential concerns? How consistent ought to be our decisions over time?<sup>2</sup> These questions emphasise the essential link between individual identity on the one hand, and economic preferences on the other. Economic research on preference formation can therefore benefit from the availability of measures assessing individual variations in identity.<sup>3</sup> In this perspective, we here propose, translate and validate a French version of the Aspects-of-Identity Questionnaire (AIQ-IV), which has been developed since twenty years by Jonathan Cheek and colleagues (Cheek and Briggs, 1982, Cheek, 1989, Cheek, Smith and Tropp, 2002, Cheek and Briggs, 2013, Cheek et al., 2014).<sup>4</sup>

The AIQ-IV provides a metric to measure the relative importance that individual grants to four domains of identity attributes (1) attributes that make her feel unique, or personal identity; (2) attributes that matter for personal relationships, or relational identity; (3) attributes that play a role in public settings, or public identity; (4) attributes pointing to collective affiliations, or collective

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1. For the Merriam-Webster dictionary, an ontology is either a “branch of metaphysics concerned with the nature and relations of being”, or a “particular theory about the nature of being or the kind of things that have existence”. For the Cambridge dictionary, it is “the part of philosophy that studies what it means to exist”. Re-identification here has to be understood as “being the same person”. Of course, individuals also have an institutional identity (civil status, fiscal number etc.) that can re-identify them. But this does not fully inform us about the stability of personal characteristics, such as economic preferences.

2. See the entry “*Personal Identity and Ethics*” in the Stanford Encyclopedia of Philosophy. (Strotz, 1956) already raised some of these issues in his pioneering analysis of inconsistency in dynamic decision problems. He implicitly related them to these issues of individuation and re-identification when he argued that “consumer sovereignty has no meaning in the context of the dynamic decision-making problem (because) the individual is an infinity of individuals, and the familiar problems of interpersonal utility comparisons are there to plague us” (p. 179). He also explained the lack of demand for pre-commitment – a strategy ensuring time consistency - to “the presence of risk and uncertainty, both as to future tastes and future opportunities” (p. 173), *i.e.* the mere fact that one’s future self is necessarily different from one’s present self.

3. Of course, the burgeoning field of social identity studies may also exploit measures that cover dimensions of individual identity going beyond collective affiliations.

4. We asked for the permission of the authors before starting this work.

identity.<sup>5</sup> The development of this scale started in 1979 with a selection of items (personal attributes) from (Sampson, 1978) distinguishing between private and social aspects of identity. The fourth version of the Aspect of Identity Questionnaire highlights the presence of four domains including the orientation of personal, relational, public and collective identity. Participants have to rate the relative importance of thirty-five items for their "sense of who they are" on a 5-points Likert scale from "not at all important"(1) to "extremely important"(5). Ten items relate to personal identity, ten to relational identity, seven to public identity and eight to collective identity. We applied back-and-forth translation to these items in order to produce a first French version of the questionnaire for the validation procedure (see Table III.1 for the wording).

The validation procedure relies on statistical techniques that are specific to the field of psychometrics (Dickes et al., 1994). A pre-test of the translated version of the questionnaire was implemented to test its understandability. Additional items were also tested in order to improve its psychometric properties. We establish the internal validity of the questionnaire using data from a large sample of French young adults (N=1,118). Exploratory factor analyses (EFA) is used to select and test the consistency of items relative to the underlying latent structure. It reveals four factors corresponding to the four aspects of identity (personal, relational, public and collective). Confirmatory factor analyses validates the internal structure of the resulting questionnaire. Results from a test-retest survey in a smaller sample demonstrates the stability of responses over time. The scales corresponding to each of the four factors correlate as expected with theoretically similar constructs (Self esteem, Social Self esteem, Self-consciousness). This demonstrates the external validity of the questionnaire. Last but not least, we display evidence that the four identity scales predicts economic preferences measured with Likert-scale, such as impulsiveness, patience, risk-taking and pro-social behaviours. We thus propose a new tool to understand how economic preferences are formed. It also complete existing psychometric measures, such as the Big-5 questionnaire. The validated questionnaire is displayed in Appendix III.A

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5. We believe that the use of the term "personal" to label the first dimension of identity is confusing and inappropriate, as personal identity refers to all attributes, from the most intimate and private to the most public and social, that we are able to list because we are persons, i.e. human beings with special mental properties such that others regard us as individuals. Nevertheless we stick in this paper to the labels proposed by Cheek and Briggs (2013).

The remainder of the paper is organized as follows. Section 2 briefly develops the conceptual background of the scale. Section 3 describes the empirical procedure. Section 4 presents the results. Section 5 examines the correlations between the four aspects of identity and economic preferences. Section 6 concludes with a brief research agenda.

Table III.1: French translation of AIQ-IV items

Item	Original Version (AIQ-IV)	French Version
1 (Pe)	My personal values and moral standards	Mes valeurs et mes principes
2 (Pe)	My dreams and imagination	Mes rêves
3 (Pe)	My personal goals and hopes for the future	Mes projets et aspirations personnels pour l'avenir
4 (Pe)	My emotions and feelings	Mes émotions et mes sentiments
5 (Pe)	My thoughts and ideas	Mes pensées et mes idées
6 (Pe)	The ways I deal with my fears and anxieties	Mes peurs et mes angoisses
7 (Pe)	My feeling of being a unique person, being distinct from others	Mon sentiment d'être une personne unique, d'être différent des autres
8 (Pe)	Knowing that I continue to be essentially the same inside even though life involves many external changes	Savoir qu'au fond de moi, je resterai toujours la même personne
ii (Pe)	My self-knowledge, my ideas about what kind of person I really am	Ma connaissance de moi-même, mes idées sur qui je suis vraiment
10 (Pe)	My personal self-evaluation, the private opinion I have of myself	Mon auto-évaluation, l'opinion privée que j'ai de moi-même
11 (Pe)	My relationships with the people I feel close to	Mes relations avec les personnes dont je me sens proche
12 (Re)	My feeling of connectedness with those I am close to	Mon sentiment de proximité avec mes proches
13 (Re)	Being a good friend to those I really care about	Être un bon ami pour ceux à qui je tiens vraiment
14 (Re)	My commitment to being a concerned relationship partner	Mon engagement à être un conjoint attentionné
15 (Re)	Sharing significant experiences with my close friends	Partager des expériences marquantes avec des amis proches
16 (Re)	Having mutually satisfying personal relationships	Entrettenir des relations personnelles mutuellement enrichissantes
17 (Re)	Connecting on an intimate level with another person	Atteindre un certain niveau d'intimité avec une autre personne
18 (Re)	Developing caring relationships with others	Développer des relations bienveillantes avec les autres
19 (Re)	My desire to understand the true thoughts and feelings of my best friend or romantic partner	Ma volonté de comprendre les pensées et sentiments profonds de mon/ma meilleur.e ami.e ou partenaire amoureux
20 (Re)	Having close bonds with other people	Créer des liens forts avec les autres
21 (Pu)	My popularity with other people	Ma popularité
22 (Pu)	The ways in which other people react to what I say and do	La façon dont les gens réagissent à mes propos ou mes actions
23 (Pu)	My physical appearance: my height, my weight, and the shape of my body	Mon apparence physique
24 (Pu)	My reputation, what others think of me	Ma réputation, ce que les autres pensent de moi
25 (Pu)	My attractiveness to other people	L'attrait que je peux susciter chez d'autres personnes
26 (Pu)	My gestures and mannerisms, the impression I make on others	Mes gestes et mes manières, l'impression que je donne aux autres
27 (Pu)	My social behavior, such as the way I act when meeting people	Mon comportement social, comme par exemple mes manières d'agir quand je rencontre des personnes
28 (Co)	Being a part of the many generations of my family	Faire partie d'une longue lignée familiale
29 (Co)	My race or ethnic background	Mes origines sociales et culturelles
30 (Co)	My religion	Ma religion
31 (Co)	Places where I live or where I was raised	Les lieux où j'ai habité et où j'ai grandi
32 (Co)	My feeling of belonging to my community	Mon sentiment d'appartenir à une communauté ou à un collectif
33 (Co)	My feeling of pride in my country, being proud to be a citizen	Mon sentiment de fierté envers mon pays, être fier d'être citoyen
34 (Co)	My commitments on political issues or my political activities	Mes convictions et engagements politiques
35 (Co)	My language, such as my regional accent or dialect or a second language that I know	Mon langage (ma langue natale, mon accent régional, un dialecte ou les langues que j'ai apprises)

**Note:** Original items of the Aspect of Identity Questionnaire (AIQ-IV) and their French translation. Every item has been translated back and forth by two independent native English speakers. Pe, Re, Pu and Co refer respectively to personal identity, relational identity, social identity and collective identity. The subject has to rate these items on a 5 point scales, from “not at all important to my sense of who I am” to “very important to my sense of who I am”

## 2. Conceptual background

### 2.1. Identity and self-reflectivity in economics

In the neo-classical model of human behaviour, individual identity boils down to stable and consistent economic preferences revealed through choices made under external constraints. Apparent variations in tastes can be accommodated for by the definition of stable meta-preferences over consumption goods and various forms of capital that accumulate as a consequence of past choices and investments (Stigler and Becker, 1977). Individuals are defined by *what* they are in terms of preferences, endowments and information (Davis, 1995, Kirman and Teschl, 2004). Ultimately, since Samuelson's reformulation of choices as revealed preferences, individuals are reduced to their observed choices. Two individuals making the same choices in the same information environment and under the same constraints are identified by the same preference order. This implies in turn that the standard approach fails to individuate the economic agents. Davis (2013, 2009) argues that this failure is rooted in the project of neoclassical economists to remove subjectivity, consciousness and self-reflectivity from economics.

The cost of eliminating subjectivity is that standard models have little to tell us about why and how individuals act on themselves and develop self-reflective cognitive activities to change consciously their preferences and, beyond this, who they are. For instance, the Grossman's demand for health model assumes that an individual's subjectivity is fundamentally left unaltered by large health shocks (Grossman et al., 1972). Yet, learning and experiencing serious chronic diseases unavoidably produce feelings of losing some aspects of oneself, not only in terms of physical or cognitive abilities, but also in terms of autonomy, life goals and and eventually preferences.<sup>6</sup> In such circumstances, continuing one's existence requires significant psychological adjustments, whose dynamics has been shown to depend on the quality of a self-reflective work that lead individuals to

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6. "To fall suddenly sick implies having to reinvent everything, to grasp again one's own life, to reassess thoroughly the order of one's relationships, one's work, one's own pleasures" (Zaoui, 2010, p. 79). Some economic research has examined the stability of risk, time and social preferences (see ?). We are not aware of studies that would have examined specifically the impact of the onset of a chronic illness on preferences.

produce an account of themselves in their illness and in their own history.<sup>7</sup> The subjective experience of disruptive life shocks cannot be captured within a stable preference modeling framework. On the contrary, asking who the person is “tells not only what she is doing, but also how she evolved toward those choices and how imagination of future ways of being will make her follow a certain path” (Kirman and Teschl, 2004, p. 63). Yet, how is re-identification possible when individuals change?

The challenge faced by economics is to explain why and how individuals may choose to develop certain preferences while maintaining a sense of persistence over time. One solution is to fully accept the mere fact that such decisions partly arise from self-reflective activities that are more intense and frequent at critical life stages: adolescence, leaving the family nest, entering the job market, forming a family, divorcing, losing one’s parents etc. The paradigm of ‘motivated beliefs and reasoning’, which has developed over the last twenty years by Roland Benabou and Jean Tirole (BT), may provide an answer (Bénabou and Tirole, 2016).<sup>8</sup> Motivated beliefs can serve two purposes: “affective (making oneself or one’s future look better) and functional (helpful to achieve certain goals, internal or external)” (Bénabou and Tirole, 2016, p. 143). However, while the production of motivated beliefs falls in the category of self-reflectivity activity, not every self-reflective thought and reasoning is driven by the need to frame our future choices. As noted by (Chater and Loewenstein, 2016, p. 136), “even the broadest notions of utility that have been proposed, for example ‘ego utility’ or ‘belief-based utility’, fail to account for the enormous time, money and attentional resources that people devote to sense-making”. Self-reflection is often oriented toward the past rather than toward the future. Individual may take a coach to help them to implement new beliefs for achieving desirable long-term goals (e.g. losing weight or quitting smoking). Yet, they also consult in psychotherapy to understand their past choices, to construct a consistent account of their lives and to produce narratives of their personal history. Self-reflective reasonings are often

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7. For instance, ruminating thoughts or attributing causalities to factors that one cannot change do not favor adaptation, while drawing positive lessons from the experience of disease is a factor of resilience (Helgeson and Zajdel, 2017).

8. This paradigm has not been developed in isolation, and is related to a large bunch of theoretical and empirical works. The interested readers will find many references in Benabou and Tirole (2011, 2016).

adaptive response to changing environments (Chater and Loewenstein, 2016, pp. 139-140).

Last, economic agents are fundamentally embedded in social structures, which create the conditions of reflexivity by providing individuals with social views of themselves (e.g. “I” as a woman) (Davis, 2013, 2009).<sup>9</sup> Individuals develop their identity under the influence of significant others, social affiliations and institutions. Even “personal” identity cannot be understood without any reference to inter-personal relationships and to social settings (Singer, 2004, McAdams and McLean, 2013). Individuation must eventually be construed as a dynamic, self-reflective, and subjective process. Personal identity is constructed from the past, and its usefulness lies in its capacity to make sense of one’s own history and to be the foundation for new life plans. The notion of self-reflexivity is necessary to solve the tension between individuation and re-identification. Individuation is possible only if individuals are free (to some extent) to choose their preferences, which requires self-reflection. Self-reflection help the individual to construct meaningful links between their past and their present, in a consistent manner, despite changes in revealed preferences.

## 2.2. Aspects of identity

Identity psychologists agree a minima with the view that people’s own view on their identity - their answers to the question "Who I am?" - consists in at least two aspects (Sedikides and Brewer, 2015, Vignoles, Schwartz and Luyckx, 2011). The first aspect is a personal self that corresponds to the person’s sense of unique identity differentiated from others (Bakan, 1966, Markus and Kitayama, 1991, Loevinger, 1976). This category may include goals, moral values, beliefs, self-esteem

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9. This does not mean that individual identity reduces to social identity à la Akerlof and Kranton (2000) Individuals may have preferences over social affiliations that impose them holding special roles and following prescriptions (Boulu-Reshef, 2015, Davis, 2006). If individuals were only produced by social structures, and their position in these social structure, then it would be difficult to find a criterion to individuate them (Luchini and Teschl, 2005). Individuation requires that individuals be in capacity to choose their social affiliations. But, one must necessarily assume the existence of an individual for this capacity to exist. A solution is to see this capacity as a specific ‘capability’ among other capabilities à la Sen (see also Livet, 2006). Luchini and Teschl (2005) note however that the capability approach leaves aside the genealogy of the motivations that drive individual choices over their social affiliations. If these motivations stem purely from environmental constraints and ‘capability-developing’ institutions, then the social realm greatly conditions the exercise of self-reflexivity and free choice. If social affiliations result from some pre-existing preference orderings, then we step back to the tautology of the neo-classical model: from where do these preferences emerge?

and self-evaluation, intimate narratives, emotions (*e.g.* visceral fears) and more generally all attributes that differentiate the person from others. This process of self-representation is based on interpersonal comparisons whose valence (positive or negative) can protect or strengthen the person (Brewer and Gardner, 1996). The second aspect is the interdependent self which is the extent to which an individual define himself *with* others. A first distinction is made between a relational self that derives from interpersonal, intimate, relationships with significant others, and a collective self that derives from membership of larger social categories. The relational self is associated with the fundamental need of caring and feeling cared through strong and stable interpersonal relationships (Leary and Baumeister, 2017, Sedikides and Brewer, 2015).<sup>10</sup> It is therefore closely linked to the notion of reflective appreciation (Brewer and Gardner, 1996). Collective identity only requires the psychological and symbolic sense of belonging to social categories defined by objective characteristics (gender, profession, etc.). Collective identity entails a depersonalised sense of self, "a shift towards the perception of self as an interchangeable exemplar of some social category and away from the perception of self as a unique person" (see Turner et al., 1987, p. 50). Cheek and Briggs (2013) add public identity as a third aspect of the interdependent self. The public self reflects how people see themselves in public contexts, including one's mannerisms, stylistic quirks, expressive qualities, roles and reputation. We thus end with a model of the self, made of four distinct dimensions that individuals use to define who they are in terms of their unique traits, intimate relationships, public conduct, and group memberships (Sedikides and Brewer, 2015, Cheek and Briggs, 2013).<sup>11</sup>

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10. Identity construction is partly based on the integration of significant others to one's own experience. For instance, the Inclusion of Other in the Self scale, which measures interpersonal closeness and intimacy with others, has been found to be correlated with the proportion of first person plural pronouns used when dating partners wrote about their relationship (Agnew et al., 1998) and with measure of interdependent self-construal relating to items such as "*when I feel close to someone, I typically think of their triumphs as if they are my own*" (Cross and Madson, 1997).

11. A number of studies have found that identity orientations predict actual behaviours. For instance, people with strong personal identity orientation are more likely to search for jobs that may help to enhance their sense of uniqueness, and they were more likely to choose individual athletic activities, while people with strong public identity orientation are more likely to look for jobs that enhance social status, and to choose collective athletic activities (Leary, Wheeler and Jenkins, 1986). Ryder, Alden and Paulhus (2000) reports that people with strong collective identity orientation are less likely to assimilate to a new culture, and value more their previous backgrounds and group memberships. Regarding health and well-being, people with strong public identity orientation tend to have lower self-esteem (Briggs and Cheek, 1986) and are more likely to engage in risky behaviours such as tanning (Leary and Jones, 1993)



### 3. Validation of a French version of the AIQ: method

The Aspects-of-Identity questionnaire intends to measure the relative importance that an individual grants to the four dimensions making one's own self: personal, relational, public and collective identities. The most recent English version (AIQ-IV) includes 35 items. Item responses are used to construct four psychometric scales, one per identity dimension.

#### 3.1. Translation and Back-Translation

The English version of AIQ-IV was submitted to two English language specialists for a back-and-forth translation, as recommended by the International Test Commission (Brislin, 1970, Hambleton, Merenda and Spielberger, 2004). We first submitted the original version to the first translator who provided a first French translation of the English AIQ-IV. Then a back translation from French to English was performed by the second translator. These two translations were then compared to ensure both the fidelity to the original tool and the clarity of translated items. Table III.1 lists the items and provide a comparison of the English vs. French versions.

#### 3.2. Population

The questionnaire was administered in May 2017 through the Qualtrics platform to collect answers from a representative sample of the French population aged from 18 to 35 years old. Respondents on Qualtrics could either answer to the questionnaire on their computer or on their mobile phone. They were paid 4.2€ for a completed questionnaire. The validation sample includes 1,118 individuals, with equal representation of men and women (18-25 years: 49.33%; Male: 50.12%).<sup>12</sup>

or binge-drinking (Hagger et al., 2007). Public identity oriented individuals are more likely to be motivated by social pressures, and they are more likely to try to meet other group's expectations to create a positive impression (Wade and Brittan-Powell, 2000). Individuals with strong personal identity are able to behave independently, are not influenced by others and are confident about who they are. However, they may also be more likely to experience negative emotions resulting from failure to live up to personal standards compared to people who place more value on public aspects of identity (Donahue et al., 1993).

12. We had  $N = 1,251$  participants. As we wanted to ensure that subjects remained attentive throughout the questionnaire, we included at a random position in the list of items an attention control question asking the participant to tick the box "Peu important pour l'idée que je me fais de moi-même" [Not at all important]. In case of wrong an-

The resulting data set has a subject/item ratio of  $\frac{1,118}{35} = 32$  which is much larger than the ratio of at least 4 recommended by MacCallum et al. (1999).

### 3.3. Questionnaire

Participants were asked to consider how each item in Table III.1 applies, and to rate their importance to their sense of who they are. Five response options are proposed, ranked on a semantic scale ranging from 1 “*Pas du tout important pour l'idée que je me fais de moi-même*” to 5 “*Extrêmement important pour l'idée que je me fais de moi-même*”.<sup>13</sup> We emphasised at the beginning of the survey that there were no right or wrong answers: participants were instructed to answer as truthfully and honestly as possible to what is true for them. We also stressed that the questionnaire was anonymous. The order of the presentation of the items was randomized to avoid order effects. The full questionnaire is in Appendix III.A.

## 4. Results

### 4.1. Exploratory Factor Analysis (EFA)

The EFA of the questionnaire is based on a principal component method (PCM with varimax rotation), which is applied to the polychoric correlation matrix of items. As expected, the eigenvalue analysis points to a four factors solution.<sup>14</sup> The results of the PCM are summarized in Table III.B.1 in Appendix III.B.2. The Kaiser-Meyer-Olkin index for the complete model is equal to 0.93, which is evidence that the factorial solution is appropriate.<sup>15</sup> The four factors explain 67.36% of total variance. With a few exceptions, the items cluster as in the English AIQ-IV scale. However,

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swer, the subject was not able to finish the questionnaire and to be paid. We have additionally excluded participants whose duration of survey completion was in the lowest decile of the observed distribution of durations, *i.e.* less than 5 minutes 15. The application of these rules explain why the analysis sample eventually includes N=1,118 observations.

13. The original instruction is “*Not important to my sense of who I am*” and “*Extremely important to my sense of who I am*”.

14. See the complete analysis in Appendix III.B.1

15. See Appendix III.B.2 for a definition

some items tend to load on two factors. In particular, three items of the personal identity dimension also loads on the relational dimension but at a lower magnitude (items 3, 5, and 9 in Table III.1). As withdrawal of these items affects the internal consistency of the personal identity scale, we decided to keep them for the confirmatory study.<sup>16</sup> Table III.C.3 Some other items are more problematic as both of their loadings are similar in magnitude. In particular, items 1 (“*Mes valeurs et mes principes*”) and items 4 (“*Mes émotions et mes sentiments*”) load positively on the personal factor and on the relational factor. Given the ambiguity of their contents, we decided to drop these items for the confirmatory factor analysis.<sup>17</sup> We also dropped items 27 (“*mon comportement social, comme par exemple, mes manières d’agir quand je rencontre des personnes*”) and 32 (“*Mon sentiment d’appartenir à une communauté*”), as they both load on the public and collective dimensions of identity.<sup>18</sup>

## 4.2. Confirmatory Factor Analysis (CFA)

We performed a CFA to test the latent structure of the questionnaire emerging from the EFA after the withdrawal of items 1, 4, 8, 27, and 32. The CFA tests a latent factor model, where each item is “forced” to load on one and only factor according to the theory. The model is estimated by maximum likelihood where we allow for covariance between latent factors. The estimation results are presented in Figure III.B.2 of Appendix III.B.4.

We use several fit indices and rules-of-thumb conventional cut-off criteria to assess the goodness of fit of the hypothesized model. Each fit index relies on the level of correspondence between the estimated and empirical distributions of responses under the null hypothesis that these

16. One can construct a scale for each of the four aspects of identity, by adding responses to the corresponding items - see Appendix III.A.4. The internal consistency of a scale is measured in psychometric studies through Cronbach’s alphas. The Cronbach’ alpha is zero for independent items, and equals 1 for perfectly correlated items. A high Cronbach’s alpha is evidence that item responses are driven by the same latent theoretical construct - see Appendix III.B.3 and Cronbach’s alphas calculations in Appendix III.B.3

17. As these items refer to “private” attributes that may drive affects in situations of interpersonal relationships, the ambiguity of loading perhaps reflects a specificity of French/catholic culture, whereby the frontier between personal identity and relational identity would be less clear than in Anglo-saxon/protestant cultures.

18. Item 32 may be ambiguous as it may relate to individuals acceptance and belonging to a community in which individuals engage interpersonal relationships.

two distributions are the same. We use absolute fit indices such as the root mean square error of approximation (RMSEA) and the root mean square residual (RMSR). We also use incremental fit indices, such as the comparative fit index (CFI) and the Tucker-Lewis index (TLI), which measure whether the estimated model provides a better fit than a baseline model that assumes that all items are independent. The estimated values of the SRMR and of the RMSEA are 0.047 and 0.049 respectively (the closer to zero, the better the fit). Both of these absolute fit indices are smaller than their respective cut-off values of 0.08 and 0.05 indicating a close fitting model (Hu and Bentler, 1999). The values of the TLI and the CFI are 0.900 and 0.908 respectively. Values larger than 0.90 for these incremental fit indices are accepted as evidence of a good fit as compared to the baseline model (Bentler and Bonett, 1980, Bentler, 1990).

The adjustment we propose between the CFA model (derived from the EFA) and the observed data is good as judged by the combined values of the absolute and the incremental fit indices. This result offers additional evidence of the internal validity of the AIQ for measuring an individual identity construct structured around four factors (aspects of identity).

### 4.3. Test-Retest

By adding the responses to the items corresponding to each identity dimension, one obtains four sub-scales (see Appendix III.A.4). Test-retest reliabilities of the four sub-scales of the AIQ have been performed on Qualtrics at a two-weeks interval in May-June 2017 by re-interviewing  $N = 124$  individuals who had participated to the original survey. Overall, the questionnaire has a good test-retest reliability in all of its sub-scales, with IntraClass Correlations (ICC) indices ranging from 0.60 to 0.82 at the individual level.<sup>19</sup> The public identity sub-scale has an excellent reliability (0.82 for individual measurement). The personal sub-scale has a very good individual ICC of 0.71. The relational and the collective sub-scale have good individual ICCs of 0.63 and 0.60 respectively.

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19. See Appendix III.B.5 for definitions.

#### 4.4. Convergent Validity

We eventually assess the convergent validity of AIQ, *i.e.* how it is correlated with psychometric scales that relate to the same theoretical concepts. In a Qualtrics online survey (September 2017),  $N = 150$  participants were administered the French AIQ and other questionnaires that produces scales tapping into the domains of personal and public identity orientations and that had already been validated in French: the Rosenberg Self-Esteem scale (SE), the Social Self-Esteem scale (SSE), the Self-Consciousness scale (SC) and social anxiety (SA).<sup>20</sup> The SE scale is an indicator of acceptance, tolerance and personal satisfaction with oneself while excluding feelings of superiority and perfection (Rosenberg, 1965, Vallieres and Vallerand, 1990).<sup>21</sup> The SSE scale measures self-esteem problems related to social interactions (Lawson 1979, Gauthier 1981 adaptation). The SC scale identifies individual differences in public and private aspects of self-consciousness, whereby private self-consciousness refers to the tendency of an individual to think and pay particular attention to hidden and intimate aspects of the self like desires or emotions (Scheier and Carver, 1985, Pelletier and Vallerand, 1990). SA is a measure of stress in interpersonal/public relationships (Heeren et al., 2012, Heimberg et al., 1999). We expect Self-esteem and private Self-consciousness to be positively correlated with personal identity orientation, while Social Self-esteem, public Self-consciousness and perhaps Social anxiety should be positively correlated with public identity.

The correlations between the four aspects of identity and the four existing scales are displayed in Table III.1. The results suggest a good convergent validity as they confirm the hypothesized relationships between the AIQ sub-scales and the other validated scales: Self-Esteem is positively and significantly correlated with personal identity (.233); Social Self-Esteem and Social Anxiety are both positively correlated with public identity and Social Self-Esteem is negatively related with social anxiety (-.357).<sup>22</sup> The subjects who score high on public or private self-consciousness have higher scores for personal, relational and public identity. However, the magnitudes of correla-

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20. The participants were aged 18-35, with an equal balance between men and women

21. It measures the extent to which the individual considers himself to be a valuable person, to possess qualities, not to consider himself a failure, etc.

22. All correlations are significant at the 1% level

Table III.1: Aspects of identity: correlations with other scales (convergent validity)

Variables	Personal	Relational	Public	Collective	SE	SSE	SA	SC-Pu
Personal Identity	1.000							
Relational Identity	<b>0.682</b> (0.000)	1.000						
Public Identity	<b>0.447</b> (0.000)	<b>0.465</b> (0.000)	1.000					
Collective Identity	<b>0.419</b> (0.000)	<b>0.365</b> (0.000)	<b>0.415</b> (0.000)	1.000				
SE: Self-esteem	<b>0.233</b> (0.004)	0.097 (0.237)	-0.047 (0.568)	0.141 (0.086)	1.000			
SSE: Social self-esteem	0.050 (0.540)	0.068 (0.410)	<b>0.311</b> (0.000)	0.090 (0.272)	<b>-0.233</b> (0.004)	1.000		
SA: Social Anxiety	-0.098 (0.239)	-0.034 (0.680)	<b>0.151</b> (0.067)	-0.073 (0.381)	<b>-0.357</b> (0.000)	<b>0.508</b> (0.000)	1.000	
SC-Pu: Public Self-consciousness	<b>0.217</b> (0.008)	<b>0.250</b> (0.002)	<b>0.577</b> (0.000)	0.071 (0.394)	-0.020 (0.811)	<b>0.185</b> (0.024)	<b>0.243</b> (0.003)	1.000
SC-Priv: Private Self-consciousness	<b>0.309</b> (0.000)	<b>0.220</b> (0.007)	<b>0.255</b> (0.002)	0.064 (0.434)	-0.076 (0.356)	<b>0.356</b> (0.000)	<b>0.174</b> (0.035)	<b>0.482</b> (0.000)

**Notes:** Significant correlations in bold. All scales have been standardized. All scales are validated in French. SE: Rosenberg Self-Esteem scale (Rosenberg, 1965, Vallieres and Vallerand, 1990) 1; SSE: Social Self-Esteem Inventory (Lawson, Marshall and McGrath, 1979, Gauthier et al., 1981); SA: social anxiety (Liebowitz/Heeren et al., 2012), SC-Pu, SC-Priv: subscales of the Self-Consciousness Scale (Scheier and Carver, 1985, Pelletier and Vallerand, 1990). Personal, Relational, Public and Collective refers to the scores for personal identity, relational identity, social identity and collective identity respectively.

tions differs across the scales: public Self-Consciousness correlates significantly more strongly with public identity than with personal identity and private Self-Consciousness correlates significantly more strongly with personal than with public identity orientation. This is predicted by Self-Consciousness Theory and confirmed by similar findings in U.S. subjects by Cheek and Briggs (1982). The pattern of correlations between the identity personal and public orientations and the theoretically similar constructs provides additional evidence regarding the psychometric validity of our French adaptation of the AIQ.

## 5. Identity and Preferences

In the introduction, we argued that economists may benefit from measures of individual identity in order to better understand how preferences form and change. We now examine the extent to which the identity sub-scales predict preferences. In the initial validation survey and in two subsequent surveys ( $N_2 = 838$  and  $N_3 = 1611$ ), participants answered the AIQ-IV questionnaire and had to rate from 0 to 10 how the following traits could apply to them: patience, impulsiveness, willingness to take risk in general, and willingness to take risk in the domains of health, consumption and labour/schooling.<sup>23</sup> These preferences measures are extensively used in large scales surveys as they are easy to collect and predict a wide range of behaviours (Dohmen et al., 2005). Pro-social behaviours were also measured through hypothetical choices as in Falk et al. (2016). Reciprocity is assessed by asking participants how much they would be willing to give between 0 and 30 euros to a stranger that helped them in a travel situation. Participants were informed that helping them cost to the stranger about 20 euros. Altruism is assessed by asking subjects how much they would be willing to give to a charity if they were given unexpectedly 1000 euros.

Table III.1 presents OLS results of preferences measures on the four identity dimensions. These regressions control for age, gender and education. The estimated coefficients can be compared to the mean sample values of the dependent variable at the bottom of the table.<sup>24</sup> The subjects who grant more importance to their public-identity attributes are significantly less patient ( $-.17$  points,  $p < .05$ ), and more willing to take risks in the domains of consumption and health. These results are consistent with evidence from social sciences that peer-pressure has a causal impact on risky behaviours (see e.g. Clark and Lohéac, 2007). This is also consistent with evidence in psychology regarding the positive correlation between public identity and risk-taking in consumption and health (see e.g. Luo, 2005, Leary and Jones, 1993). In contrast, personal identity is negatively correlated with risk-taking in health, as in Hagger et al. (2007). Interestingly, personal identity is

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23. We used the Qualtrics online platform. In each survey, the participants were aged 18-35 and the sampling were equally balanced between men and women.

24. Since we estimate regression models for multiple outcomes, p-values should be adjusted for the number of regressions. In particular, significance of coefficients is calculated using the overly conservative Bonferroni adjustment.

Table III.1: Identity and Economic Preferences

VARIABLES	Patience	Impuls.	Risk (General)	Risk (Health)	Risk (Consum.)	Risk (Lab./Sch.)	Recipro.	Altruism
Personal (std)	0,10 (0,060)	0,06 (0,08)	0,10 (0,06)	-0,17** (0,06)	-0,10 (0,06)	0,21*** (0,06)	0,20 (0,32)	-11,26 (6,79)
Relational (std)	0,08 (0,06)	0,02 (0,08)	-0,04 (0,06)	-0,15* (0,06)	0,10 (0,06)	-0,02 (0,06)	1,76*** (0,31)	-10,32 (6,63)
Public (std)	-0,17** (0,05)	0,14 (0,06)	-0,04 (0,05)	0,19*** (0,05)	0,17*** (0,05)	-0,11* (0,05)	-1,01*** (0,27)	-18,88*** (5,68)
Collective (std)	0,09* (0,050)	0,29*** (0,06)	0,29*** (0,05)	0,12** (0,05)	0,03* (0,05)	0,21*** (0,05)	0,33** (0,28)	54,49*** (6,01)
Mean Sample Value	6.45	6.15	5.71	4.99	5.75	6.05	16.26	168.75
Observations	3,693	2,082	3,693	3,693	3,693	3,693	1,611	1,611

**Notes:** OLS regressions controlling for Age-Sex-Education of subjects; Standard errors in parentheses; P-values are calculated using Bonferroni adjustment for three families of outcomes: time preferences (patience and impulsiveness), risk preferences (General, health, consumption, lab./sch.) and pro-social behaviours (reciprocity and altruism). This correction is performed to avoid misleading inferences; \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ ; Patience, Impulsivity (Impuls.), Willingness-to-take risks in general and in the domains of health, consumption (Consum.) and labour/schooling (Lab./Sch.) through Likert scales on 11 points from 0 to 10. Reciprocity (Recipro.) is measured through a question asking how much between 0 and 30 euros you would be willing to give to a stranger that helped you when helping you costs the stranger about 20 euros in total. Altruism is measured through a question asking how much you would be willing to donate to a good cause if you were given unexpectedly 1000 euros. Personal, Relational, Public and Collective (std) refers to the standardized scores of model 2 for personal identity, relational identity, public identity and collective identity respectively. The preference measures were collected in the validation study and in two subsequent studies, but Impulsivity, Reciprocity and Altruism were not present in all studies. This explains why the sample size varies from one regression to another.

positively correlated with risk-taking in labour/schooling, which might be a factor of economic success. It also worth noting that collective identity is positively correlated with impulsiveness (and less significantly to patience), and risk-taking in general, in health and in labour/schooling.

We also uncover evidence of significant correlations between identity and altruism or reciprocity. First, relational-oriented individuals reciprocate more (+1.76€, *i.e.*, +10.8% as compared to the mean,  $p < 0.01$ ). This is particularly interesting since the measure of reciprocity here corresponds to a dyadic mutual exchange. Although relational identity refers to relationships with close and significant others, our result suggests that this construct may have broader implications for understanding the heterogeneity of behaviours in situations of small-group interactions. The last column also shows that collective identity is positively correlated with altruism: people with a one



standard deviation on the collective identity score have a +32.3% (54.49/168.75) increase in their donation to charities. It is consistent with the idea that individuals with a strong sense of collective identity are more likely to consider having big stakes in collective fate. We also note the negative relationship between public identity (and to a lesser extent personal identity) and pro-social behaviours. Individuals with strong public or personal identities may contribute less to the extent that the pro-social decisions that are proposed are not publicly made, or that they do not need such behaviours to boost their self-esteem. It would be interesting to test whether these aspects of identity are directly related to social- and self-image motives in pro-social behaviours.

Overall, these correlations show significant relationships between aspects of identity and economic preferences, but much remains to be done to understand the specific correlations between a given aspect of identity and a given aspect of economic preference.

## **6. Conclusion**

The main objective of this paper was to validate a French translation of the Aspect of Identity questionnaire while preserving its theoretical background. The validation process relied on an exploratory factor analysis, a confirmatory factor analysis, a test-retest and a test of convergent validity. The scale was successfully validated after reformulation and re-arrangement of items. Aspects of identity correlates diversely with proxies of risk, time and pro-social preferences. We think that this questionnaire can be a relevant tool in economic research. Thanks to its short duration, it is easy to administer in during experiments and short versions with a subset of items can be included in surveys. Further work should propose causal analyses of the relationships between aspects of identity and economic preferences. Beyond this, it would be worth examining how identity orientation can explain or be affected by economic and social behaviours and outcomes, in a world where the broad question of identity is crystallizing dangerous passions.

# Appendix

## III.A. French Version of the AIQ-IV

Please cite as:

Yin, R. and Etilé, F. (2018) "Measuring Identity Orientations for Understanding Preferences: A French Validation of the Aspects-of-Identity Questionnaire (AIQ-IV)", [to be completed].

### III.A.1. Instructions

*Le questionnaire suivant porte sur la façon dont vous définissez votre identité, c'est-à-dire la manière dont vous définissez qui vous êtes. Ainsi, il ne comporte en soi ni bonnes ni mauvaises réponses. Nous vous demandons simplement de répondre aussi sincèrement et honnêtement que possible à ce qui est vrai pour vous. Le questionnaire vous propose différents éléments qui se rapportent à différents aspects de votre identité. Nous vous demandons d'évaluer dans quelle mesure chacun de ces éléments est important pour vous, pour l'idée que vous vous faites de vous-même. La durée de ce questionnaire est d'environ 10 minutes. Il y a cinq réponses possibles à chaque proposition, de «pas du tout important» à «extrêmement important» :*

- (1) «Pas du tout important pour l'idée que je me fais de moi-même »
- (2) «Peu important pour l'idée que je me fais que j'ai de moi-même »
- (3) «Moyennement important pour l'idée que je me fais de moi-même»
- (4) «Très important pour l'idée que je me fais de moi-même»
- (5) «Extrêmement important pour l'idée que je me fais de moi-même »

Ce questionnaire est confidentiel et anonyme. Essayez de donner la réponse qui se présente à vous naturellement, sans tenir compte des réponses que vous avez déjà données, même si vous avez l'impression que certaines propositions se répètent ou se contredisent. Nous ne nous intéressons pas aux réponses à des questions particulières, mais à vos réponses considérées toutes ensemble. Répondez aussi sincèrement et honnêtement que possible à ce qui est vrai pour vous. Il n'y a pas de bonne ou mauvaise réponse à donner.

[Note for the interviewer: the order of items should be randomized]

### III.A.2. Items

1. \_ Mes valeurs et mes principes
2. \_ Mes rêves
3. \_ Mes projets et aspirations personnels pour l'avenir
4. \_ Mes émotions et mes sentiments
5. \_ Mes pensées et mes idées
6. \_ Mes peurs et mes angoisses
7. \_ Mon sentiment d'être une personne unique, d'être différent.e des autres
8. \_ Savoir qu'au fond de moi, je resterai toujours la même personne
9. \_ Ma connaissance de moi-même, mes idées sur qui je suis vraiment
10. \_ Mon auto-évaluation, l'opinion privée que j'ai de moi-même
11. \_ Mes relations avec les personnes dont je me sens proche
12. \_ Mon sentiment de proximité avec mes proches
13. \_ Être un bon ami pour ceux à qui je tiens vraiment
14. \_ Mon engagement à être un conjoint attentionné
15. \_ Partager des expériences marquantes avec des amis proches
16. \_ Entretenir des relations personnelles mutuellement enrichissantes
17. \_ Atteindre un certain niveau d'intimité avec une autre personne
18. \_ Développer des relations bienveillantes avec les autres
19. \_ Ma volonté de comprendre les pensées et sentiments profonds de mon/ma meilleur.e ami.e ou partenaire amoureux
20. \_ Créer des liens forts avec les autres
21. \_ Ma popularité
22. \_ La façon dont les gens réagissent à mes propos ou à mes actions
23. \_ Mon apparence physique
24. \_ Ma réputation, ce que les autres pensent de moi
25. \_ L'attrait que je peux susciter chez d'autres personnes
26. \_ Mes gestes et mes manières, l'impression que je donne aux autres
27. \_ Mon comportement social, comme par exemple mes manières d'agir quand je rencontre des personnes

- 28. \_ Faire partie d'une longue lignée familiale
- 29. \_ Mes origines sociales et culturelles
- 30. \_ Ma religion
- 31. \_ Les lieux où j'ai habité et où j'ai grandi
- 32. \_ Mon sentiment d'appartenir à une communauté ou à un collectif
- 33. \_ Mon sentiment de fierté envers mon pays, être fier d'être citoyen
- 34. \_ Mes convictions et engagements politiques
- 35. \_ Mon langage (ma langue natale, mon accent régional, un dialecte ou les langues que j'ai apprises)

### **III.A.3. Additional items that were tested**

- i \_ Mes compétences individuelles
  - ii \_ Bien me connaître
  - iii \_ Mes envie, désirs et besoins
  - iv \_ Avoir le sentiment de ne pas dépendre des autres
  - v \_ Mes réussites personnelles
  - vi \_ L'intensité de mes relations avec mes proches
  - vii \_ Mon entourage
  - viii \_ Ressentir souvent un profond sentiment d'unité avec mes proches
  - ix \_ Aimer faire plaisir aux autres autant que je le peux
  - x \_ Me soucier du fait que les gens approuvent mes façons de faire
  - xi \_ L'image que je renvoie aux autres
  - xii \_ La culture dans laquelle j'ai grandi
- 
- a \_ Attendre des autres qu'ils trouvent des solutions à mes problèmes
  - b \_ Préférer la compagnie des autres aux moments de solitude
  - c \_ Accepter mes rôles sociaux
  - d \_ Mon rôle au sein de ma famille

### III.A.4. Scoring for AIQ IV

One can use the item responses to construct the four following scales:

- (Pe): Personal Identity Orientation
- (Re): Relational Identity Orientation
- (Pb): Public Identity Orientation
- (Co): Collective Identity Orientation

Each of the scale scores is the sum of the answers (1-5) given to the corresponding items.

We offer three models which slightly differ in definition and use:

- Model 1 strictly corresponds to the American validation. It should be used for studies involving international comparisons.
- Model 2 is directly derived from Model 1, but some items were assessed as ambiguous for the French population. It is the model emerging from the validation study presented in the core of our validation study.
- Model 3 includes new items and has better psychometric properties than Model 2. However, it cannot be used for international comparisons.

#### Model 2 (Main text) - Scoring Numbering:

- **Pe**= 2 3 5 6 7 9 10
- **Re**= 11 12 13 14 15 16 17 18 19 20
- **Pb**= 21 22 23 24 25 26
- **Co**= 28 29 30 31 33 34 35

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#### Model 1 (Cheek and Briggs, 2013)

- **Pe**= 1 2 3 4 5 6 7 8 9 10
- **Re**= 11 12 13 14 15 16 17 18 19 20
- **Pb**= 21 22 23 24 25 26 27
- **Co**= 28 29 30 31 32 33 34 35

#### Model 3 (cf. Appendix III.C.2)

- **Pe**= 2 6 7 9 10 iii iii iv v
- **Re**= 11 12 14 15 18 vi vii viii ix
- **Pb**= 21 22 24 25 26 x xi
- **Co**= 28 29 30 31 33 34 35 xii

## III.B. Main model (Model 2): technical details of the validation study

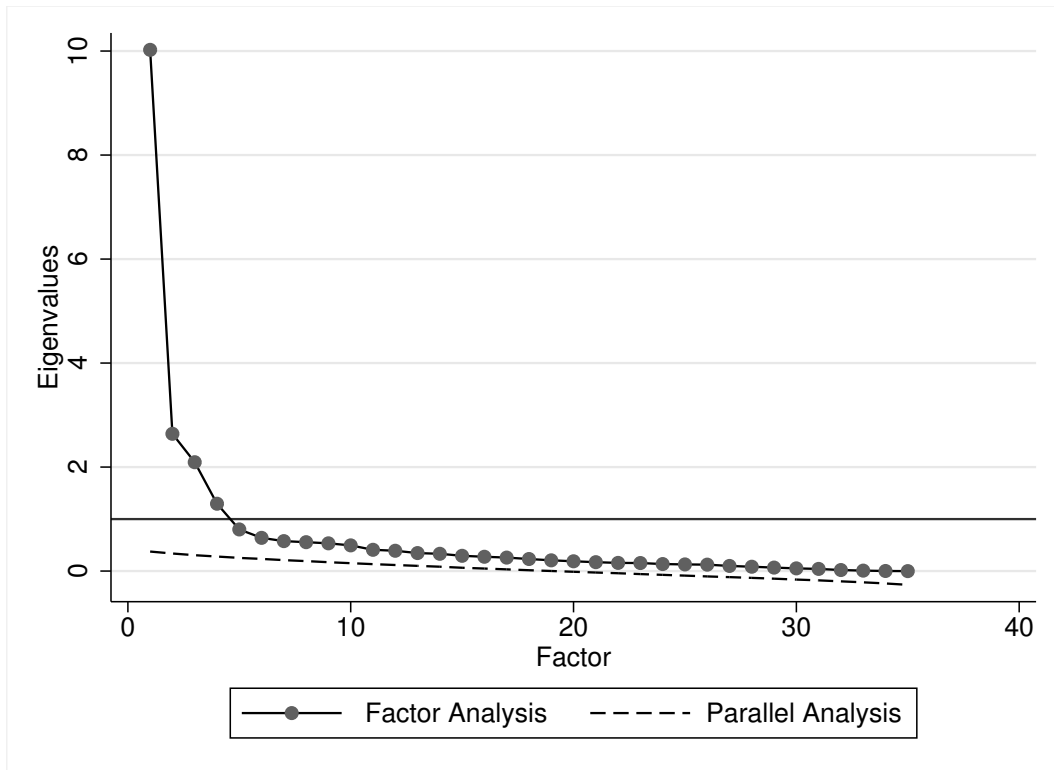
### III.B.1. Eigenvalue analysis

Determining the number of factors to extract from a principal component analysis (PCA) without constraints on the number of factors requires a visual examination of the scree plot of the eigenvalues resulting from the factorial solution. Eigenvalues in a PCA represent a partitioning of the total variation accounted for by each principal component.

The scree test is a heuristic graphical method that consists in plotting the eigenvalues against the components and inspecting the shape of the resulting curve in order to determine how many factors are the most important to explain the data. We use two methods to determine the number of factors to extract. First, we can use Kaiser's rule which is based on the simple idea that in the normed PCA, the average of the sum of the eigenvalues is equal to unity. A factor is therefore considered as relevant when its eigenvalue is higher than 1. Second, we can perform a parallel analysis. The parallel solution corresponds to eigenvalues arising from a random correlation matrix produced by a dataset with the same numbers of observations and variables as the original data. The stopping rule consists in retaining the  $K$  first factors whose eigenvalues are distinct from those produced by the parallel solution.

Figure III.B.1 shows the relevance of retaining a four factors solution according to both rules. Using the Kaiser rule, four factors are retained since the four first eigenvalues are larger than 1. The graph also displays the parallel curve of the average factorial solution arising the analysis of 50 simulated random datasets containing the same number of observations and variables. Again, we distinguish essentially four eigenvalues, as the line joining the eigenvalues beyond the fourth one is parallel and close to the line of eigenvalues produced by the parallel solution.

Figure III.B.1: Parallel Analysis for Factor Analysis of the Original Questionnaire



**Note:** This graph plots the eigenvalues of the factor analysis without restricting the number of factors. First, according to the Kaiser's rule, the comparison of eigenvalues to the line  $y = 1$  determines the maximum number of factors to retain. Second, following a parallel analysis, one can compare the line of eigenvalues produced by the observation data to the dashed line generated by a random correlation matrix with same numbers of observations and variables.

### III.B.2. Exploratory Factor Analysis (EFA)

The EFA applies a principal component decomposition to the polychoric correlation matrix of items. The results are displayed in Table III.B.1. KMO is the Kaiser-Meyer-Olkin index and SMC is the Squared Multiple Correlation statistics. They both indicate whether an item is well-correlated with the other items, meaning that it is susceptible to capture common individual latent factors. Uniqueness measures on the contrary the variance that is specific to a variable, and therefore the specific information brought by this variable. Ideally, one would like to have items with high KMO and SMC, but not very low uniqueness, in order to avoid redundancy between items: we want items to measure a common latent factor, but each item to be a distinct instrument for measuring

a factor.

Table III.B.1: Responses to the Aspect of Identity Questionnaire: Explanatory Factor Analysis

ITEM	Desc. Stats		KMO	SMC	Factors				Uniqueness
	Mean	Std			Collective	Relational	Personal	Public	
<b>11 (Re)</b>	3,99	0,91	0,96	0,56		<b>0,73</b>			0,40
<b>12 (Re)</b>	3,81	0,94	0,96	0,46		<b>0,60</b>			0,55
<b>13 (Re)</b>	4,11	0,91	0,96	0,50		<b>0,68</b>			0,47
<b>14 (Re)</b>	3,97	0,99	0,93	0,47		<b>0,57</b>			0,60
<b>15 (Re)</b>	3,77	0,95	0,96	0,46		<b>0,63</b>			0,54
<b>16 (Re)</b>	3,74	0,94	0,97	0,43		<b>0,56</b>			0,58
<b>17 (Re)</b>	3,73	0,99	0,95	0,37		<b>0,49</b>			0,68
<b>18 (Re)</b>	3,82	0,93	0,96	0,49		<b>0,62</b>			0,52
<b>19 (Re)</b>	3,99	0,97	0,95	0,52		<b>0,64</b>	0,31		0,50
<b>20 (Re)</b>	3,65	0,98	0,95	0,51		<b>0,65</b>			0,47
1 (Pr)	4,16	0,88	0,96	0,44		0,41	0,51		0,54
<b>2 (Pe)</b>	3,87	0,98	0,96	0,36			<b>0,51</b>		0,64
<b>3 (Pe)</b>	3,90	0,94	0,97	0,36		0,35	<b>0,45</b>		0,64
4 (Pe)	3,86	0,95	0,98	0,42		0,44	0,45		0,57
<b>5 (Pe)</b>	4,01	0,87	0,95	0,49		0,34	<b>0,64</b>		0,47
<b>6 (Pe)</b>	3,63	0,97	0,98	0,29			<b>0,41</b>		0,70
<b>7 (Pr)</b>	3,53	1,09	0,96	0,30			<b>0,44</b>		0,70
8 (Pe)	3,78	1,04	0,96	0,27		0,31	0,33		0,74
<b>9 (Pe)</b>	3,88	0,94	0,95	0,47		0,30	<b>0,63</b>		0,49
<b>10 (Pe)</b>	3,72	1,02	0,95	0,41			<b>0,59</b>		0,55
<b>21 (Pu)</b>	2,63	1,10	0,90	0,43				<b>0,67</b>	0,52
<b>22 (Pu)</b>	3,32	1,04	0,95	0,42				<b>0,61</b>	0,55
<b>23 (Pu)</b>	3,46	1,02	0,95	0,35				<b>0,52</b>	0,65
<b>24 (Pu)</b>	3,13	1,18	0,90	0,53				<b>0,77</b>	0,38
<b>25 (Pu)</b>	3,19	1,07	0,95	0,43				<b>0,67</b>	0,51
<b>26 (Pu)</b>	3,41	1,05	0,94	0,49				<b>0,66</b>	0,48
27 (Pu)	3,66	0,95	0,97	0,39		0,40		0,37	0,61
<b>28 (Co)</b>	2,65	1,23	0,89	0,37	<b>0,63</b>				0,57
<b>29 (Co)</b>	3,23	1,16	0,92	0,45	<b>0,67</b>				0,48
<b>30 (Co)</b>	2,30	1,38	0,83	0,33	<b>0,57</b>				0,65
<b>31 (Co)</b>	3,40	1,13	0,95	0,28	<b>0,45</b>				0,72
32 (Co)	3,00	1,11	0,95	0,36	0,41			0,36	0,63
<b>33 (Co)</b>	3,18	1,19	0,92	0,38	<b>0,63</b>				0,56
<b>34 (Co)</b>	2,85	1,21	0,92	0,20	<b>0,34</b>				0,84
<b>35 (Co)</b>	3,45	1,14	0,94	0,37	<b>0,55</b>				0,61

**Notes:** This table represents the principal component analysis using Polychoric correlations. The analysis is performed by using a Varimax rotation and we requested a four factors solution. The PCA explain 67.36% of the variance. Variables that we keep for the confirmatory analysis are displayed in bold. Personal, Relational, Public, and Collective stands for the factor for personal identity, relational identity, public identity and collective identity respectively.



**Kaiser-Meyer-Olkin Index** The Kaiser-Meyer-Olkin index is a measure of how suited data is for factor analysis. It measures sampling adequacy for each variable in the model and for the complete model as a proportion of variance among variables that might be common variance. The formula for the KMO of the complete model is:

$$KMO = \frac{\sum_{i=1}^K \sum_{j \neq i} r_{ij}^2}{\sum_{i=1}^K \sum_{j \neq i} r_{ij}^2 + \sum_{i=1}^K \sum_{j \neq i} p_{ij}^2} \quad (\text{III.1})$$

where  $r_{ij}$  is the correlation between items  $i$  and  $j$ , and  $p_{ij}$  is the partial correlation. The formula for the KMO of one item is:

$$KMO_j = \frac{\sum_{i \neq j} r_{ij}^2}{\sum_{i \neq j} r_{ij}^2 + \sum_{i \neq j} p_{ij}^2} \quad (\text{III.2})$$

The KMO index can take values between 0 and 1. Kaiser (1974) proposes the following labels of the KMO values:

- $KMO > 0.90$ : Marvelous.
- $0.80 \leq KMO \leq 0.89$  : Meritorious.
- $0.70 \leq KMO \leq 0.79$  : Middling.
- $0.60 \leq KMO \leq 0.69$  : Mediocre.
- $0.50 \leq KMO \leq 0.59$  : Miserable.
- $KMO < 0.49$ : Unacceptable.

### III.B.3. Internal Consistency

A scale is said to be consistent when all of its items converge to the same response intensity. In other words, the more the items are correlated to each other and to the total score of the scale, and the higher is the scale consistency. The Cronbach's alpha coefficient is a statistics used to evaluate the internal consistency (or the reliability) of questions asked for a test that measures the same construct. Its value lies between 0 and 1. A score is said to be consistent when its value tends to

1. The commonly accepted rule for describing internal consistency using Cronbach's alpha is as follows:

- $\alpha \geq 0.90$  : Excellent
- $0.80 \leq \alpha \leq 0.90$  : Good
- $0.70 \leq \alpha \leq 0.80$  : Acceptable
- $0.60 \leq \alpha \leq 0.70$  : Questionable
- $0.50 \leq \alpha \leq 0.60$  : Poor
- $\alpha \leq .50$  : Unacceptable

**Cronbach's alpha** The Cronbach's alpha is generally defined as:

$$\alpha = \frac{K\bar{c}}{(\bar{v} + (K - 1)\bar{c})} \quad (\text{III.3})$$

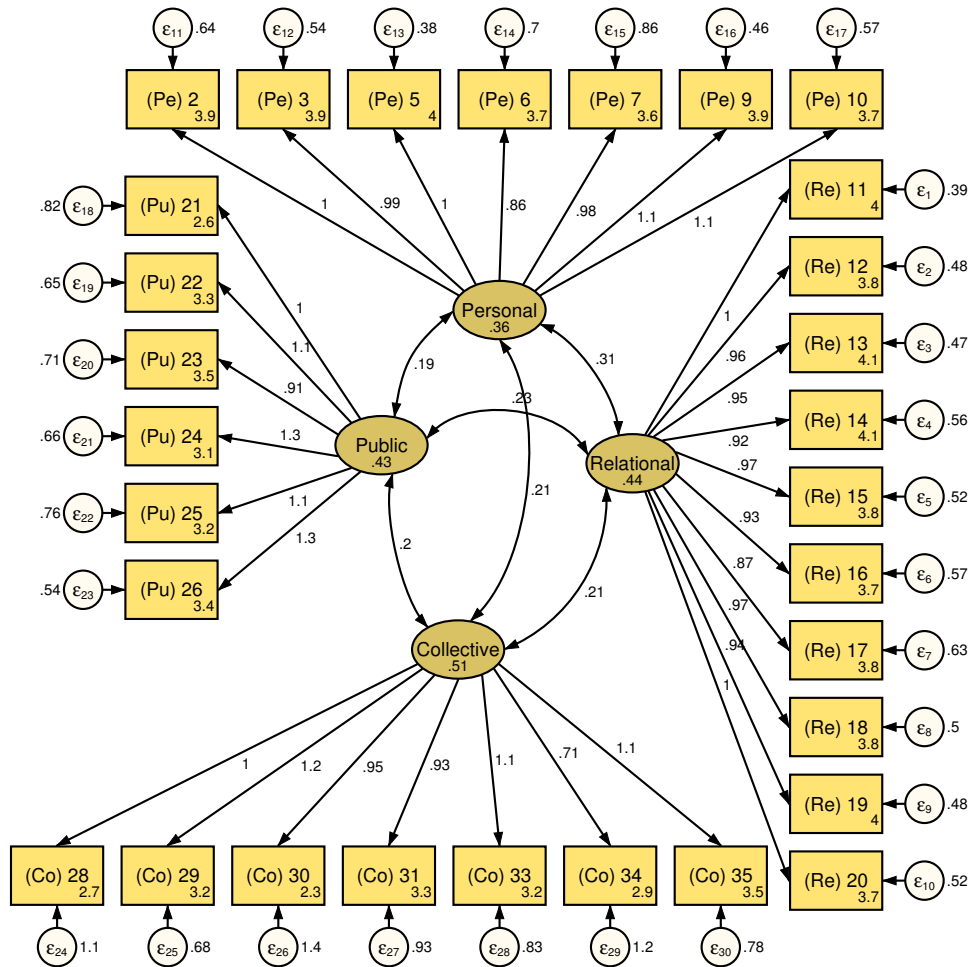
where  $K$  is the number of items,  $\bar{v}$  is the average variance of each item,  $\bar{c}$  the average of all covariances between the components across the current sample.

#### III.B.4. Confirmatory Factor Analysis

Testing the factorial structure of our list of items requires constructing a confirmatory factor analysis based on a Structural Equation Model (SEM). An hypothesized model consistent with the theory is proposed to estimate a population covariance matrix, which is then compared with the observed covariance matrix. The goal is to find the model for which the difference between the two covariance matrices is minimal.

Technically, the CFA uses the observed variables (in our case, the items) to elicit latent factors with the underlying theoretical assumption that these latent factors have generated the observed variables. A path diagram is generally used to depict how the observed variables and the latent factors are interrelated. The model can be estimated by maximum likelihood. Figure III.B.2 proposes a graphical representation of the estimated model.

Figure III.B.2: Structural Equation for the Confirmatory Factor Analysis



**Note:** Path diagram for the confirmatory factor analysis of the model with four factors from the Exploratory Factor Analysis in the main text. Rectangular boxes are observed variables and represent French items of the AIQ-IV. Round boxes are measurements errors in each item. Ellipses are the latent factors that are measured by the items. Straight lines link a predicting and a predicted variable. Curved lines correspond to covariance between the factors.

To assess the goodness-of-fit of the theoretical model, several indices and rules of thumb conventional cutoff criteria are used. The first index is the  $\chi^2$  statistics. It corresponds to the likelihood ratio between the estimated and observed distribution under the null hypothesis that the observed covariance variance matrix  $S$  is similar to the matrix predicted by the model  $\Sigma(\hat{\theta})$ . A high  $\chi^2$  statistics thus suggests that the model poorly fits the observed data. However, many researchers caution the use of the  $\chi^2$  as a cut-off criteria, notably when the data tends to exhibit excess kurtosis, and also because the null hypothesis is very restrictive: it assumes that the model provides a perfect description of the reality. Hence, the probability of rejecting the null mechanically increases with sample size, even if the discrepancy between the model and the data remains low (Bollen, 1989, Kenny, 2014). The decision rule favours often unjustifiably the rejection of the proposed model. To overcome this inflation, we favour other statistics correcting for degrees of freedom. They are classified into absolute and incremental fit indices.

### Absolute Fit Indices

An absolute fit index assesses how well a model reproduces the sample data. Absolute fit indices include the Root Mean Square Error of Approximation (RMSEA) and the Root Mean Square Residual (RMSR).

**RMSEA** This absolute measure of fit is based on the non-centrality parameter. Introduced by Steiger and Lind (1980), it is an index of the difference between the observed covariance matrix  $S$  per degree of freedom and the estimated covariance matrix from the target model,  $\Sigma(\hat{\theta})$ :

$$RMSEA = \sqrt{\max\left\{\left(\frac{F(S, \Sigma(\hat{\theta}))}{df} - \frac{1}{N-1}\right), 0\right\}} \quad (\text{III.4})$$

where  $N$  is the sample size,  $F(S, \Sigma(\hat{\theta}))$  is the weighted sum of squared deviations between matrix components (or  $(N-1)$  times the  $\chi^2$  of the model),  $df$  the degrees of freedom of the model. We can infer from the formula that the RMSEA performs better as the sample size increases. When the sample size is large, the term  $\frac{1}{N-1}$  tends towards zero.

The RMSEA penalizes the model complexity by adjusting the fit for the loss of degrees of freedom. Yet, it can be shown that the measure is positively biased (*i.e.* tends to over-reject a true model), with a bias that decreases with the sample size (Hu and Bentler, 1998). Nevertheless, the RMSEA is currently the most popular measure of model fit and it now reported in virtually all papers that use CFA or SEM.

A RMSEA below the cut-off of 0.05 or 0.06 indicates a good fit (MacCallum, Browne and Sugawara, 1996, Hu and Bentler, 1999). One advantage of the RMSEA lies in the possibility of constructing confidence intervals as the distribution of the statistics is known. In conjunction of the point estimate, a 95% confidence interval is generally reported for which the upper limit should be less than 0.08.

**SRMR** The standardized root mean square of residual is the mean absolute value of the covariance residuals (Byrne, 2013). The formula for the standardized SRMR is:

$$SRMR = \sqrt{\frac{2 \sum_{i=1}^p \sum_{j=1}^i \left[ \frac{s_{ij} - \hat{\sigma}_{ij}}{s_{ii} s_{jj}} \right]^2}{p(p+1)}} \quad (\text{III.5})$$

where  $p$  is the number of observed variables,  $s_{ij}$  is the observed covariances,  $\hat{\sigma}_{ij}$  are the estimated covariances, and  $s_{ii}$  and  $s_{jj}$  are the observed standard deviations. The SRMR can broadly be interpreted as the euclidean distance between the estimated covariance matrix and the observed covariance. Hu and Bentler (1999) suggest that an adjustment is considered acceptable if the RMSR is less than .08.

### Incremental Fit Indices

Incremental fit indices measure the proportionate improvement in fit by comparing a model with a nested baseline model in which all the observed variables are restricted to be uncorrelated. Incremental fit indexes include the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). The rationale for using these indices is that the researcher wants primarily make progresses in her

understanding of the structure of the data.

**CFI** The comparative fit index is based on a comparison of  $\chi^2$  statistics of models. It equals:

$$CFI = 1 - \frac{\max[\chi_1^2 - df_1, 0]}{\max[(\chi_1^2 - df_1), (\chi_0^2 - df_0), 0]} \quad (\text{III.6})$$

where  $\chi_0^2$  and  $\chi_1^2$  are respectively the statistics associated to a baseline model (e.g. one assuming independence between items) and the target model, and  $df_0$  and  $df_1$  are the associated degrees of freedom.

The CFI produces a value between 0 and 1, where a value greater or equal to 0.9 indicates a good fit.

**TLI** The Tucker Lewis index (TLI) is another incremental fit index. It is also known as the non-normed fit index (NNFI). It is calculated as follows:

$$TLI = \frac{\frac{\chi_0^2}{df_0} - \frac{\chi_1^2}{df_1}}{\frac{\chi_0^2}{df_0} - 1} \quad (\text{III.7})$$

where the various elements are defined as for the CFI. A high value of the TLI indicates a high fit of the model. The TLI should be also larger than 0.9 to indicate a good model fit.

### III.B.5. Test-retest methodology

Test-retest analyses aims at testing the variation in measurements at different points in time. A reliable instrument should provide very similar measures of a stable psychological construct.

**ICC** The intraclass correlation (ICC) is a widely used reliability index in test-retest analyses. Here, we use as ICC the single measurement, absolute agreement two-way mixed effect (Koo and Li, 2016). We use a two-way mixed effect model rather than a two-way random effect model because

repeated measurements are done on the same subjects or raters (they are considered as fixed effects). In addition, absolute agreement definition is used rather than consistency because measurements would be meaningless if there were no agreement between repeated measurements. The analysis of the variance hence relies on the following model:

$$x_{it} = \mu + r_i + c_t + e_{it} \quad (\text{III.8})$$

where  $x_{ij}$  corresponds to the item response for individual  $i$  at time  $t$ ,  $\mu$  is the population mean,  $r_i$  the subject (rater) effect,  $c_t$  is the time effect,  $e_{it}$  the error term that is independent and normally distributed with mean 0 and variance  $\sigma_e^2$

The formula for single score for the two-way mixed effect model of intraclass correlation is:

$$ICC(A, 1) = \frac{MSR - MSE}{MSR + (K - 1)MSE + \frac{K}{N}(MSC - MSE)} \quad (\text{III.9})$$

where MSR is the mean square for individual, MSE is the mean square of errors, MSC is the mean square for time. K is the number of measurements (K=2), and N is the number of subjects.

Cicchetti (1994) provides the following rule of thumb for interpretation of ICC agreement measures:

- $ICC < 0.40$  : poor
- $0.40 \leq ICC \leq 0.59$ : fair
- $0.60 \leq ICC \leq 0.74$  : good
- $ICC \geq 0.75$  : excellent

## **III.C. Development of new items and model comparisons**

### **III.C.1. New items**

To further improve the psychometric properties of the questionnaire, we came up with new items corresponding to the latent factors that we seek to elicit. A total of 101 new items were first proposed to improve the original questionnaire. A pre-test on a sample of 400 individuals (aged 18-35 years-old, 50:50 males/females) and a careful examination of the questionnaire responses led us to drop a certain number of items. The items that were dropped were either redundant or were affected by a social desirability bias or an emotional valence that could contaminate the original questionnaire. We eventually kept only 16 of them. Table [III.C.1](#) describes these new items with their translation and the dimension in which they are expected to tap.

We perform an independent validation for the whole set of items, including the new ones, after validation of the set of items originally present in the American questionnaire since the latter is likely to be more conservative. The addition of new items may indeed force the clustering of items into the four right factors into an artificial way due to a potential redundancy of the new items with the original ones.



Table III.C.1: French additional items

Item	Additional Item	English Translation	Dimension
i	Mes compétences individuelles	My individual abilities	Personal
ii	Bien me connaître	Knowing myself well	Personal
iii	Mes envies, désirs et besoins	My wishes, desires and needs	Personal
iv	Avoir le sentiment de ne pas dépendre des autres	The feeling of not being dependent of others	Personal
v	Mes réussites personnelles	My personal achievements	Personal
vi	L'intensité de mes relations avec mes proches	The intensity of my relationships with my close ones	Relational
a	Attendre des autres qu'ils trouvent des solutions a mes problèmes	Waiting for others to find solutions to my problems	Relational
vii	Mon entourage	My entourage	Relational
viii	Ressentir souvent un profond sentiment d'unité avec mes proches	Often feeling a deep sense of unity with my loved ones	Relational
ix	Aimer faire plaisir aux autres autant que je le peux	Enjoy pleasing others as much as I can	Relational
b	Préférer la compagnie des autres aux moments de solitude	Prefer the company of others to moments of loneliness	Relational
x	Me soucier du fait que les gens approuvent mes façons de faire	Caring that people approve of my ways of doing things	Public
xi	L'image que je renvoie aux autres	The image I send back to others	Public
c	Accepter mes rôles sociaux	Accepting social roles	Public
xii	La culture dans laquelle j'ai grandi	The culture in which I grew up	Collective
d	Mon rôle au sein de ma famille	My role in my family	Collective

**Note:** Additional items for the Aspect of Identity Questionnaire (AIQ-IV) and their counterpart English translation. Personal, Relational, Public and Collective refers to personal identity, relational identity, social identity and collective identity respectively.

### III.C.2. Exploratory Factor Analysis

An EFA was then performed for the model including the additional items. Table III.C.2 displays the results. Our rule of thumb was to keep items that have a unique loading of 0.3 on one factor. The rule of exclusion could be more restrictive since the expanded list contained a large number of items. Thus we decided to exclude 32, 1, 3, 4, 8, and 27. Items KMO indexes range from 0.87 to 0.98 and the KMO index of the complete model equals 0.94.

Table III.C.2: Exploratory Factor Analysis with new items

	Des. Stats		KMO	SMC	Factors				Uniqueness
	Mean	Std			Collective	Relational	Public	Personal	
<b>28</b>	2,65	1,23	0,93	0,46	<b>0,64</b>				0,54
<b>29</b>	3,23	1,16	0,95	0,52	<b>0,69</b>				0,46
<b>30</b>	2,30	1,38	0,87	0,41	<b>0,60</b>				0,63
<b>31</b>	3,40	1,13	0,95	0,39	<b>0,51</b>				0,65
<b>32</b>	3,00	1,11	0,97	0,45	0,42		0,39		0,59
<b>33</b>	3,18	1,19	0,95	0,45	<b>0,63</b>				0,54
<b>34</b>	2,85	1,21	0,93	0,25	<b>0,32</b>				0,83
<b>35</b>	3,45	1,14	0,96	0,44	<b>0,57</b>				0,58
<b>xii*</b>	3,39	1,14	0,94	0,58	<b>0,69</b>				0,42
<b>d*</b>	3,78	1,04	0,97	0,50	0,32	0,53			0,58
<b>1</b>	4,16	0,88	0,97	0,47		0,38		0,52	0,56
<b>2</b>	3,87	0,98	0,97	0,42				<b>0,55</b>	0,62
<b>3</b>	3,90	0,94	0,97	0,48		0,32		0,55	0,56
<b>4</b>	3,86	0,95	0,98	0,47		0,45		0,43	0,57
<b>5</b>	4,01	0,87	0,97	0,59		0,32		0,68	0,42
<b>6</b>	3,63	0,97	0,97	0,39				<b>0,44</b>	0,65
<b>7</b>	3,53	1,09	0,97	0,38				<b>0,49</b>	0,65
<b>8</b>	3,78	1,04	0,97	0,36		0,39		0,34	0,68
<b>9</b>	3,88	0,94	0,96	0,55				<b>0,65</b>	0,49
<b>10</b>	3,72	1,02	0,97	0,49				<b>0,61</b>	0,54
<b>i*</b>	3,86	0,91	0,97	0,52				<b>0,64</b>	0,49
<b>ii*</b>	3,94	0,94	0,95	0,56				<b>0,63</b>	0,50
<b>iii*</b>	3,92	0,93	0,96	0,52				<b>0,59</b>	0,53
<b>iv*</b>	3,93	1,03	0,97	0,36				<b>0,48</b>	0,69
<b>v*</b>	4,01	0,94	0,97	0,52				<b>0,58</b>	0,54
<b>21</b>	2,63	1,10	0,94	0,46			<b>0,63</b>		0,56
<b>22</b>	3,32	1,04	0,97	0,49			<b>0,65</b>		0,51
<b>23</b>	3,46	1,02	0,96	0,42			0,49	0,30	0,63
<b>24</b>	3,13	1,18	0,93	0,63			<b>0,79</b>		0,36
<b>25</b>	3,19	1,07	0,96	0,48			<b>0,67</b>		0,51
<b>26</b>	3,41	1,05	0,96	0,60			<b>0,69</b>		0,43
<b>27</b>	3,66	0,95	0,97	0,47		0,37	0,38	0,33	0,59
<b>x*</b>	3,09	1,13	0,96	0,46			<b>0,65</b>		0,53
<b>xi*</b>	3,38	1,10	0,93	0,66			<b>0,78</b>		0,35
<b>c*</b>	3,30	1,09	0,97	0,38	0,35		0,32		0,68
<b>11</b>	3,99	0,91	0,97	0,64		<b>0,73</b>			0,38
<b>12</b>	3,81	0,94	0,97	0,57		<b>0,65</b>			0,47
<b>13*</b>	4,11	0,91	0,97	0,56		0,64		0,31	0,47
<b>14</b>	3,97	0,99	0,95	0,53		<b>0,57</b>			0,58
<b>15</b>	3,77	0,95	0,97	0,52		<b>0,58</b>			0,56
<b>16</b>	3,74	0,94	0,98	0,44		0,49		0,30	0,61
<b>17</b>	3,73	0,99	0,96	0,43		0,44		0,31	0,67
<b>18</b>	3,82	0,93	0,97	0,53		<b>0,60</b>			0,52
<b>19</b>	3,99	0,97	0,97	0,57		0,59		0,40	0,49
<b>20</b>	3,65	0,98	0,97	0,56		0,61	0,31		0,49
<b>vi*</b>	3,85	0,95	0,97	0,64		<b>0,72</b>			0,38
<b>a*</b>	2,36	1,14	0,90	0,34	0,32		0,43		0,70
<b>vii*</b>	4,05	0,95	0,97	0,57		<b>0,68</b>			0,46
<b>viii*</b>	3,66	1,00	0,98	0,55		<b>0,64</b>			0,46
<b>ix*</b>	3,94	0,93	0,98	0,47		<b>0,61</b>			0,55
<b>b*</b>	3,16	1,14	0,96	0,35		0,38	0,34		0,70

**Note:** This table displays results from the principal component analysis (PCA) using Polychoric correlations. The analysis is performed by using a Varimax rotation and we specified a four factors solution. Variables that are used later in the confirmatory analysis are displayed in bold. Personal, Relational, Public, and Collective stands for the factor of personal identity, relational identity, public identity and collective identity respectively. The PCA, using these new items, explains 62.33% of the variance.

### III.C.3. Models comparison

The EFA from subsection III.C.2 allows us to construct a new theoretical model based on the classification of the items emerging from the rotated factorial solutions. The question then is how this new models compares with the “American” model (based on the English version of the AIQ) and the “French” model (our validation) in terms of psychometric properties. The three models are defined as follows:

- **Model 1** based on the repartition of items observed in the American validation.
- **Model 2** based on the repartition of items obtained from the EFA carried out in our validation study.
- **Model 3** based on the repartition of items obtained from the EFA carried out with the addition of new items.

#### Comparison of Cronbach's Alphas

We compute for the three models the Cronbach's alphas, in order to compare the internal consistency of the item sets associated to each factor/identity dimensions. The Cronbach's alpha of a set of items tends to zero for independent items, and to one for perfectly correlated items. The results are displayed in Table III.C.3, which also includes the Cronbach's alphas from the US validation (Cheek, Smith and Tropp, 2002). The measured internal consistency of the item sets for personal identity and public identity are classified as good for the three models. The internal consistency is excellent for relational identity. For collective identity, internal consistency is good in Models 1 and 3, and acceptable in Model 2. The Cronbach's alpha have roughly the same magnitude as in the US sample for relational and public identity, regardless of the model. Interestingly, for the three models we find higher internal consistencies for the personal and collective identity dimensions as compared to the US sample. This table shows that the four scales display overall good to excellent internal consistencies.

Table III.C.3: Comparison of Cronbach's alpha for the competing models

	US sample	Model 1	Model 2	Model 3
Personal	0.73	0.87	0.83	0.89
Relational	0.92	0.90	0.90	0.90
Public	0.84	0.84	0.83	0.86
Collective	0.72	0.81	0.79	0.82

**Note:** This table compares the Cronbach's alphas of sets of items, classified according to three different models emerging from an EFA performed on our survey data. The first column displays in addition the results for the item sets identified in the original US study by [Cheek, Smith and Tropp \(2002\)](#). Model 1 corresponds to the item classification of the original model using the French data. Model 2 corresponds to the item classification resulting from the first exploratory factor analysis on the French data. Model 3 corresponds to the item classification resulting from the second exploratory factor analysis in which new items were added. Personal, Relational, Public and Collective refers to personal identity, relational identity, social identity and collective identity respectively.

### Comparison of the Fit Indices from the Confirmatory Factor Analyses

For each model, a CFA is performed by maximum likelihood with unconstrained covariance between latent factors. Figure [III.C.1](#) represents the path diagram for the structural equation model based on the classification from [Cheek and Briggs \(2013\)](#) (Model 1). Model 2 is represented by Figure [III.B.2](#) in Appendix [III.B](#). Figure [III.C.2](#) represents the path diagram for the structural equation model emerging from the EFA in Section [III.C.2](#).

Table [III.C.4](#) compares the models with adjustment quality indices (see Section [III.B.4](#)). First, Model 2 has a better fit than Model 1: the SRMR and the RMSEA of Model 1 are smaller. Moreover, both absolute fit indexes are smaller than the cut-off values of 0.05 for the RMSEA and 0.08 for the SRMR indicating an acceptable model fit. The incremental fit indices also confirms that Model 1 fits the data better than Model 2 as the TLI and CFI values are higher (0.900 and 0.908 respectively for Model 1, as against 0.87 and 0.879 respectively for Model 2).

These estimated adjustment quality measures are satisfactory, as judged by the combined values of the RMSEA and the SRMR, even though the TLI and CFI do not exceed the conventional cut-offs. [Rigdon \(1996\)](#) points out that, in CFA, relying on the RMSEA rather than the CFI is wiser

especially for large sample sizes. The reason is that the CFI is not only built on the assumption that the target model is correct, but also on the prior that all variables should be uncorrelated in the null model to be compared with the theoretical model. This hypothesis is questionable as it is unlikely that this null model should hold in a large population, given the objectives pursued by the researchers, and the fact that the variables are often correlated due to "background correlation, method factors or halo effects". Therefore, while the CFI is preferable in exploratory context in which the researchers have no prior knowledge on the theoretical structure of the data, the RMSEA is better suited for confirmatory analyses. In this perspective, our Model 2 is better than Model 1.

Comparing Model 3 with Models 1 and 2, we find that both the SRMR and the RMSEA are lower than those of Model 1 and Model 2. In addition, the RMSEA is statistically lower than 0.5, and Model 3 improves the CFI and TLI with the new values being equal to 0.928 and 0.923 respectively.

Table III.C.4: Fit indices from the confirmatory factor analysis for the two competing models

Fit Indexes	Model 1	Model 2	Model 3
$\chi^2$	2375.28	1 534.11	2 576.85
SRMR	0.058	0.047	0.041
RMSEA	0.053	0.049	0.043
RMSEA [CI 90%]	[0.051 ; 0.055]	[0.047 ; 0.052]	[0.041 ; 0.044]
TLI	0.870	0.900	0.923
CFI	0.879	0.908	0.928
CD	1,00	1,00	1,00

**Note:** This table represents the fit indices resulting from the confirmatory factor analysis of the model of [Cheek and Briggs \(2013\)](#) item classification (Model 1), the model from the first exploratory factor analysis (Model 2) and the model with additional items (Model 3). Fit indices used to compare the two competing models are the  $\chi^2$  statistics, the Square Root Mean Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA) and its confidence interval, the Tucker-Lewis Index (TLI), the Bentler's Comparative Fit Index (CFI) and the coefficient of determination (CD).

### Comparison of the models' Intraclass correlations

Table III.C.5 compares the intraclass correlations of the four subscales from the three competing models. Overall, the individual ICC of the four subscales are roughly similar for the three models. However, the personal subscale of Model 3 has a large decrease of its individual ICC. Based on the classification of Cicchetti (1994), Model 2 seems to be the most reliable structure as the lowest ICC is still classified as a good ICC.

Table III.C.5: ICC of total scores on Aspect of Identity

	Model 1		Model 2		Model 3	
	Individual ICC	Average ICC	Individual ICC	Average ICC	Individual ICC	Average ICC
Personal	0.71	0.83	0.71	0.83	0.62	0.77
Relational	0.62	0.77	0.63	0.77	0.59	0.74
Public	0.80	0.89	0.82	0.90	0.83	0.91
Collective	0.57	0.73	0.60	0.75	0.61	0.75

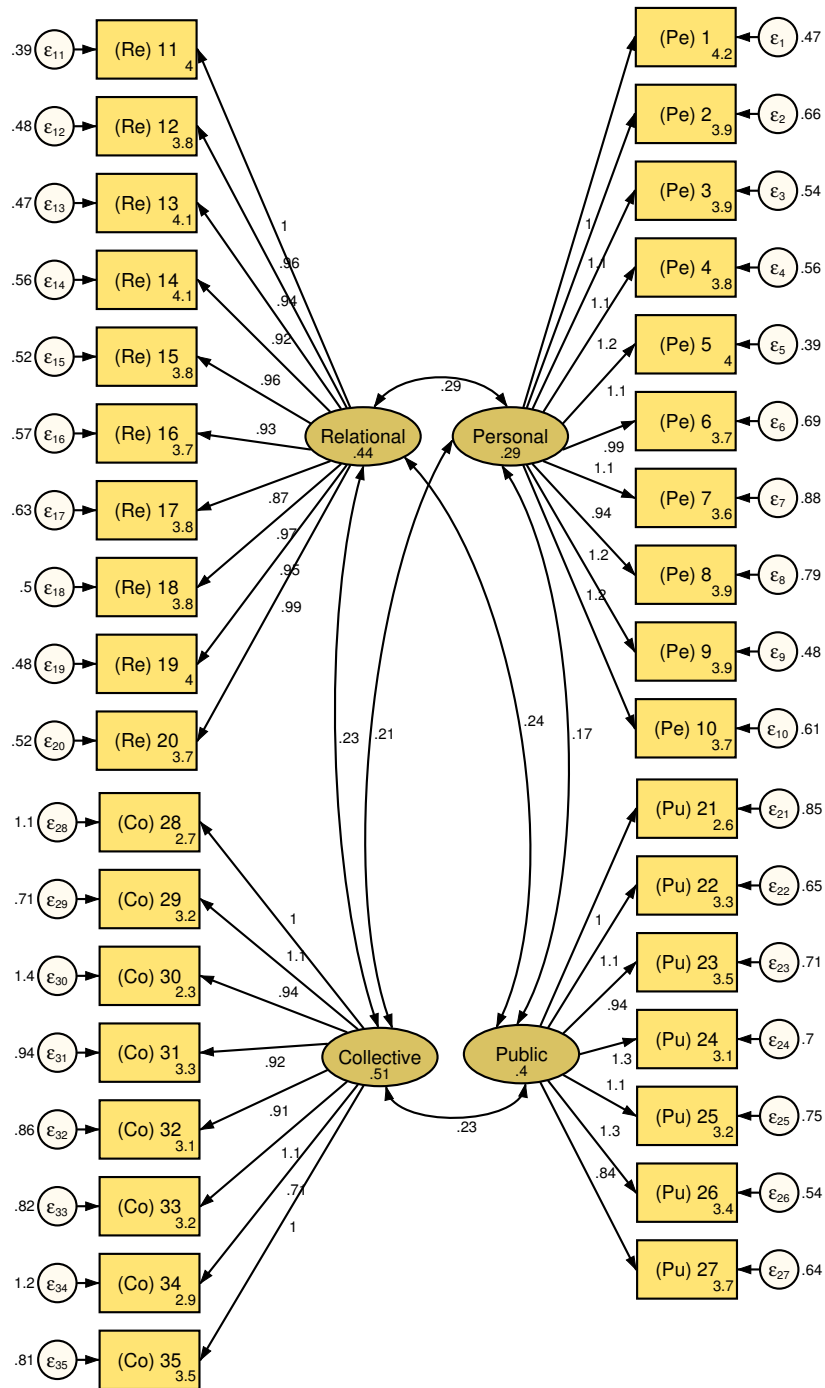
**Note:** Intraclass correlations (ICC) are calculated using a two-way mixed effects model for both individual and average with absolute agreement measurements. Personal, Relational, Public and Collective stands for the scores of personal identity, relational identity, social identity and collective identity respectively.

### Conclusion of the Model Comparisons

Based on the comparison of the confirmatory analysis, we conclude that Model 2 is more appropriate than Model 1 for a subsequent administration of the questionnaire to a French population. Model 3 presents higher values for the CFI and TLI approaching the conventional cut-off points and its RMSEA and RMSR are also lower than Model 2. However, Model 2 performs slightly better in the test-retest procedure since the four subscales of Model 2 have better intraclass correlations. In addition to a technical approach to assess which model is better, the relevance and the meaning of the items that we added in model 3 should still be discussed from a psychological stand-point. In particular, one has to be cautious in the use of this amended scale since it is a preliminary work. However, we are confident in the potential improvements that can be done to the

AIQ-IV to strengthen its psychometric properties.

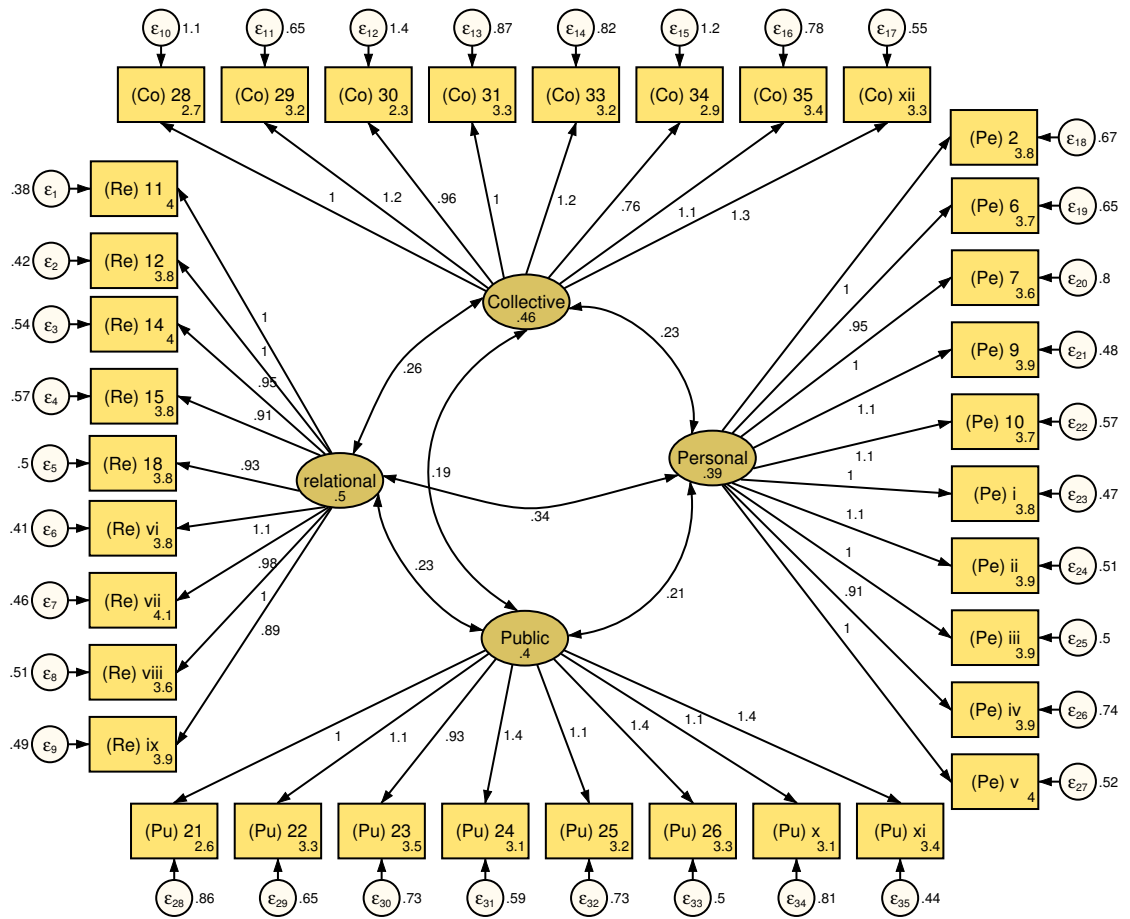
Figure III.C.1: Structural Equation modeling for the CFA from Cheek and Briggs (2013) (Model 1)



**Note:** Path diagram for the four factors confirmatory factor analysis. Rectangular boxes are observed variables and represent French items of the AIQ-IV. Round boxes are measurements errors in each item. Ellipses are the latent factors that are measured by the items. Straight lines link a predicting and a predicted variable. Curved lines correspond to covariance between the factors.



Figure III.C.2: Structural Equation modeling for the CFA using new items (Model 3)



**Note:** Path diagram for the four factors confirmatory factor analysis. Rectangular boxes are observed variables and represent French items of the AIQ-IV. Round boxes are measurements errors in each item. Ellipses are the latent factors that are measured by the items. Straight lines link a predicting and a predicted variable. Curved lines correspond to covariance between the factors.





## TIME PREFERENCES AND RELATIONAL IDENTITY

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*This chapter is a joint work with Fabrice Étilé.*

*“Sorry, I’m just scared of the future*

*’Til 3005, I got your back, we can do this, hold up”*

- Childish Gambino, 3005

### 1. Introduction

In a Rawlsian conception of rationality in intertemporal choices, what would happen to us today should yield the same utility as if this were to happen to us in the future. All parts of our future should be equally parts of ourselves and human existence over time must be considered as a whole regardless of the temporal position (Rawls, 1971, p. 298).<sup>1</sup> Such a conception assumes that an individual can be essentially be reduced to a single and permanent entity for whom future utilities are also part of his current utility. Although it is *a priori* hard to dispute that the person we are today and the person we will be in the future are fundamentally the same entity, personal identity is confined to be what remains constant over time. This view cannot constitute a basis for a normative rationalization of temporal discounting. If the self today is identical to the future self,

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1. “The mere difference of location in time, of something’s being earlier or later, is not a rational ground for having more or less regard for it.” (Rawls, 1971, p. 259)

choosing a smaller reward now over a larger reward in the future would be irrational as it would reduce the total well-being of the individual as a whole persisting over time.

In order to provide a normative justification of why people discount their utility over time, one needs to embrace a more complex view of personal identity. Although a person can be objectively re-identified over time through observable descriptors such as physical attributes, institutional identities (civil status, fiscal number etc.), and memories, she continuously becomes a new person by acquiring new thoughts, new tastes, new social affiliations, during his life experience (Parfit, 1984). Hence, the so-called complex view of identity denies the existence of such an irreducible entity that remains unchanged over time. Some modern philosophers and economists instead endorse a more tenable conception that the individual over time can be viewed as an infinite succession of overlapping selves that share to a certain degree of continuity based on characteristics including personality, apparent memories, interests and so on (Parfit, 1984, Strotz, 1955, Wachsborg, 1983).<sup>2</sup> This varying sense of continuity between the selves can serve as a basis for the justification of discounting behaviour: the extent to which she cares for her future selves ultimately depends on the degree of perceived similarity with our future selves. As we are likely to be more psychologically connected with our tomorrow self than with a much later self—because of the uncertainty of what/who we will become in a more distant future, or large anticipated discontinuities in identity—this reduced degree of continuity justifies an increased discounting (Frederick, 2003, Bartels and Rips, 2010, Bartels and Urminsky, 2011).<sup>3</sup> In this perspective, determining what are the

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2. A person  $P_1$  at time  $t_1$  is said to be psychologically connected to a person  $P_2$  at a later time  $t_2$ , if a particular mental fact characterizing  $P_2$  at  $t_2$  has been caused in large part by a particular mental fact of  $P_1$  or events lived by  $P_1$  at  $t_1$ . Interpersonal connections thus arise from relations of causal dependence between events and mental facts through time. Further,  $P_1$  is said to be psychologically continuous with  $P_2$  if they are many overlapping psychological connections between them. Parfit calls it “Relation  $R$ ”. It is important to note that the relation  $R$  involves neither subjective judgment nor objective inference about the quality of the connections, i.e. whether some memories are more vivid, or  $Y$  holds one psychological connections more important than another. It is rather a quantitative judgment about the number of connections that one can observe, i.e. an impersonal way of describing relations between persons.

3. “Indeed people are less concerned with their much later selves than with their tomorrow selves, and it is not difficult to see why: if they cannot imagine being the self in question, it is extremely difficult either to imagine what that self’s interest are or to take those interests into account equally with their more closely related stages in practical deliberation. But what generally enables that act of projective imagination is the expectation of a significant degree of psychological connectedness, so the less there is expected to be of that relation, the less our concern for those distant stages is likely to be.” (Shoemaker, 2005, p. 12)

important components of identity that affect continuity with one's future selves can help to open the black box of the formation of time preferences.

Parfit (1971, 1984) views private attributes of identity—such as personality, temperament, likes and dislikes, beliefs, values, ambitions, goals or ideals—to be central for the evaluation of continuity between the current and the future self. Although these elements may be part of an individual's self-definition, two objections can be raised. First, emphasising these particular elements leaves no room for individual subjectivity regarding what is genuinely important for them in defining they we are. The elements mentioned above may be not relevant for individuals self-continuity judgments. For instance, someone who predicts that he will be more and more keen on Jazz music will not necessarily feel fundamentally dissimilar to what he is today, as long as he does not judge his likes and dislikes to be fundamental elements of his identity. The question “Who I am” is directed at the subject herself. This has straightforward consequences for how we ground self-regarding and other-regarding concerns. We cannot identify concerns, without asking for whom these concerns matter. Second, individual identity reduced to private attributes of the self—as if one's own identity is constructed by an isolated agent operating independently and autonomously—thus fails to account for the fact that individual identity also reflects interpersonal and social contexts (Vignoles, Schwartz and Luyckx, 2011, Sedikides, Olsen and Reis, 1993, Sedikides and Brewer, 2015, Markus and Kitayama, 1991). In particular, the individual can defined herself as being a member of a family (“I am the mother of three children”), as a member of a wider social category (“I am French”) or by one's public representation (“my social behavior, mannerisms, stylistic quirks, and expressive qualities”). “The sense of ‘who I am’ is [...] a self-understanding defined in relation to a material and social context” (Atkins, 2000, p. 341). From birth to death, our social embedment contributes to the continuity of our personal identity through institutional devices (e.g. our civil registration, our citizenship,...), social norms, relationships with significant others etc.

Hence, the understanding of variation in self-continuity and therefore time preferences necessarily requires the rehabilitation of the subjectivity in individual identity accounting for the importance of personal and interpersonal aspects. As such, a growing psychology literature on identity

considers that individuals tends to define themselves on four different levels of identity orientations: who they are in terms of their unique traits (personal identity), of dyadic relationships (relational identity),<sup>4</sup> of public conduct (public identity), and of group memberships (collective identity). These four different orientations can be understood in part as a distinction among different forms of identity content, but it is often understood to refer to different kinds of processes by which identities are formed, maintained, or changed over time. These four different levels coexist within each individual and their relative importance may differ between each individuals (Sedikides and Brewer, 2015, p. 2). Hence, we believe that a deeper understanding of the role of self-continuity on time preferences should take into account a broader conception of identity reflecting the four different levels of self-definition, and their relative and subjective importance for each individual in order to determine what are the important drivers of self-continuity.

In this article, we explore which identity orientation matters the most for self-continuity judgments and time discounting. It consists in three independent studies performed on web-based platform with a French representative sample. The first study examines how identity orientations are associated to self-continuity with one's future selves. The second study shifts to the use of a priming manipulation<sup>5</sup> that consists in making the personal, the relational, and the public identity currently salient on self-continuity levels using the procedure from (Berzonsky, 2005). The third study uses a priming manipulation aiming to make participants view their personal, or relational identity unstable over time, using the priming manipulation of (Bartels and Rips, 2010).<sup>6</sup> We thus investigate whether this priming manipulation affects both self-continuity ratings on Study 2 and 3, and monetary discounting on Study 3.

Contrary to previous evidence in the literature from Frederick (2003) or from Bartels and Rips (2010), Bartels and Urminsky (2011), we do not find that personal identity is an important identity

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4. Dyadic is an adjective describing the interaction between a pair of individuals

5. Priming is a technique intended to influence a stimulus without conscious guidance or attention by the exposure of a previous stimulus.

6. These studies essentially revolves around personal and relational identity orientations but treatment on public identities orientations are also performed in the second study.

aspect for self-continuity evaluation. In study 1, there is no evidence that people defining themselves in terms of personal characteristics have higher self-continuity. In studies 2 and 3, we do not find significant priming effect of either increasing the salience or the perceived instability of personal identity on self-continuity.

In contrast, relational identity is found to be the most important identity orientation for self-continuity. Not only we find that people with high relational identity have larger self-continuity but both priming manipulations on relational identity also increase self-continuity providing some evidence of a causal impact. More specifically, increasing the availability of the relational identity increases self-continuity in the short-run, and making them view that their relational identity is unstable decreases self-continuity in the long-run. In study 3, in which we also measure time discounting through hypothetical choices, we also find that the instability of relational identity priming makes subjects more impatient in the monetary domain providing consistent evidence with the previous result of relational instability priming on self-continuity. A potential explanation of the causal relationship between relational identity and self-continuity and time preferences is that people may have a more stable view of their life as a whole when their own existence is integrated in a stable interpersonal network. In particular, stable significant relationships may serve as a “commitment device” generating interdependence between partners who are emotionally and behaviourally linked to achieve long-term goals. For instance, it is not unreasonable to assume that a married man, with a newborn child, has more ease in projecting himself in the future than a single person who is more likely to feel that the course of his life as unstable.<sup>7</sup>

Lastly, evidence supporting the importance of social identity orientation for self-continuity ratings is mixed: In study 1, we find that people who define themselves in terms of public appearance and reputation have lower self-continuity. In study 2, a raw investigation of treatment effects on self-continuity levels suggests that making this orientation more salient increases self-continuity

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7. Social interactions may also be important because the idea of responsibility pre-suppose that there are others – especially ‘significant’ others – who can ask “who did this?” and enter in a dialogue with the person. First-person narratives are not mere illusion, or worthless stories, because they can often be checked against others’ (third-person) narratives and their knowledge on the person: a narrative is a story told to someone else. Narratives are also infused with culture, from singular terms and stylistic figures to schemes of story-telling and typical characters.



proving an inconsistent result with study 1 from a theoretical perspective. However, controlling for a structural model of self-continuity discounting mitigates the treatment effect regarding its magnitude, significance and its temporal impact.

This article contributes to the literature on the relationship between time discounting and self-continuity by rehabilitating the subjectivity of the definition of identity that would matter in individual's sense of continuity and by questioning the importance of personal characteristics on self-continuity. We provide statistical evidence that self-continuity and time preferences are mainly influenced by the quality of the intimate relationships and how these relationships are important to define the identity of the individual.

As described previously, the article is divided into three independent studies that share a common methodology. The remainder of the paper is as follows: section 2 presents the general methodology underlying the three studies; section 3 presents the first study that examines at the cross-sectional levels associations between identity orientations and self-continuity; section 4 presents the experiment in which we study the effect of manipulating the salience or availability of identity orientations on self-continuity rating; section 5 presents the experiment in which we manipulate the perceived discontinuities of participants' selves and future selves over identity orientations and their effects on self-continuity and time discounting; section 6 concludes.

## **2. General Methodology**

We propose three independent studies, embedded in the same theoretical and experimental strategy, that test the assumption that individuals develop their self-definition and therefore their self-continuity through a broader conception of identity that is embedded in a relational context. Because the three experiments are virtually identical in their basic design, we first present a general methodological section with a theoretical model and the relevant instruments for the three studies. Some additional details of each study are given in their corresponding sections.

## 2.1. Theoretical Framework

The following section presents the empirical strategy rehabilitating the subjectivity of one's own self-definition and its consequences on psychological continuity. We develop a theoretical framework serving as a guideline for the empirical strategy, whereby self-continuity can be expressed as a function of the similarities between current and future selves according to different levels of self-definition: personal, relational, public and collective identity.

We define self-continuity as the perceived level of similarity between the current self and the future self. Therefore, we represent individual's self-continuity in  $t$  years as a function of the (dis)similarity between the current self identity  $\mathbf{i}_0$  and possible future selves identities  $\mathbf{i}_j$  at time  $t$  with  $j$  the index of possible selves and  $j = 0$  being the current self.

Let  $p_{j,t}$  be the subjective probability of becoming self  $j$  at  $t$  and  $\delta_{i,j,t}$  the perceived dissimilarity between the current self and possible self  $j$  identity at time  $t$ . As such, self-continuity can be expressed as the expected valuation of dissimilarities between the current self identity and all other possible selves identities at time  $t$ :

$$SC_t = \sum_j p_{j,t} v(\delta_{i,j,t}) \quad (\text{IV.1})$$

with  $v$  being the value function of possible selves that may be feared or desired (Vignoles et al., 2008) and  $v(0)$  being the valence of current self.

As stated above, following Cheek and Briggs (2013), Sedikides and Brewer (2015), Vignoles, Schwartz and Luyckx (2011), we assume that identity can be defined on four different levels: personal, relational, public and collective identity. The distinction among these identities represents different kinds of processes by which identities are formed and maintained or changed over time. Personal identity reflects the degree to which respondents define themselves as a unique person differentiated from others (e.g., emotions and feelings; feeling of being a unique person; thoughts and ideas; personal goals and hopes for the future). Relational identity reflects the degree to which the respondents report that their identities are derived from interpersonal relationships with sig-

nificant others (e.g. relationships with the people I feel close to; having mutually satisfying personal relationships ; connecting on an intimate level with another person). Public identity reflects the degree to which the respondents report that their identities are based upon social identity characteristics (e.g., reputation; attractiveness to other people; popularity with other people; belonging to the various groups that one is a member of). Lastly, collective identity reflects the degree to which the respondents identify themselves as part of a group that shares common characteristics (e.g. religion; race and ethnic background; feeling of belonging to my community). Thus, the identity of self  $j$   $\mathbf{i}_j$  consists in the vector:  $\mathbf{i}_j = \{i_j^k\}_k$  with  $i_j^k$  being an unspecified list of measurable attributes for  $k = \{personal, relational, public, collective\}$ , relevant for the subject, observable or not.

As a first-order approximation, we assume additive separability between aspects of identity in valuation and perception of similarity, so that the valuation of the dissimilarity between current self identity and future self  $j$  identity is the sum of the valuation of the dissimilarities according to the personal, relational, public and collective aspect:

$$v(\delta_{i,j,t}) = \sum_k v_k(\delta_{i,j,t}^k) \quad (IV.2)$$

with  $v_k$  being the importance of aspect  $k$  of identity in the valuation of dissimilarity and  $\delta_{i,j,t}^k$ : dissimilarity measure for aspect  $k$ .

Replacing the valuation function of equation IV.1 in the self-continuity function of equation IV.2 yields:

$$SC_t = \sum_k \underbrace{\sum_j p_{j,t} v_k(\delta_{i,j,t}^k)}_{V_{k,t}} \quad (IV.3)$$

Self-continuity can be here interpreted as a linear combination of the four expected valuations of dissimilarities with respect to aspect of identity  $k$ . This equation allows us to develop three strategies, each integrated into one of the three studies, to identify the sign of each valuation of

aspect of identity.

**Study 1 (Cross-section)** It may be possible using cross-sectional regressions to identify the sign of  $V_{k,t}$  but only if there is no *unobserved* factor that simultaneously affects self-continuity ratings and current identity, expected future identities, or perceptions of potential changes (*e.g.* past disruptive events).

Since these cross-sectional regressions may be subjects to potential biases resulting from unobserved variables and reverse causality, we propose experimental strategies aiming at changing exogenously the parameters of equation IV.3 to identify the sign of  $V_{k,t}$ .

**Study 2 (Salience manipulation)** For randomly chosen individuals, we render salient aspect  $k$  before eliciting self-continuity. If the priming works, subjective valuation of aspect  $k$  is magnified by some positive factor  $\lambda_k$  relatively to individuals in a control group, and absent cross-effects on other aspects of identity or dissimilarity judgments regarding attributes:

$$\Delta SC_t = \lambda_k V_{k,t}$$

Hence, we identify the sign of  $V_{k,t}$ . However, this identification strategy works only if the priming changes the salience or availability and not the valuation itself. Thus, the first hypothesis we have to test before investigating the impact of the priming of self-continuity is that the salience priming should not affect the relative importance that people place on their aspects of identity.

**Hypothesis 1** *Priming one aspect of identity will not affect its assessed importance, if identity orientation is a non-contextual individual construct.*

If the priming has not affected the importance of the aspect of identity, then it would be possible to identify the sign of  $V_k$ . The second set of hypotheses hence tests this idea.

**Hypothesis 2a** *Increasing the perceived salience of one aspect of identity will increase future self-continuity if it has a positive valence.*

**Hypothesis 2b** *Impact of salience priming is higher for more important aspects of identity.*

**Study 3 (Instability manipulation)** We prime subjects by telling them that their aspect of identity  $k$  is very likely to change over time. By doing so, we aim to increase the perceived probability that identity at  $t$  differs from identity at 0. Let  $\pi_{j,t} = \frac{p_{j,t}}{(1-p_{0,t})}$  the conditional probability that  $i$  changes to self  $j$  between 0 and  $t$ , we expect:

$$\Delta SC_t = \Delta V_{k,t} = \underbrace{-\Delta p_{0,t}}_{+} \sum_{j \neq 0} \pi_{j,t} \left[ v_k \left( \delta_{i,j,t}^k \right) - v^k(0) \right] \quad (\text{IV.4})$$

We will find a significant effect if the priming works ( $\Delta p_{0,t} < 0$ ) and subjects use aspect  $k$  in their self-continuity ratings ( $v_k \left( \delta_{i,j,t}^k \right) \neq v^k(0)$ ). The effect will be positive, if people have positive expectations of change in identity, and negative otherwise.

**Hypothesis 3a** *Increasing the perceived instability of one aspect of identity will decrease future self-continuity over time if people value stability.*

**Hypothesis 3b** *Impact of instability priming is higher for more important aspects of identity.*

## 2.2. Instruments

**Self-Continuity** We measure individual's self-continuity with future selves in the same way that has been operated by [Frederick \(2003\)](#), [Bartels and Rips \(2010\)](#), [Bartels and Urminsky \(2011\)](#). Respondents were asked to indicate, on a continuous 10 points scale, to evaluate how similar they expected to be from their future selves in  $t$  years. A self-continuity with the self in  $t$  years of 10 means that the person will remain exactly the same in  $t$  years and 0 means that the person will be completely different in  $t$  years. We measured self-continuity for  $t = 1, 5, 10, 20, 30$  and 40 years. Figure [IV.1](#) displays how the self-continuity measure was implemented.

From these self-continuity measurements at several time intervals, it is possible to estimate a model of self-continuity that allows testing the nature of the discounting in similarity with ones future selves. The underlying reason behind this extension of the self-continuity framework lies in the idea that people may underweight their similarity with their long-term future selves because they are systematically biased in their mapping of objective time to subjective time that is non-linear (Zauberman et al., 2009). To test for the discounting pattern in self-continuity, we estimate quasi-hyperbolic models:<sup>8</sup> let  $Y_t$  be the self-continuity between Self-0 and Self- $t$ , with  $Y_0 = 100$  and  $t = 1, 5, 10, 20, 30, 40$ . We have for the quasi-hyperbolic discounting model:

$$Y_t = \beta \delta^t Y_0$$

$$\delta = \frac{1}{1+r} \quad \text{where } r \text{ is the long-term discount rate.}$$

With such a structural model, we can estimate for  $t > 0$  (5 observations per individual) the effects of manipulation and identity aspects on long-term discount rate and on the present-bias of self-continuity using the following equation:

$$\begin{cases} \frac{1}{\tau} \ln\left(\frac{Y_t}{Y_{t+\tau}}\right) = \ln(1+r) = X_i \gamma \\ \frac{\tau \ln(Y_1) - \ln\left(\frac{Y_t}{Y_{t+\tau}}\right)}{\tau} = \ln(\beta) = X_i \mu \end{cases}$$

where  $\tau > t$  and  $X_i$  is a vector of individual observable characteristics.

**The Aspect of Identity Questionnaire - IV** Participants first had to complete the Aspect of Identity - IV (AIQ-IV) questionnaire (Cheek and Briggs, 2013) that had been translated and validated in French (Yin and Etilé, 2018). The AIQ-IV is a 45-item questionnaire measuring the relative importance or value that individuals place on various identity attributes when constructing their self-definition. It specifically highlights the presence of four domains including the orientation of

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8. Quasi-hyperbolic models are particularly appropriate for studying self-continuity ratings because of their flexibility (a quasi-hyperbolic model with a present-bias parameter equal to unity would be equivalent to an exponential model) and its ability to differentiate short-term and long-term devaluation of self-continuity.

Figure IV.1: Slider for Self Continuity in Study 1 and 2



**Notes:** This figure represents the design of the self-continuity task. Participants must chose a number between 0 and 10 corresponding to their perceived similarity between themselves today and themselves in one, five, ten, twenty, thirty, and forty year(s). The number 0 means that they will be a completely different person, and 10 means that they will be exactly the same person.

personal, relational, public and collective identity. On a Likert scale from 1 (not at all important) to 5 (extremely important), participants indicated on 45 propositions which were the most important for their "sense of who they are". The questionnaire contains 10 elements related to personal identity, 10 elements related to relational identity, 7 elements related to public identity and 8 elements related to collective identity.

The score of each aspect of identity is calculated by averaging the responses to items referring to the same construct  $k$ . Scores are then standardized to interpret the impact of one standard deviation of the score on self-continuity. The entire questionnaire and the scoring numbering is detailed in the appendix [III.A](#).

### 3. Study 1: Is Self-continuity associated with Aspects of Identity?

The first study examines how the four aspects of identity correlate in cross-section with perceived degree of self-continuity between one's current and future selves.

#### 3.1. Subjects

$N = 1,261$  participants were contacted on Qualtrics to complete a short survey on identity. We used a representative sample of the French population between 18 and 35 years old with equal representation of males and females.<sup>9</sup> Participants were paid between 4.2 euros and 5 euros upon the full completion of the questionnaire. The duration of this study was approximately 15 minutes.

#### 3.2. Method

Participants were informed that this survey revolved around the topic of identity. Participants had to complete the AIQ-IV first and then the self-continuity questionnaire.<sup>10</sup> In this study, we used the same instructions as [Bartels and Urminsky \(2011\)](#). Respondents were told to think of their similarities with their future selves regarding their characteristics such as “personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals, etc.”

Because the survey was designed for computer and smartphone administration, a special attention was paid to the quality of the responses. In addition to a timer that screened out people responding too quickly to the survey, we used an attention check in a random location of the AIQ-IV questionnaire for which individuals had to answer "not important" to be able to complete with the survey (see [Yin and Etilé, 2018](#)).

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9. In our studies, we restrict the inclusion criteria to “young” participants since they must rate their self-continuity with their future selves up to 40 years. Not only self-continuity might be interpreted differently depending on the age of the subject, we also suspect that rating self-continuity for 40 years makes less sense for people in old age.

10. The main purpose of the survey was to perform a validation of a French version of the AIQ-IV scale ([Yin and Etilé, 2018](#)). We have taken advantage of the availability of the large sample size and the short duration of the experiment to ask participants about their self-continuity at the end of the survey.



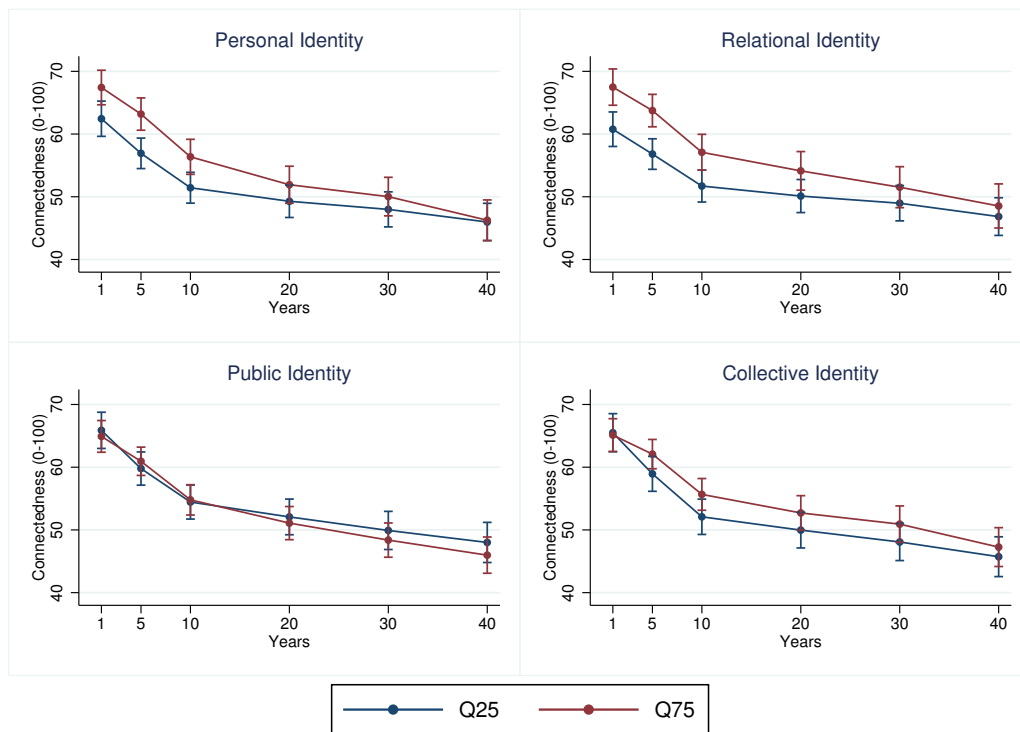
### 3.3. Results

**Does the importance of specific aspects of identity increase self-continuity?** As a first evaluation of the relationship between aspects of identity and self-continuity, we examine the difference in self-continuity levels by scores on the four aspects of identity. Figure IV.1 shows the average self-continuity levels by low and high quartiles of personal, relational, public, and collective score. Short term self-continuity is significantly higher for people who score high on personal and relational identities with the difference fading away over delays. Neither the public identity nor the collective identity is significantly associated with a difference in self-continuity. Of course, these results should be treated with caution as these bilateral relationships fail to account for potential correlations between the four aspects of identity and socio-demographic characteristics that may lead to biased estimates.

A more careful examination was thus performed by regressing the standardized self-continuity levels on the four standardized scores of aspects of identity, controlling for sex, age categories and levels of education. Figure IV.2 displays the marginal effects of each scores on the levels of self-continuity. These regressions reinforce the finding that relational identity is indeed positively associated with short-term self-continuity with the effect fading away over longer delays as well: a one standard deviation of the score of relational identity is significantly associated at the 1% level with a  $+0.134$  increase in standardized self-continuity with future self in one year while it is only associated with a  $+0.077$  increased self-continuity with future self in 10 years.

These regressions show no statistically significant effects of personal identity score on self-continuity, contrary to the previous results from Figure IV.1. It suggests that the raw positive correlation between personal identity and self-continuity results from the positive correlation between personal and relational identity. On the other hand, people indicating that their public identity is important to define who they are tend to feel significantly less similar to their future selves in 1 year, 5 years, 10 years, and 20 years. This result suggests that further work should investigate why public identity would potentially cause lack of self-continuity.

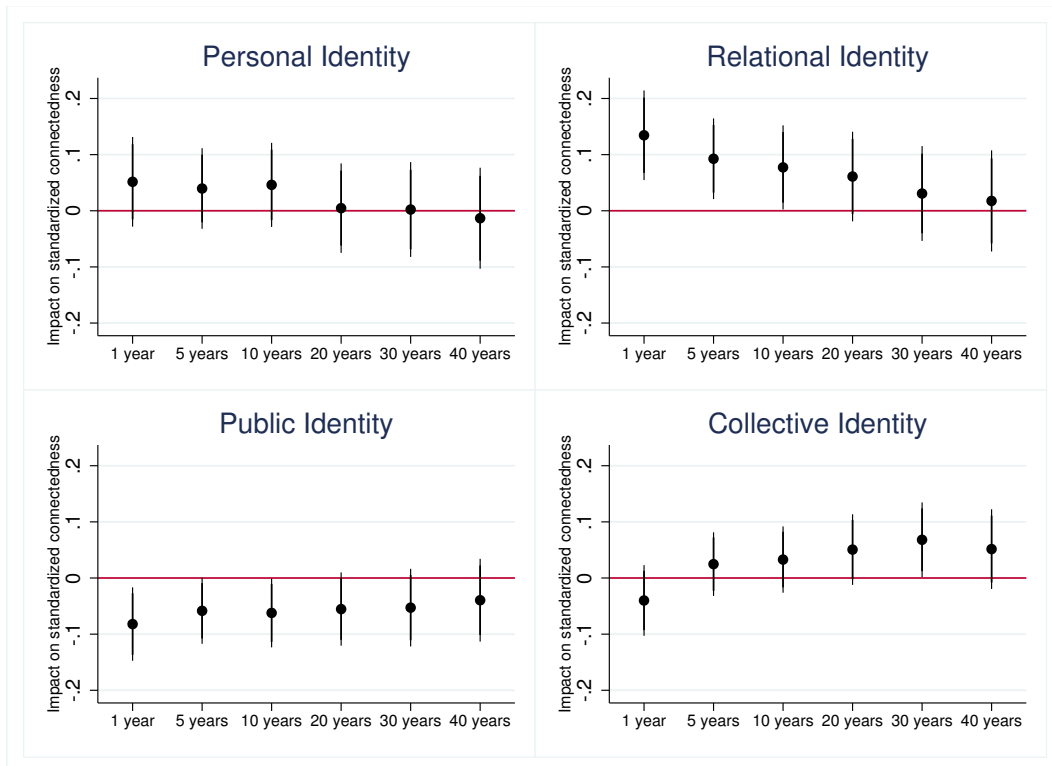
Figure IV.1: Heterogeneity of Connectedness, lower vs upper quartiles of Aspects of identity scores,  $S_{ij}$



**Notes:** Qualtrics Data on  $N = 1,244$ ; This figure displays the comparison of the average levels self-continuity at 1 year, 5, 10, 20 and, 30 years for low and high scores of personal, relational, public and collective identity. Low and high scores are calculated using the quartiles of the standardized scores of aspects of identity. The horizontal bars corresponds to the confidence interval at the 95% level;

**Comparison of Self-Continuity Discounting Models** In Table IV.1, we compare and report the result of regressions of the parameters of the exponential and the quasi-hyperbolic models of self-continuity discounting on aspects of identity controlling for age, sex and educational achievements.

Assuming a standard model of exponential discounting for self-continuity, people with a high relational identity perceive themselves more similar to their future selves: a one standard deviation of relational identity score is associated with a 0.014 decrease of the discount rate of self-continuity (a 6.3% decrease as compared to the mean,  $p < 0.05$ ). People who score high on public identity "discount" significantly more their similarity with their future selves as it is associated to a 0.001

Figure IV.2: Associations between Aspects of Identity and self-continuity,  $Std_{ij}$ 

**Notes:** Qualtrics data on  $N = 1,244$  ; This figure represents the marginal effects of the standardized scores of personal, relational, public and collective identity on self-continuity for 1 year, 5 years, 10 years, 20 years and, 30 years. The vertical bars corresponds to the 95% confidence interval and the red horizontal bar corresponds to a zero marginal effect.

increase of the discount rate (a 4.5% increase as compared to the mean,  $p < 0.1$ ). No significant association is found between personal or collective identities and the discount rate of self-continuity. The results from the exponential discounting are consistent with the results displayed in Table IV.2 highlighting the importance of relational and public identity on self-continuity.

The hyperbolic discounting offers a richer view on how identity aspects are related to similarity judgements. First, if we assume that individuals discount their self continuity at a non-constant rate, relational, and public identity are still associated to self-continuity but through the  $\beta$  parameter describing an over-evaluation of short-term self-continuity: a one standard deviation of relational identity score is associated with a 0.0034 increase in  $\beta$ , corresponding to an increase of self-continuity in one year (a 4.9% increase as compared to the mean,  $p < 0.05$ ); a one standard

deviation of public identity is associated with a 0.019 decrease in  $\beta$  corresponding to a decrease of self-continuity in one year (a 2.7% decrease as compared to the mean,  $p < 0.1$ ). Unlike previous results, when controlling for potential present-bias in self-continuity judgements, personal identity is associated with a decrease of long-term self-continuity: a one standard deviation increase of personal identity score is associated with a 0.005 increase in discount rate (a 31% increase as compared to the mean,  $p < 0.01$ ). Not only this result contradicts the absence of correlation between personal identity and self-continuity, it also contradicts the hypothesized direction of the correlation as we would have expected that elements relating to the importance of personal goals, values and beliefs would increase the individual's perception of stability of the self over time and hence self-continuity.

Overall, these results tend to suggest that relational identity is the most important aspect in self continuity judgements in both the exponential and the quasi-hyperbolic discounting model. However, since the two models proposes slightly different channels through which relational identity is related to self-continuity, we examine which model produces the most realistic estimated discounting parameters to assess which channel is more likely. The exponential model produces a large value for the estimated discount rate of 22%. In contrast, the value of the estimated discount rate in the quasi-hyperbolic model is 1.6% which appears to be more realistic. The estimated present-bias parameter is 0.681 suggesting that people under-estimate their long-term self-continuity. Given the lack of realism of the exponential discounting parameters values and its lack of flexibility, the resulting interpretation of the quasi-hyperbolic model and its use for subsequent studies are preferred.

### 3.4. Discussion

It may be that the results are just an artefact related to individual heterogeneity in response style. Individuals may chose to answer to all of the items in a way that is orthogonal to the content of the question but in a systematic way (*e.g.*, rating every AIQ items as important or very important). Specifically, it can be argued that people who score high on all the constructs are also people

Table IV.1: Structural model of Discounting with Standardized Values  $Std_{i,j}$ 

	Exponential discounting	Quasi-hyperbolic discounting	
	$r$	$r$	$\beta$
Personal Identity (std)	0.002 (0.007)	0.005*** (0.002)	0.019 (0.014)
Relational Identity (std)	-0.014** (0.007)	-0.001 (0.002)	0.034** (0.014)
Public Identity (std)	0.010* (0.005)	0.000 (0.001)	-0.019* (0.011)
Collective Identity (std)	-0.007 (0.005)	-0.004*** (0.001)	-0.010 (0.011)
Mean sample value	0.220*** (0.009)	0.016*** (0.001)	0.681*** (0.004)
$N$	7,166	5,911	5,856

**Notes:** This table displays the result of the OLS regressions evaluating the effect of the standardized scores of personal, relational, public and collective identity on the parameters of self-continuity discounting. The first column represents the discount rate parameter if we assume an exponential discounting model. The two last columns represent the discount rate and the present-bias parameter if we assume a quasi-hyperbolic discounting of self-continuity. Control variables are age, sex, and level of education; \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

who have a high degree of self-continuity. In order to circumvent the response style issue, we can construct a within-individual standardization  $Std_{i,j}^w$  of scores for personal, relational and public identity. Each of the three scores is divided by the collective identity standardized score, the collective standardized remains unchanged.

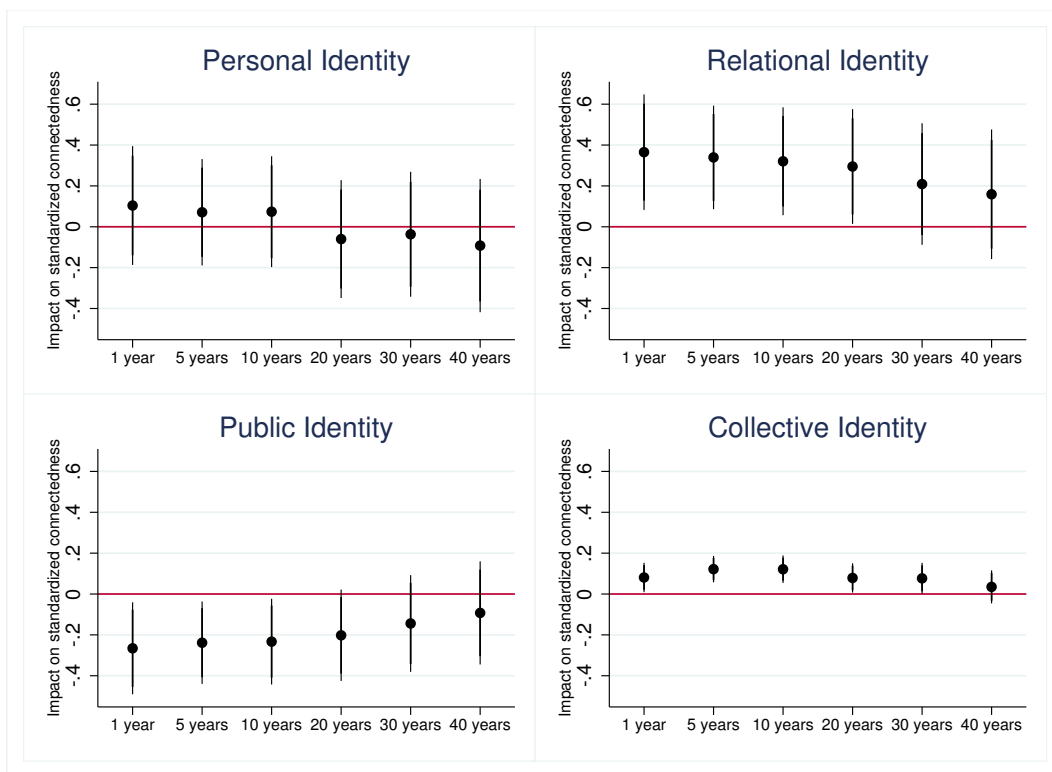
$$Std_{i,j}^w = \frac{Std_{i,j}}{Std_{i,collective}}, \quad j = \text{personal, relational, social}$$

$$Std_{i,collective}^w = Std_{i,collective}$$

This standardization has the advantage of removing the variance that would be due to the response style in the AIQ-IV: a participant whose responses for the collective and relational items are identical will have a standardized score of unity. The collective score serves as baseline for two reasons. First, our main interest lies mainly in the personal and relational identities. Second, we make the assumption that the collective score is the most stable in the questionnaire. Figure IV.3 displays

the marginal impacts of each ratio of identity scores on self-continuity regression. Controlling for response style, we still find a significant effect of relational and public identities on short-term self-continuity but nothing significant for personal identity. The coefficient associated to the score for collective identity becomes significant but it is the result of the relatively higher magnitude of this score compared to the other scales.

Figure IV.3: Associations between Aspects of Identity and self-continuity, ratios of standardized scores



**Notes:** Qualtrics data; This figure represents the marginal effects of the ratios of standardized scores of personal, relational, public over the standardized score of collective identity on self-continuity for 1 year, 5 years, 10 years, 20 years and, 30 years. The last score of collective identity is only standardized. The vertical bars corresponds to the 95% confidence interval and the red horizontal bar corresponds to a zero marginal effect.

Table IV.2 performs the structural estimation of the discounting parameter for self-continuity on the ratio of aspects of identity. Similarly to the previous structural estimations, we show that the relational identity has a negative and significant effect on the discount rate if we assume that the discounting is exponential; we also show a positive and significant effect on the present-bias

Table IV.2: Structural model of Discounting with Within Standardized Values  $Std_{i,j}^w$ 

	Exponential discounting	Quasi-hyperbolic discounting	
	$r$	$r$	$\beta$
Ratio Personal Id/Collective Id	0.013 (0.024)	0.022*** (0.006)	0.052 (0.049)
Ratio Relational Id/Collective Id	-0.046* (0.023)	-0.010 (0.006)	0.102** (0.049)
Ratio Public Id/Collective Id	0.025 (0.018)	-0.000 (0.005)	-0.055 (0.039)
Collective Identity (std)	-0.012** (0.006)	0.001 (0.002)	0.036*** (0.012)
Mean sample value	0.220*** (0.009)	0.016*** (0.001)	0.681*** (0.004)
$N$	7,166	5,911	5,856

**Note:** This table displays the result of the OLS regressions evaluating the effect of the ratios of the standardized scores of personal, relational, public identity on the parameters of self-continuity discounting. Collective identity is only standardized. The first column represents the discount rate parameter if we assume an exponential discounting model. The two last columns represent the discount rate and the present-bias parameter if we assume a quasi-hyperbolic discounting of self-continuity. Control variables are age, sex, and level of education; \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

parameter  $\beta$  if we assume that the discounting model is quasi-hyperbolic. In addition, we still find that personal identity has a significant effect on the discount rate on the quasi-hyperbolic model that goes in the opposite direction as expected. Finally, using such a standardization, we find no effect of public identity on self-continuity, neither in the exponential discounting nor in the quasi-hyperbolic discounting model. Thus, these results nuance previous findings showing that public identity would be important for self-continuity judgments.

In summary, we find that relational identity is associated with higher self-continuity levels. Personal identity is not significantly associated with higher level of self-continuity and the structural model actually describes a negative association between self-continuity levels and personal identity scores if we assume that people discount their self-continuity in a quasi-hyperbolic fashion. Public identity is associated with a decrease of self-continuity but controlling for individuals' response style of the survey, the association is no longer significant. Do these correlations reflect causal effects? We test causalities using experimental manipulations by either increasing

the salience of one aspect of identity in Study 2, or by increasing the perceived instability of their identity over time in Study 3.

## 4. Study 2: Priming the Salience of Aspects of Identity

The main objective of this study is to increase experimentally the salience of either personal, relational or public identity to identify the effect of the increase in the availability of one identity aspect on self-continuity.

### 4.1. Subjects

$N = 413$  participants were contacted on Qualtrics to complete a survey on identity on their computer or on their cellphone. The conditions under which individuals were asked to answer this questionnaire were similar to those in Study 1: individuals were paid 4 euros for completing the questionnaire, questions were hidden inside the questionnaire to ensure that participants were attentive, and a timer was also used to screen-out individuals who responded too rapidly to the survey. The average duration of the survey was 17 minutes.

### 4.2. Method

**Priming conditions** This study relies on a between analysis whereby participants are randomly assigned to treatment groups. We used the priming condition proposed by [Berzonsky \(2005\)](#) which is designed to increase the personal salience and availability ([Tversky and Kahneman, 1973](#)) of either personal, relational, or public self-elements. Subjects were randomly allocated to one of three cognitive priming conditions in which they were required to list either the personal characteristics ( $N = 105$ ), their significant relationships ( $N = 93$ ), or the public concerns ( $N = 99$ ) that define who they are as a person. In each condition, they were then instructed “to spend a few minutes thinking about what distinguishes them from other persons [or their relationships with others or their public appearances in different contexts] that are an important part of how they define them-



selves. They were provided some examples relevant to their specific condition and asked to write down as many (personal, relational or public) characteristics and attributes that define who they are. It was stressed out that there were no right or wrong answers. Full instructions are provided in Appendix IV.B.1.

We compare the treatments defined above with a control group that must also provide subjective perceptions about themselves.  $N = 116$  subjects were allocated to the control group and they were asked to take a few minutes to think about five elements of their identity which are important to describe who they are. We did not provide any example of what could be an element of their identity.<sup>11</sup>

**Measures** After the priming conditions, the attributes the subjects used to define their sense of identity were measured by the AIQ-IV. Once the questionnaire has been completed, participants had to report their degree of self-continuity for 1, 5, 10, 20, 30 and 40 year(s) in a similar fashion to Study 1. The survey ends with questions related to socio-demographic characteristics such as age, gender, location, and health behaviours.

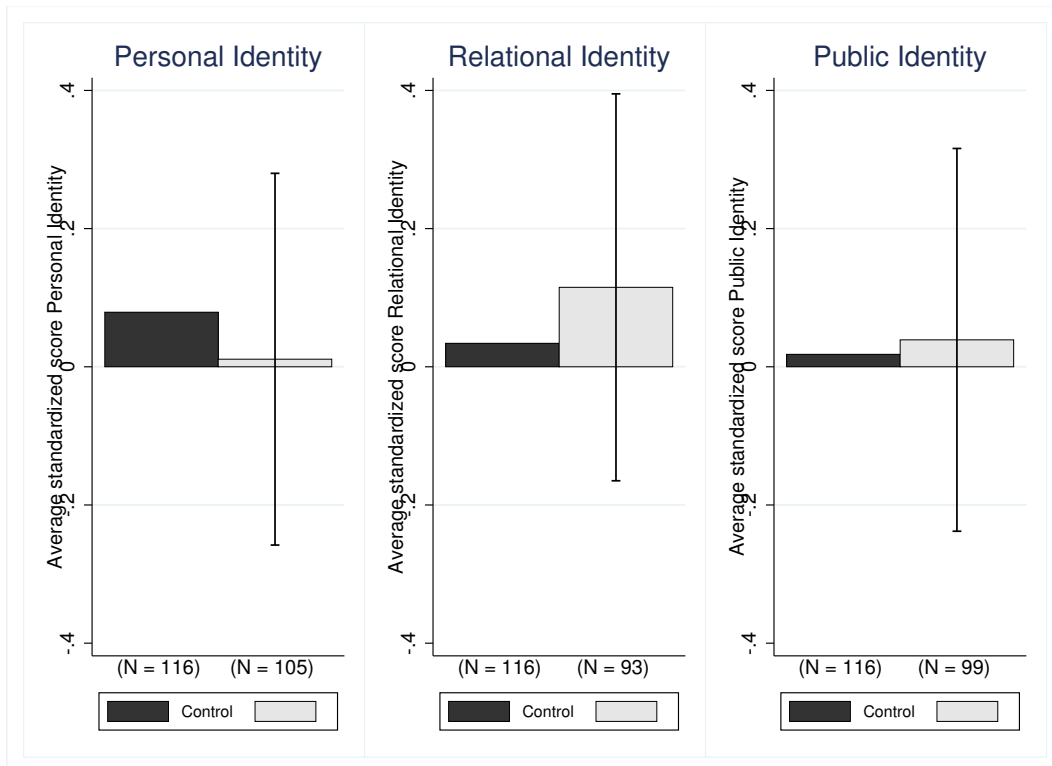
### 4.3. Results

**Impact of salience treatment on the score of the Aspect of Identity Questionnaire** We test hypothesis 1 stating that priming one aspect of identity will not affect its centrality. To evaluate the impact of salience priming on self-definition, we compare the average standardized scores of personal, relational, and social identity between the control group in contrast to priming groups of personal, relational, and social identity respectively (Figure IV.1). None of the priming of personal, relational or social identity affects significantly individuals' relative importance of the targeted aspect of identity. The availability of attributes within a particular self-domain appears to be inde-

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11. The purpose of this control condition is to make participants perform a cognitively similar task to the ones presented to the participants in the treatment groups. For that purpose, participants were instructed to think of their identity(ies) without any emphasis on a particular aspect. In that sense, we propose a very conservative comparison between the control and the treatment groups since it might be likely that the control priming make a particular and important aspect salient.

Figure IV.1: Impact of salience treatments on AI scores



**Note:** Qualtrics data, *Expe 1*; This figure displays the average standardized scores of personal, relational and public identity for the control group in black and the group that has been primed on respectively personal, relational and public identity. The horizontal bar represents the confidence interval at 95%.

pendent from the self-definitional importance one assigns to those attributes, which is consistent with results from [Berzonsky \(2005\)](#). It suggests that self-definitional emphases are relatively stable and non-contextual.

**Impact of salience treatments on self-continuity** Figure [IV.2](#) displays the self-continuity levels for the control, personal, relational, and social identities. Graphs allow a comparison of self-continuity between a specific priming treatment and the control group. Priming personal identity has little and non-significant impact on self-continuity. This result adds another evidence that would suggest that personal identity has a limited role in self-continuity judgements.

In contrast, we find that people whose relational and public identity are salient have higher

self-continuity when compared to the control group.<sup>12</sup> The robustness of the treatment effect of personal and relational identity salience is examined in Appendix IV.C.1. The p-values associated to the treatment on self-continuity have been adjusted by the numbers of total outcomes tested. The adjusted p-values of both Bonferroni and Holm corrections still provide the following result: personal identity has no impact on self-continuity, but increasing the salience of relational and public identity have a positive and significant impact on self-continuity. Although the impact of relational identity salience on self-continuity is consistent with previous findings of study 1, the positive effect of public identity priming is inconsistent with the previous study as we expected that making the public identity salient would decrease self-continuity, given the negative association found earlier.

**Quasi-Hyperbolic discounting in similarity Judgements** In Table IV.1, we estimate the treatment effect of the increasing salience of personal, relational, and public identity on the discount rate and present-bias parameters of self-continuity.<sup>13</sup> We also test hypothesis 2b examining whether the impact of the increased salience of one aspect of identity is higher when this aspect is more important. For that matter, we use an interaction between the treatments and dummy variables indicating a high score on the corresponding identity orientation.<sup>14</sup> In the upper block of Table IV.1, we find that neither the treatments of personal or relational identity, nor their interactions with their corresponding identity orientations affect self-continuity discount rate. This means that the salience has virtually no impact on self-continuity levels for self-continuity beyond 5 years. In the lower block, we find that making relational identity salient increases short-term self-continuity, evidenced by a 0.120 increase of the  $\beta$  parameter (a 16.4% increase as compared to the sample mean,  $p < 0.01$ ). This result is consistent with the descriptive statistics of Figure IV.2 showing that

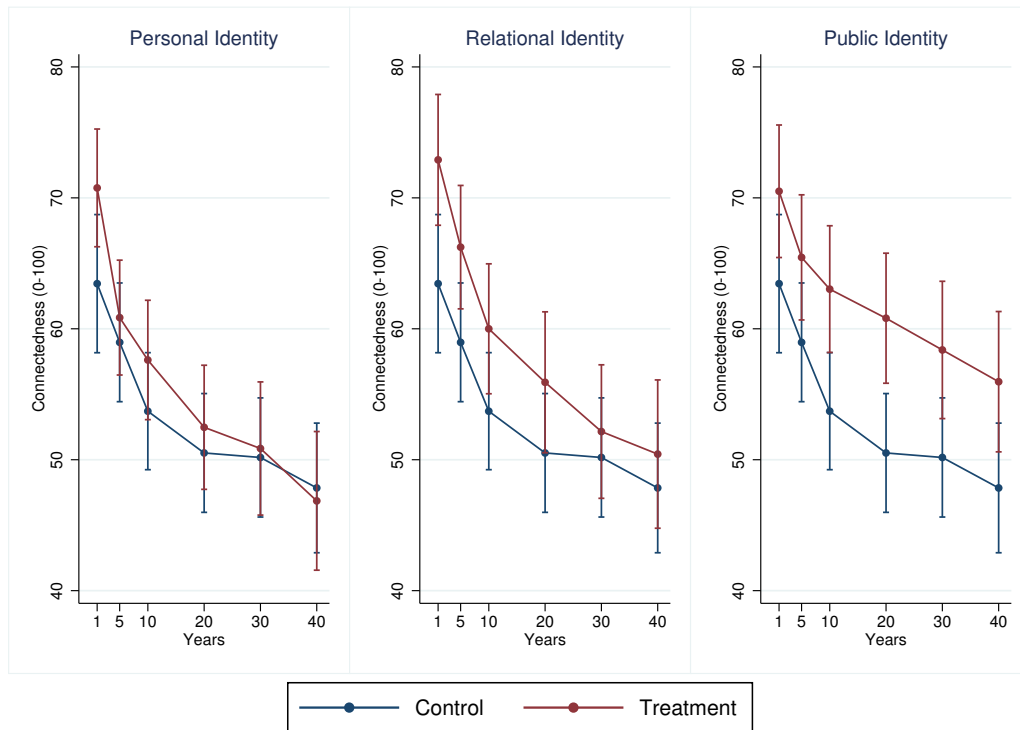
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12. The differences in self-continuity are significant at the 90% level.

13. As described previously, we focus on the quasi-hyperbolic model because the exponential model yielded unrealistic discount rates in Study 1.

14. In order to assess whether an individual scores high or low on an identity construct, we standardized the score and we split the distribution of responses in three. A high identity score is defined as being larger than one standard deviation of the score. Conversely, a low identity score is defined as being lower than minus one standard deviation. The remainder of the analysis uses the average score as a baseline for comparison.

Figure IV.2: Raw Salience Priming Effect of Personal, Relational, and Public Identity on Self-Continuity



**Notes:** Qualtrics data, *Expe 1*; This figure displays the comparison of the average levels self-continuity at 1 year, 5, 10, 20 and, 30 years for the control group in blue and the salience treatment group of respectively personal, relational, and public identity. The horizontal bars correspond to the confidence interval at the 95% level.

relational identity has a positive and significant impact on the overall level of self-continuity. In addition, the effect of making relational identity salient is larger when the score of relational identity orientation is high, evidenced by the 0.169 increase of short-term self-continuity associated to the interaction effect (a 23.18% increase as compared to the sample mean,  $p < 0.05$ ).

As shown in the previous results, the public identity treatment has a positive effect on self-continuity as it increases the present-bias parameter of self-continuity by 0.086 but only at the 10% level. No interaction effect on self-continuity is found for public identity.

Table IV.1: *Saliency priming* Effect on Quasi-hyperbolic Discounting Parameters of Self-Continuity

	Personal - Treat.	Relational - Treat.	Public - Treat.
<i>r</i> - Quasi-hyperbolic discounting			
<b>Treatment effect</b>	0.007 (0.005)	0.007 (0.005)	-0.001 (0.005)
<b><i>Treatment heterogeneity</i></b>			
Low <i>Std<sub>i,j</sub></i> (-1 std)	0.006 (0.007)	0.007 (0.008)	-0.001 (0.007)
High <i>Std<sub>i,j</sub></i> (+1 std)	0.007 (0.007)	0.007 (0.007)	-0.001 (0.007)
Mean sample value	0.015*** (0.001)	0.015*** (0.001)	0.015*** (0.001)
$\beta$ - Quasi-hyperbolic discounting			
<b>Treatment effect</b>	0.069 (0.045)	0.120*** (0.046)	0.086* (0.048)
<b><i>Treatment heterogeneity</i></b>			
Low <i>Std<sub>i,j</sub></i> (-1 std)	0.036 (0.060)	0.066 (0.068)	0.070 (0.073)
High <i>Std<sub>i,j</sub></i> (+1 std)	0.104 (0.069)	0.169** (0.067)	0.100 (0.063)
Mean sample value	0.729*** (0.004)	0.729*** (0.004)	0.729*** (0.004)
<i>N<sub>obs</sub></i>	1,074	1,004	1,040

**Notes:** This table represents the treatment effects on the parameters of self-continuity discounting. Assuming a quasi-hyperbolic discounting of self-continuity, the first part of the table corresponds to the OLS regression of the discount rate of self-continuity on the saliency treatment of personal, relational and public identity. The second part of the table regresses the present-bias parameter of self-continuity on the saliency treatment of personal, relational and public identity. In the independent variables, we also add an interaction effect of the treatment and dummies variables indicating whether the individual has a low or high score of standardized aspect of identity *Std<sub>i,j</sub>* that has been primed. We classify low and high scores being one standard deviation respectively below or above the mean. The regressions are controlled by age, sex and level of education. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

#### 4.4. Discussion

The results of the current study are consistent with findings from Study 1 showing the importance of relational identity on self-continuity ratings. More strikingly, increasing the salience of relational identity has an impact on short-run self-continuity only, and the effect is even larger for people whose relational identity orientation is important. Also consistent with Study 1, we do not find an impact of salience of personal identity orientation on self-continuity. This finding is all the more surprising since self-continuity measurements have been framed around personal characteristics. The question that remains unanswered at this stage is whether we found no effect either because the personal identity is already a fully available construct to participants or because our priming manipulation is inefficient to make this construct salient. Finally, while we expected a negative impact of the salience of public identity on self-continuity, Figure IV.2 displays a raw but positive effect. At first, it casts some doubts on whether the priming manipulation actually affects the salience or the valuation of this identity orientation; but since we find no statistical difference in public identity scores between the control and the treatment group, it seems very unlikely that the priming manipulation had changed the valence of public identity in self-continuity rating. However, controlling carefully for a structural model of self-continuity discounting and socio-demographic characteristics, the treatment effect of public salience is lower and found only significant at the 10% level which mitigates the contradictory results between studies 1 and 2.

Hence, the overall results of study 2 also highlights the importance of relational identity on self-continuity ratings since the current availability of this construct affects the perceived continuity with near future selves.

### 5. Study 3: Instability of Identity Priming

We investigate the effect of manipulating people's perceived of the instability of their personal or relational identity on self-continuity and intertemporal discounting (Bartels and Urminsky, 2011).

## 5.1. Subjects

N=1069 participants were recruited on Qualtrics to answer a survey on their computer or on their smartphone. The condition for the survey administration was similar to the one described in the previous studies. The sample consists in young adults (age 18-35) with equal representation of men and women. They were recruited on Qualtrics to answer a short survey on identity to be paid between 4.2 euros and 5 euros.

## 5.2. Method

**Priming Conditions** This study used a 2 (personal identity, relational identity)  $\times$  2 (stability, instability) between-participants design. We manipulate self-continuity by having participants read a passage that described general life changes, that would either impart changes specifically to one's personal ( $N = 276$ ) or relational identity ( $N = 279$ ) or that would specifically not change one's personal ( $N = 259$ ) or relational identity ( $N = 255$ ). More specifically, in the treatment of personal (resp. relational) identity instability, subjects began to read a short description of "recent research" suggesting that young adulthood is characterized by instability in personal (resp. relational) identity, that is "all the characteristics that relates to personal aspirations and goals, beliefs, values, emotions, skills (resp. the characteristics that relates to their behavior to significant others (family, friends, confidants, spouses) and their role regarding these people) [...] are established early in life and fixed by the end of adolescence". In the personal (resp. relational) stability treatment, subjects read about personal (resp. relational) identity instability, that is "all the characteristics [...] are likely to change radically in young adulthood". After the passage's reading, every subject had to answer a short multiple-choice questionnaire to ensure that they understood what personal or relational identity meant according to the text and whether their specific identity would change or not over the course of their lives.

### Measures

**AIQ** Once participants had read the manipulation passage, they had to complete the AIQ-IV in a similar fashion to the previous studies (see studies 1 and 2).

**Self-continuity** Although the structure of self-continuity assessment was similar to the one used in Studies 1 and 2, we removed the initial references to personal characteristics like "personality, temperament, likes and dislikes, beliefs, values, ambitions, goals, ideals and so on. This change departs from the original formulation that has been used by [Frederick \(1999\)](#) and [Bartels and Rips \(2010\)](#) and in Study 2, in order to enrich participants' understanding of identity. We used a rating on a scale of 100 points instead of 10 described in previous studies to increase the scales variability. Lastly, we added two overlapping circles to illustrate the degree of self-continuity between the person she is now and the person she will be in one year, five years, 10 years, 20 years, 30 years, and 40 years where no overlap means 'completely different' and complete overlap means 'exactly the same.' Figure [IV.1](#) displays how the self-continuity measure was implemented.

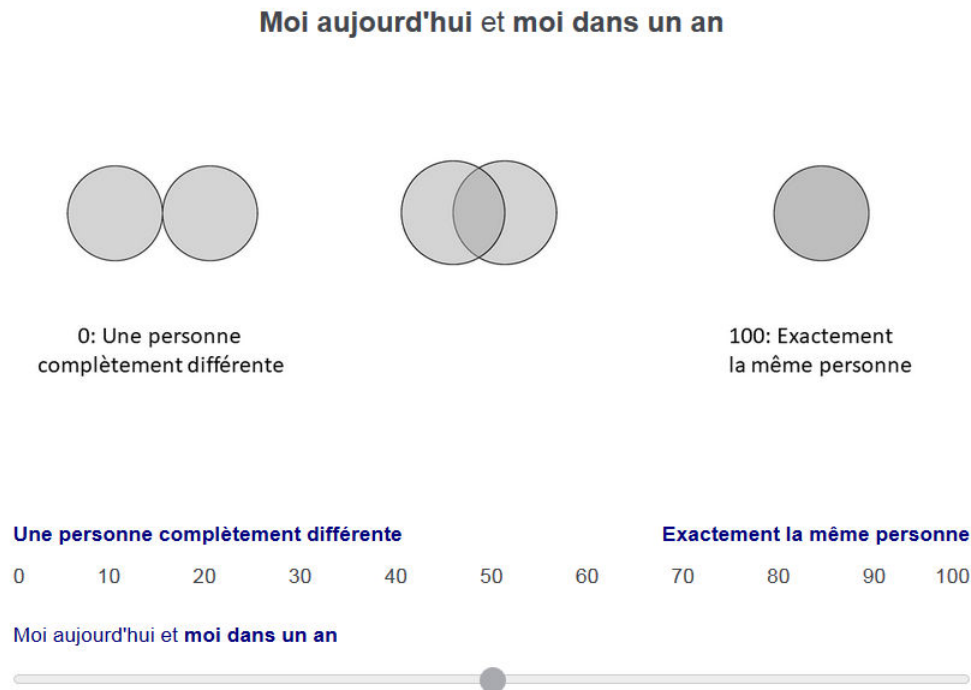
**Time Discounting** Time discounting is measured through a series of hypothetical choices between monetary payments occurring at different periods. We use an amended version of the staircase method proposed by [Falk et al. \(2016\)](#).<sup>15</sup> The staircase method is a time efficient method to elicit time discounting since it only requires five hypothetical and interdependent choices between a sooner and smaller (SS) payment and a later and larger (LL) payment for a given delay  $t$ . The SS payment is always fixed to 100 euros in one week. In the first question, subjects must make hypothetical choices between receiving the SS payment in one week and a varying LL payment in  $t$  years. If the subject chooses the SS payment, then he is asked to make another choice between the

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15. A first pre-test of the original version of [Falk et al. \(2016\)](#) was performed on a sample consisting in 50 participants and we found that a large majority of participants always choose the SS reward. Such a set of choices is problematic as it provides right-censored values of the elicited discount rates: people are very impatient but we would have been unable to measure to which extent. In order to circumvent this issue, all the LL rewards have been multiplied by a proportional factor to increase the valuation of the LL reward, so that we would be able to estimate a discount rate interior value. The original version of the time discounting task can be easily amended to study long-term discount rates. After having answered the five set of questions asking to choose between 100 euros in one week and  $y$  in one year, we asked participants additional sets of questions asking them to choose between 100 euros in one week and  $\lambda_t \times y$  in five and ten years,  $\lambda_t$  being a proportionate factor accounting for the potential higher discounting due to a larger delay.



Figure IV.1: Slider for Self Continuity in Study 3



**Note:** This figure represents the design of the self-continuity task of study 3. Participants are asked to rate on a 100-points scales their perceived similarity between themselves today and themselves in a year. The overlapping circles represent an illustration of the number they have to chose. 0 means that they will be a completely different person in one year, and 100 means that they will be exactly the same persone in one year.

SS payment in one week and an increased LL payment in  $t$  years. Otherwise, if the subject chooses the LL payment, he must choose between the same SS payment and a decreased LL payment in  $t$  years. The last choice provides an approximate measure of the individual discount rate for time  $t$  at the end of the iterative process.<sup>16</sup>

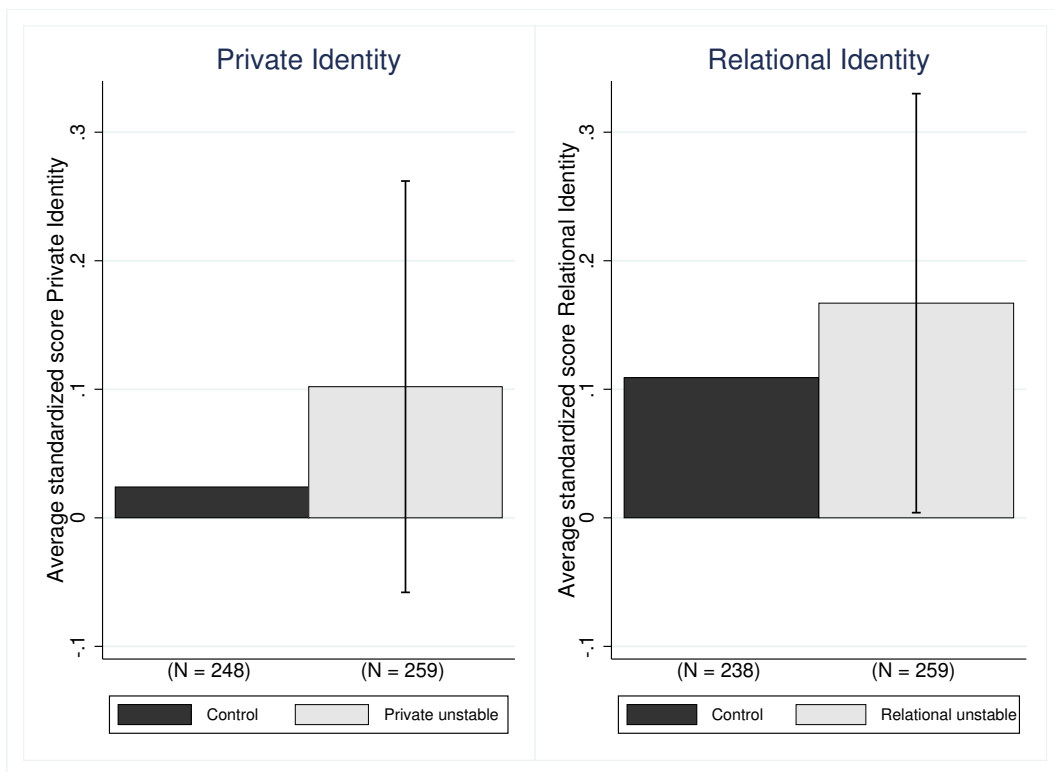
In total, subjects were asked to make  $5 \times 3$  inter-temporal choices for varying delays over  $t = 1, 5, 10$  year(s). Full instructions of the instrument are provided in Appendix IV.A.3 and Table IV.A.1 reports the intertemporal experimental parameters changing from one question to another.

16. The last choice is assumed to provide the point of indifference between the SS and the LL payments. The discount rate is then computed using the last choice with the following formula:  $\delta_t = (\frac{100}{LL})^{\frac{1}{t}}$

### 5.3. Results

**Impact of instability treatments on aspects of identity scores** Figure IV.2 displays the average standardized score of personal and relational identity by manipulation treatment. We find no significant impact of personal or relational instability on their corresponding identity orientations. Similarly to study 2, identity orientations appear to be relatively stable constructs.

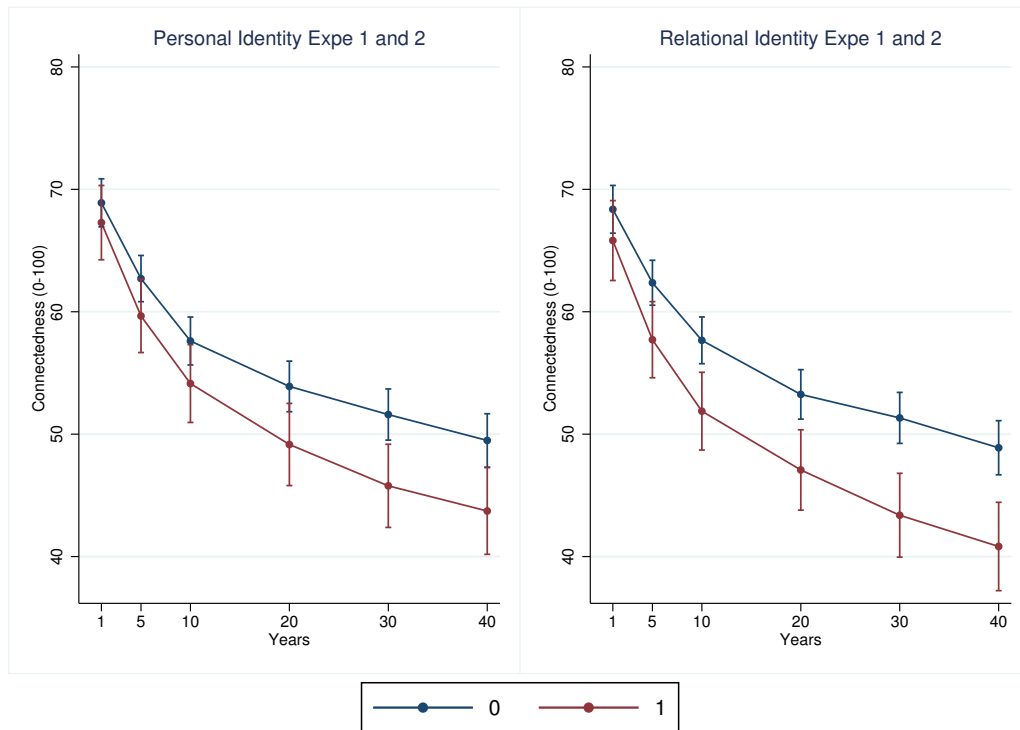
Figure IV.2: Impact of Instability Primings on AIQ scores



**Note:** Qualtrics data, *Expe 1 and Expe 2*; This figure displays the average standardized scores of personal, and relational identity for the stability groups in black and the instability groups that has been primed on respectively personal, and relational. The horizontal bar represents the confidence interval at 95%

**Impact of instability treatments on self-continuity** Self-continuity by treatments of stability or instability for the personal or relational identity priming are displayed in Figure IV.3. While instability of personal identity has no significant impact on self-continuity, making people view their relational identity as unstable has a significant negative impact on self-continuity at 10, 20, 30 and

Figure IV.3: Raw Effect of Instability Manipulation of Personal and Relational Identity on Self-Continuity, pooled

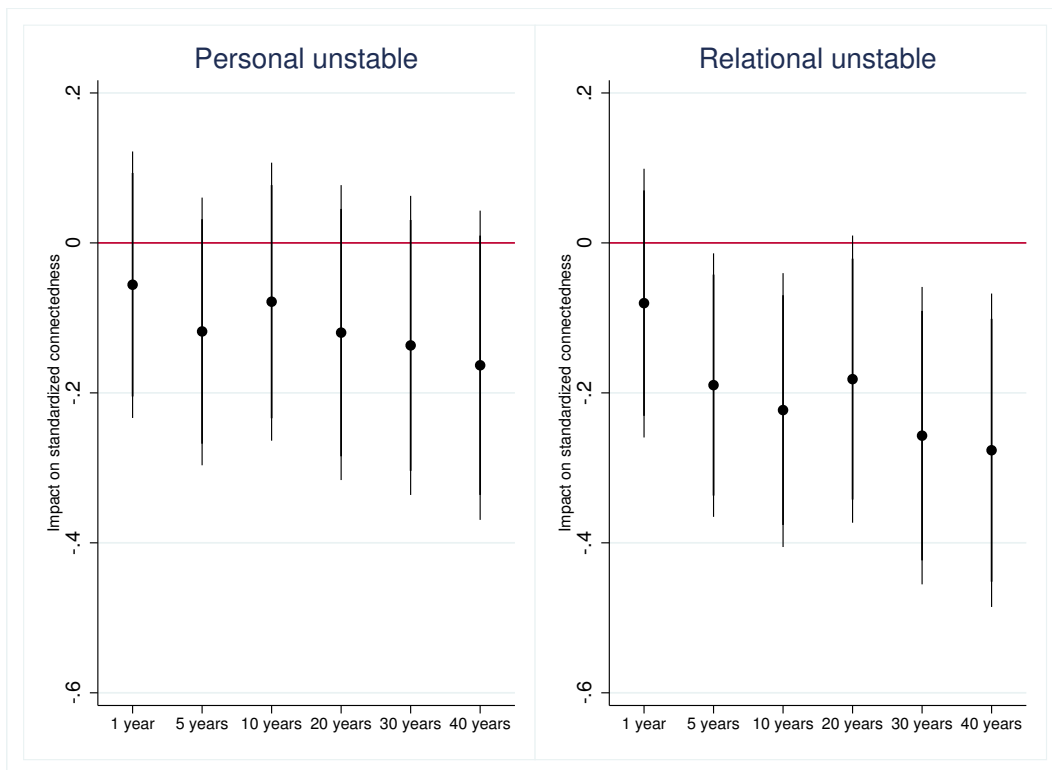


**Note:** Qualtrics data, *Expe 1 and Expe 2*; This figure displays the comparison of the average levels self-continuity at 1 year, 5, 10, 20 and, 30 years for the stability group in blue and the instability treatment group of respectively personal, and relational. The horizontal bars correspond to the confidence interval at the 95% level.

40 years.

In figure IV.4, we plot the marginal impact resulting from the OLS regression of instability of personal and relational identity on self-continuity levels controlling for the other scores of identity aspects and sociodemographic characteristics. We find negative and significant effects of priming the instability of relational identity on self-continuity at year 5 10, 30 and 40 years. As with the previous analysis, the priming on personal identity instability does not have a significant impact on levels of self-continuity even when we control for other aspects of identity. In Appendix IV.C.2, we examine the robustness of the treatment effect of personal and relational identity instability by adjusting the p-values by the numbers of measures of self-continuity tested. The adjusted p-values

Figure IV.4: Estimated Average Impact of Instability Priming of Personal and Relational Identity on Self-Continuity



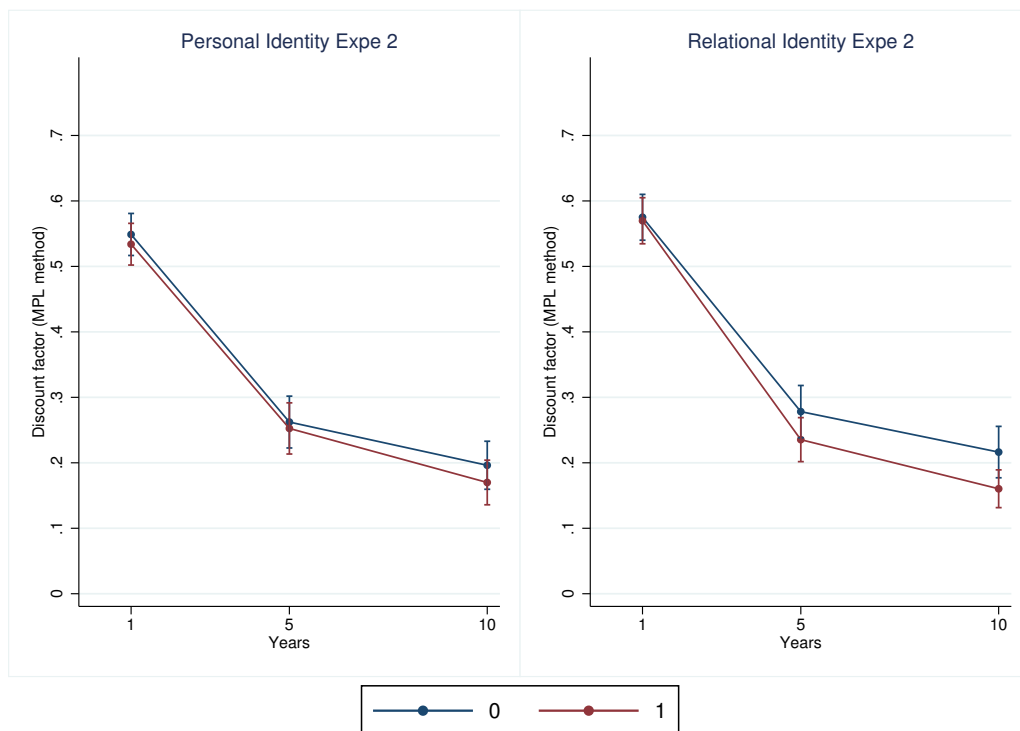
**Note:** Qualtrics data, *Expe 1 and 2*; This figure represents the marginal effects of the instability treatment of personal and relational on self-continuity levels at 1 year, 5 years, 10 years, 20 years, and 30 years. These marginal effects result from the OLS regression of the treatment on self-continuity levels, controlling for age, sex and level of education. Vertical bars represent 95% confidence interval and the red horizontal bar represents a null marginal effect.

of both Bonferroni and Holm corrections still provide the result that making personal identity unstable has no impact on self-continuity, but making relational identity unstable has a negative and significant impact on self-continuity.

**Impact of instability treatments on discount factors** We examine the impact of priming personal or relational identity instability on discount factors. In Figure IV.5, we contrast elicited discount factors for personal and relational identity groups by stability or instability treatment. Instability of personal identity has no impact on time discounting: we find virtually no difference in discounting for 1, 5 or 10 year(s) between the control and treatment groups related to personal

identity. Instability of relational identity has a significant and negative impact on discount factor at 10 years.

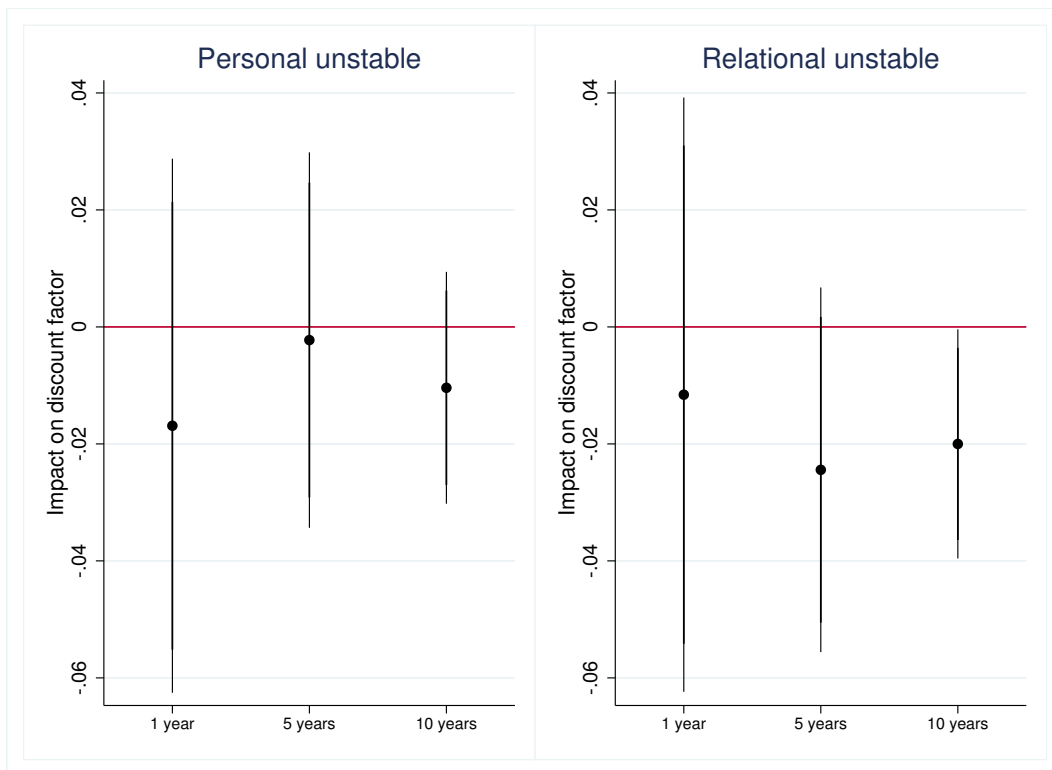
Figure IV.5: Raw Effect of Instability Priming of Personal and Relational Identity on Monetary Discount Rates



**Notes:** Qualtrics data, *Expe 2*; This figure displays the comparison of the average levels of discount factor at 1 year, 5, and 10 years for the stability group in blue and the instability treatment group of respectively personal, and relational. The horizontal bars correspond to the confidence interval at the 95% level.

Figure IV.6 reports the results regressing the discount factor on the priming of personal and relational identity instability controlling for identity orientations and socio-demographic variables. Results are similar to those previously reported: while making people view their personal identity unstable has no significant effect on the elicited discount factors of one, five, and ten years, we still find that making the relational identity unstable has a significant and negative effect on the 10 years discount factor: people are less willing to wait for a larger outcome that will occur in the future when they anticipate a large discontinuity of their relational identity in the future.

Figure IV.6: Estimated average Impact of instability Priming of Personal and Relational Identity on Monetary Discount Rates



**Note:** Qualtrics data, *Expe 1 and 2*; This figure represents the marginal effects of the instability treatment of personal and relational on the discount factor at 1 year, 5 years, and 10 years. These marginal effects result from the OLS regression of the treatment on discount factors, controlling for age, sex and level of education. Vertical bars represent 95% confidence interval and the red horizontal bar represents a null marginal effect.

**Quasi-Hyperbolic Discounting in Self-Continuity and Monetary choices** Table IV.1 reports the regression of the quasi-hyperbolic discounting parameters of self-continuity and time preferences. The first two columns correspond to the regression of the discount rate and present bias parameters associated to self-continuity as dependent variables, and the last two columns correspond to discount rate and present-bias parameters associated to monetary choices as dependent variables. The covariates are the treatment of personal or relational identity and its interaction with dummy variables indicating a high score of the corresponding identity orientation.

Focusing on the first two columns of the upper panel, no significant effect is found for the treatment of personal and relational instability and their interactions on the discount rate of self-

continuity. Focusing on the first two columns in the lower panel, we find no main treatment effects of personal or relational identity on the present-bias parameter of self-continuity. However, we find that people whose relational orientation score is low have lower self-continuity levels at the short-run when their relational identity is unstable in the future.

In the last two columns, while we find that the instability of personal identity has no impact on either the discount rate, or the present-bias of monetary discounting, instability of relational identity has a main positive impact on discount rate which is indicative of higher impatience in the monetary domain. In addition, the treatment effect is higher for people who score high on relational identity. These results are significant at the 1% level. Interestingly and contrary to the previous results, the relational priming affects only the discount rate and not the present-bias. A potential explanation would lie in the fact that the priming of stability or instability of one's identity makes people think of who they would become in the distant future hence only affecting discounting of both self-continuity and monetary discounting in the long-run.

#### **5.4. Discussion**

This third study corroborates previous findings that relational identity is an important component for self-continuity ratings. Inducing to participants a psychological discontinuity of their future relational identity decreases their self-continuity both on a reduced form and on a structural model. More strikingly, the instability priming of relational identity makes people more impatient in terms of monetary rewards and this impatience is even larger when the relational identity is an important aspect of their identity. At this stage, we cannot state that the effect on monetary discounting resulting from the perceived discontinuity of relational identity is actually moderated by self-continuity. However, the consistency of the findings offers an important avenue of investigation of the importance of relational aspect of identity on time preferences and its channel.

Table IV.1: *Instability priming* Effect on Quasi-Hyperbolic Discounting Parameters

<i>Instability Priming</i>	Self-Continuity		Monetary discounting	
	Personal Id	Relational Id	Personal Id	Relational Id
<i>r</i> - Quasi-hyperbolic discounting				
<b>Treatment effect</b>	0.005 (0.006)	0.004 (0.005)	0.009 (0.014)	0.035*** (0.013)
<b><i>Treatment heterogeneity</i></b>				
Low $S_{i,j}$ (-1 std)	0.009 (0.006)	0.003 (0.006)	-0.003 (0.021)	0.014 (0.021)
High $S_{i,j}$ (+1 std)	-0.001 (0.006)	0.007 (0.005)	0.020 (0.021)	0.049*** (0.017)
Mean sample value	0.020*** (0.001)	0.021*** (0.001)	0.236*** (0.010)	0.233*** (0.010)
$\beta$ - Quasi-hyperbolic discounting				
<b>Treatment effect</b>	0.013 (0.032)	-0.047 (0.036)	-0.012 (0.022)	0.002 (0.024)
<b><i>Treatment heterogeneity</i></b>				
Low $S_{i,j}$ (-1 std)	-0.016 (0.047)	-0.072** (0.033)	-0.034 (0.033)	0.042 (0.039)
High $S_{i,j}$ (+1 std)	-0.009 (0.036)	-0.021 (0.046)	0.009 (0.033)	-0.025 (0.031)
Mean sample value	0.443*** (0.007)	0.432*** (0.007)	0.701*** (0.006)	0.682*** (0.006)
<i>N<sub>ind Expe 2</sub></i>	313	310	323	321

**Notes:** This table represents the treatment effects on the parameters of self-continuity discounting and on the parameter of monetary discounting. Assuming a quasi-hyperbolic discounting model, the first part of the table corresponds to the OLS regression of the discount rate of self-continuity and monetary discounting on the instability treatment of personal and relational identity. The second part of the table regresses the present-bias parameter of self-continuity and the present-bias parameter of monetary discounting on the instability treatment of personal and relational identity. In the independent variables, we also add interactions between the treatment and dummies variables indicating whether the individual has a low or high score of the standardized aspect of identity  $Std_{i,j}$  that has been primed. We classify low and high scores being one standard deviation respectively below or above the mean. The regressions are controlled by age, sex and level of education.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .



The hypothetical nature of monetary choices to measure time preferences, as opposed to incentivized method, is likely to generate measurement error and a bias in the estimation of the true values of discount rate and present-bias. That said, first, a potential bias in the parameters estimates due to the hypothetical procedure does not bias the coefficients displayed in Table IV.1 since discounting parameters are dependent variables in the regression models. Second, estimating the effect of the explanatory variables for such dependent variables that are measured with error requires higher statistical power and, hence the resulting regressions are likely to be more conservative. Yet, we find that relational identity instability treatment and its interaction with the relational identity score is significant at the 1% level. Thus, we believe that replicating this study with incentivized methods to elicit time discounting may also provide significant effects.

## 6. Concluding Remarks

In this work-in-progress, we have examined the impact of the personal, relational, and public dimensions of identity on short-term and long-term self-continuity, using a quantitative measure for the latter and priming manipulations.

These three studies show little evidence that personal identity matters in self-continuity. Not only these results contradicts previous studies that find a significant role for personal identity but we are unable to replicate their results using a roughly similar methodology (Bartels and Rips, 2010, Bartels and Urminsky, 2011). The difference in our findings may result from two specificities of the French cultural context, that would provide different scripts for achieving self-continuity. First, relational aspect of one's identity may matter more for self-continuity than the personal aspect for a French population. Second, we cannot state that these findings are indicative of the unimportance of personal identity. The primings may be too weak to alter the weight of personal identity in self-continuity ratings, or alter perceptions of its stability, especially for French subjects whose cultural background emphasizes individual boldness and creativity.

Nonetheless, these three studies converge to outline the importance of relational identity on self-continuity judgements. While relational identity is significantly correlated with self-continuity,

studies 2 and 3 provide evidence that simple priming manipulation of relational identity can affect both self-continuity and monetary discounting. A potential explanation is that people may have a more stable view of their life as a whole when their own existence is integrated in a stable social network. For instance, it is not unreasonable to assume that a married wo/man, with a newborn child, has more ease in projecting him/her-self in the future than a single person who is more likely to feel that the course of his/her life as unstable. A further investigation of the explanation underlying this relationship should be investigated. The impact of social identity remains ambiguous: while it is associated with a decrease in self-continuity, increasing the salience of this aspect has the opposite effect of increasing the sense of continuity. Since priming the salience of public identity had no effect on the public identity score, it is unlikely that the priming affected the valence of public identity in self-continuity rating. However, it may be that people who are less self-continuous over time invest more in public identity. One of our future work will consist in also testing the impact of instability of social identity on self-continuity. Although the result still has to be replicated in a laboratory context in order to provide a incentivized measure of time discounting, this study opens interesting research perspectives linking time preferences and personal identity and provide a valuable framework for future investigations on the importance of stable relational identity on self-continuity and time discounting.



# Appendix

## IV.A. Instruments

### IV.A.1. The French Aspects-of-Identity Questionnaire

#### Instructions

Le questionnaire suivant porte sur la façon dont vous définissez votre identité, c'est-à-dire la manière dont vous définissez qui vous êtes. Ainsi, il ne comporte en soi ni bonnes ni mauvaises réponses. Nous vous demandons simplement de répondre aussi sincèrement et honnêtement que possible à ce qui est vrai pour vous. Le questionnaire vous propose différents éléments qui se rapportent à différents aspects de votre identité. Nous vous demandons d'évaluer dans quelle mesure chacun de ces éléments est important pour vous, pour l'idée que vous vous faites de vous-même. La durée de ce questionnaire est d'environ 10 minutes. Il y a cinq réponses possibles à chaque proposition, de 'pas du tout important' à 'extrêmement important' :

- (1) «Pas du tout important pour l'idée que je me fais de moi-même »
- (2) «Peu important pour l'idée que je me fais que j'ai de moi-même »
- (3) «Moyennement important pour l'idée que je me fais de moi-même»
- (4) «Très important pour l'idée que je me fais de moi-même»
- (5) «Extrêmement important pour l'idée que je me fais de moi-même »

Ce questionnaire est confidentiel et anonyme. Essayez de donner la réponse qui se présente à vous naturellement et sans tenir compte des réponses que vous avez déjà données, même si vous avez l'impression que certaines propositions se répètent ou se contredisent. Nous ne nous intéressons pas aux réponses à des questions particulières, mais à vos réponses considérées toutes ensemble. Répondez aussi sincèrement et honnêtement que possible à ce qui est vrai pour vous. Il n'y a pas de bonne ou mauvaise réponse à donner.

**Items**

1. \_ Mes valeurs et mes principes
2. \_ Mes rêves
3. \_ Mes projets et aspirations personnels pour l'avenir
4. \_ Mes émotions et mes sentiments
5. \_ Mes pensées et mes idées
6. \_ Mes peurs et mes angoisses
7. \_ Mon sentiment d'être une personne unique, d'être différent.e des autres
8. \_ Savoir qu'au fond de moi, je resterai toujours la même personne
9. \_ Ma connaissance de moi-même, mes idées sur qui je suis vraiment
10. \_ Mon auto-évaluation, l'opinion privée que j'ai de moi-même
11. \_ Mes relations avec les personnes dont je me sens proche
12. \_ Mon sentiment de proximité avec mes proches
13. \_ Être un bon ami pour ceux à qui je tiens vraiment
14. \_ Mon engagement à être un conjoint attentionné
15. \_ Partager des expériences marquantes avec des amis proches
16. \_ Entretenir des relations personnelles mutuellement enrichissantes
17. \_ Atteindre un certain niveau d'intimité avec une autre personne
18. \_ Développer des relations bienveillantes avec les autres
19. \_ Ma volonté de comprendre les pensées et sentiments profonds de mon/ma meilleur.e ami.e ou partenaire amoureux
20. \_ Créer des liens forts avec les autres
21. \_ Ma popularité
22. \_ La façon dont les gens réagissent à mes propos ou à mes actions
23. \_ Mon apparence physique
24. \_ Ma réputation, ce que les autres pensent de moi
25. \_ L'attrait que je peux susciter chez d'autres personnes
26. \_ Mes gestes et mes manières, l'impression que je donne aux autres
27. \_ Mon comportement social, comme par exemple mes manières d'agir quand je rencontre des personnes
28. \_ Faire partie d'une longue lignée familiale
29. \_ Mes origines sociales et culturelles
30. \_ Ma religion
31. \_ Les lieux où j'ai habité et où j'ai grandi

- 
32. \_ Mon sentiment d'appartenir à une communauté ou à un collectif
  33. \_ Mon sentiment de fierté envers mon pays, être fier d'être citoyen
  34. \_ Mes convictions et engagements politiques
  35. \_ Mon langage (ma langue natale, mon accent régional, un dialecte ou les langues que j'ai apprises)
    - i \_ Mes compétences individuelles
    - ii \_ Bien me connaître
    - iii \_ Mes envie, désirs et besoins
    - iv \_ Avoir le sentiment de ne pas dépendre des autres
    - v \_ Mes réussites personnelles
    - vi \_ L'intensité de mes relations avec mes proches
    - vii \_ Mon entourage
    - viii \_ Ressentir souvent un profond sentiment d'unité avec mes proches
    - ix \_ Aimer faire plaisir aux autres autant que je le peux
    - x \_ Me soucier du fait que les gens approuvent mes façons de faire
    - xi \_ L'image que je renvoie aux autres
    - xii \_ La culture dans laquelle j'ai grandi
      - a \_ Attendre des autres qu'ils trouvent des solutions à mes problèmes
      - b \_ Préférer la compagnie des autres aux moments de solitude
      - c \_ Accepter mes rôles sociaux
      - d \_ Mon rôle au sein de ma famille

### Scoring for AIQ IV

- (Pe): Personal Identity Orientation
- (Re): Relational Identity Orientation
- (Pb): Public Identity Orientation
- (Co): Collective Identity Orientation

Each of the scale scores is the sum of the answers (1-5) given to those items. The order of items should be randomized.

#### Scoring Numbering:

- **Pe**= 2 3 5 6 7 9 10
- **Re**= 11 12 13 14 15 16 17 18 19 20
- **Pb**= 21 22 23 24 25 26
- **Co**= 28 29 30 31 33 34 35

---

#### Model 1 (Cheek and Briggs, 2013)

- **Pe**= 1 2 3 4 5 6 7 8 9 10
- **Re**= 11 12 13 14 15 16 17 18 19 20
- **Pb**= 21 22 23 24 25 26 27
- **Co**= 28 29 30 31 32 33 34 35

#### Model 3 (cf. appendix III.C.2)

- **Pe**= 2 6 7 9 10 iii iii iv v
- **Re**= 11 12 14 15 18 vi vii viii ix
- **Pb**= 21 22 24 25 26 x xi
- **Co**= 28 29 30 31 33 34 35 xii

## IV.A.2. Self-Continuity Measures

### Study 1 and 2

Dans les questions qui suivent, nous vous demandons d'évaluer la similarité entre la personne que vous êtes aujourd'hui et la personne que vous serez dans un futur plus ou moins proche. Pour cela, pensez à tout ce qui fait de vous la personne que vous êtes aujourd'hui - **comme, par exemple, votre tempérament, vos goûts et dégoûts, vos croyances, vos valeurs, vos ambitions, vos objectifs, vos idéaux etc.** - puis évaluez sur une échelle de 0 à 10 votre degré de similarité entre vous aujourd'hui et vous dans le futur.

0 veut dire que vous serez complètement différent de la personne que vous êtes aujourd'hui et 10 veut dire que vous serez dans le futur exactement la même personne qu'aujourd'hui.

### Study 3

Dans les questions qui suivent, nous vous demandons d'évaluer la similarité entre la personne que vous êtes aujourd'hui et la personne que vous serez dans un futur plus ou moins proche.

Pour cela, pensez à tout ce qui fait de vous la personne que vous êtes aujourd'hui - c'est-à-dire, **tous les éléments que vous considérez comme important pour définir qui vous êtes** - puis évaluez sur une échelle de 0 à 100 votre degré de similarité entre vous aujourd'hui et vous dans le futur.

0 veut dire que vous serez complètement différent de la personne que vous êtes aujourd'hui et 100 veut dire que vous serez dans le futur exactement la même personne qu'aujourd'hui.

In the following questions, we ask you to assess the similarity between the person you are today and the person you will be in the near future. To do that, think about everything that makes you the person you are today - like, for example, your temperament, your likes and dislikes, your beliefs, your values, your ambitions, your goals, your ideals and so on. - then rate on a scale of 0 to 10 your degree of similarity between you today and you in the future.

0 means that you will be completely different from the person you are today and 10 means that you will be exactly the same person in the future as you are today.

In the following questions, we ask you to assess the similarity between the person you are today and the person you will be in the near future.

To do this, think about everything that makes you the person you are today - that is, everything you consider important in defining who you are - and then rate your degree of similarity between you today and yourself in the future on a scale of 0 to 100.

0 means that you will be completely different from the person you are today and 100 means that you will be exactly the same person in the future as you are today.



### IV.A.3. Intertemporal Choices

#### One Year Delay

Imaginez qu'on vous donne le choix entre recevoir un paiement dans **une semaine** ou dans **un an**. Nous allons maintenant vous présenter cinq situations:

- Le paiement que vous pouvez recevoir **dans une semaine** est le même dans toutes les situations.
- Le paiement dans un an est différent dans chacune des situations.

Nous aimerions savoir ce que vous choisiriez dans chacune des situations. Veuillez supposer qu'il n'y a pas d'inflation, c'est-à-dire que les prix restent les mêmes que ceux d'aujourd'hui.

- (Q1) **Préférez-vous recevoir 100 euros dans une semaine ou 176 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 76%.
- (a) 100 euros dans une semaine → Q17
- (b) 176 euros dans un an → Q2
- (Q2) **Préférez-vous recevoir 100 euros dans une semaine ou 135 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 35%.
- (a) 100 euros dans une semaine → Q10
- (b) 135 euros dans un an → Q3
- (Q3) **Préférez-vous recevoir 100 euros dans une semaine ou 117 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 17%.
- (a) 100 euros dans une semaine → Q7
- (b) 117 euros dans un an → Q4
- (Q4) **Préférez-vous recevoir 100 euros dans une semaine ou 108 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 8%.
- (a) 100 euros dans une semaine → Q6
- (b) 108 euros dans un an → Q5
- (Q5) **Préférez-vous recevoir 100 euros dans une semaine ou 104 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 4%.
- (a) 100 euros dans une semaine
- (b) 104 euros dans un an
- (Q6) **Préférez-vous recevoir 100 euros dans une semaine ou 113 euros dans un an?** Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 13%.

- (a) 100 euros dans une semaine
- (b) 113 euros dans un an

(Q7) **Préférez-vous recevoir 100 euros dans une semaine ou 127 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 27%.*

- (a) 100 euros dans une semaine → Q8
- (b) 127 euros dans un an → Q9

(Q8) **Préférez-vous recevoir 100 euros dans une semaine ou 131 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 31%.*

- (a) 100 euros dans une semaine
- (b) 131 euros dans un an

(Q9) **Préférez-vous recevoir 100 euros dans une semaine ou 122 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 22%.*

- (a) 100 euros dans une semaine
- (b) 122 euros dans un an

(Q10) **Préférez-vous recevoir 100 euros dans une semaine ou 155 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 55%.*

- (a) 100 euros dans une semaine → Q14
- (b) 155 euros dans un an → Q11

(Q11) **Préférez-vous recevoir 100 euros dans une semaine ou 145 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 45%.*

- (a) 100 euros dans une semaine → Q13
- (b) 145 euros dans un an → Q12

(Q12) **Préférez-vous recevoir 100 euros dans une semaine ou 141 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 41%.*

- (a) 100 euros dans une semaine
- (b) 141 euros dans un an

(Q13) **Préférez-vous recevoir 100 euros dans une semaine ou 150 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 50%.*

- (a) 100 euros dans une semaine
- (b) 150 euros dans un an

- (Q14) **Préférez-vous recevoir 100 euros dans une semaine ou 164 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 64%.*
- (a) 100 euros dans une semaine → Q16
  - (b) 164 euros dans un an → Q15
- (Q15) **Préférez-vous recevoir 100 euros dans une semaine ou 160 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 60%.*
- (a) 100 euros dans une semaine
  - (b) 160 euros dans un an
- (Q16) **Préférez-vous recevoir 100 euros dans une semaine ou 170 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 70%.*
- (a) 100 euros dans une semaine
  - (b) 170 euros dans un an
- (Q17) **Préférez-vous recevoir 100 euros dans une semaine ou 219 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 119%.*
- (a) 100 euros dans une semaine → Q18
  - (b) 219 euros dans un an → Q25
- (Q18) **Préférez-vous recevoir 100 euros dans une semaine ou 243 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 143%.*
- (a) 100 euros dans une semaine → Q22
  - (b) 243 euros dans un an → Q19
- (Q19) **Préférez-vous recevoir 100 euros dans une semaine ou 230 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 130%.*
- (a) 100 euros dans une semaine → Q20
  - (b) 230 euros dans un an → Q21
- (Q20) **Préférez-vous recevoir 100 euros dans une semaine ou 236 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 136%.*
- (a) 100 euros dans une semaine
  - (b) 236 euros dans un an
- (Q21) **Préférez-vous recevoir 100 euros dans une semaine ou 225 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 125%.*
- (a) 100 euros dans une semaine

(b) 225 euros dans un an

(Q22) **Préférez-vous recevoir 100 euros dans une semaine ou 254 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 154%.*

(a) 100 euros dans une semaine → Q23

(b) 254 euros dans un an → Q24

(Q23) **Préférez-vous recevoir 100 euros dans une semaine ou 261 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 161%.*

(a) 100 euros dans une semaine

(b) 261 euros dans un an

(Q24) **Préférez-vous recevoir 100 euros dans une semaine ou 248 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 148%.*

(a) 100 euros dans une semaine

(b) 248 euros dans un an

(Q25) **Préférez-vous recevoir 100 euros dans une semaine ou 197 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 97%.*

(a) 100 euros dans une semaine → Q29

(b) 197 euros dans un an → Q26

(Q26) **Préférez-vous recevoir 100 euros dans une semaine ou 185 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 85%.*

(a) 100 euros dans une semaine → Q28

(b) 185 euros dans un an → Q27

(Q27) **Préférez-vous recevoir 100 euros dans une semaine ou 181 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 81%.*

(a) 100 euros dans une semaine

(b) 181 euros dans un an

(Q28) **Préférez-vous recevoir 100 euros dans une semaine ou 91 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 91%.*

(a) 100 euros dans une semaine

(b) 191 euros dans un an

(Q29) **Préférez-vous recevoir 100 euros dans une semaine ou 208 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 108%.*

(a) 100 euros dans une semaine → Q31

(b) 208 euros dans un an → Q30

(Q30) **Préférez-vous recevoir 100 euros dans une semaine ou 202 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 102%.*

(a) 100 euros dans une semaine

(b) 202 euros dans un an

(Q31) **Préférez-vous recevoir 100 euros dans une semaine ou 213 euros dans un an?** *Le paiement dans un an correspond à un placement des 100 euros au taux d'intérêt annuel de 113%.*

(a) 100 euros dans une semaine

(b) 213 euros dans un an

## Intertemporal Payments Values

Table IV.A.1: Intertemporal Experimental Parameters

Q.	Sooner Smaller Payment (SS)	Larger Later Payment (LL)			If SS is chosen,	If LL is chosen
	In one week	1 year Delay	5 year Delay	10 year Delay	Go to Question	
1(*)	100	176	497	565	17	2
2	100	135	224	231	10	3
3	100	117	150	151	7	4
4	100	108	123	123	6	5
5	100	104	11	111	.	.
6	100	113	136	136	.	.
7	100	127	187	190	8	9
8	100	131	205	210	.	.
9	100	122	170	172	.	.
10	100	155	334	359	14	11
11	100	145	275	289	13	12
12	100	141	252	263	.	.
13	100	150	308	328	.	.
14	100	164	404	445	16	15
15	100	160	373	406	.	.
16	100	170	170	502	.	.
17	100	219	1032	1352	18	25
18	100	243	1479	2117	22	19
19	100	230	1227	1674	20	21
20	100	236	1334	1860	.	.
21	100	225	1126	1506	.	.
22	100	254	1737	2597	23	24
23	100	261	1916	2945	.	.
24	100	248	1604	2346	.	.
25	100	197	717	870	29	26
26	100	185	592	692	28	27
27	100	181	549	635	.	.
28	100	91	652	777	.	.
29	100	208	863	1087	31	30
30	100	202	788	973	.	.
31	100	213	181	1213	.	.

**Notes:** This table represents the parameters of the time discounting task inspired from [Falk et al. \(2016\)](#). The first question that should be asked is denoted by (\*). At each row, individual have to choose between the sooner and smaller payment (SS) or a larger and later payment occurring in one year, a five years, or a ten years. The SS payment is always fixed to 100 whatever the delay of the LL payment. For instance, in the first question, if the participant prefers the SS payment, then the following question is number 17. If s.he chooses the LL payment, then the following question is question 2. The iterative process stops after the fifth question.

## IV.B. Priming Manipulations

### IV.B.1. Study 2: Identity Salience

#### *Control group*

Avant de commencer cette enquête, nous allons vous demander de prendre quelques minutes pour réfléchir à cinq éléments de votre identité qui vous semblent importants pour décrire qui vous êtes. Il n'y a aucune bonne ou mauvaise réponse car il s'agit d'une perception subjective de vous-même. Prenez donc cinq minutes pour décrire brièvement ces cinq éléments de votre identité.

Exemples :

J'ai les yeux bleus,

Je suis étudiant,

Je fais de la course à pied.

Before starting this survey, we are asking you to take a few minutes to think about five elements of your identity which are important to describe who you are. There is no right or wrong answer because it is a subjective perception of yourself. So take five minutes to briefly describe these five elements of your identity.

Examples:

I have got blue eyes

I am a student

I run

#### *Public Identity priming*

Avant de commencer cette enquête, nous allons vous demander de prendre quelques minutes pour réfléchir à cinq éléments de votre identité sociale qui vous semblent importants pour décrire qui vous êtes. Décrivez par-exemple des éléments liés à vos rôles sociaux dans différents contextes (professionnel, études, etc.), à votre popularité, à votre réputation, à l'impression que vous donnez aux autres. Il n'y a aucune bonne ou mauvaise réponse car il s'agit d'une perception subjective de vous-même. Prenez donc cinq minutes pour décrire brièvement ces cinq éléments de votre identité sociale.

Exemples :

J'ai confiance en moi quand je parle en public,

Je suis populaire dans mon lieu d'étude/de travail,

Je suis soucieux de mon apparence.

Before starting this survey, we are asking you to take a few minutes to think about five elements of your social identity which are important to describe who you are. For example, describe elements related to your social roles in different contexts (professional, academic, etc.), your popularity, your reputation, the impression you give to others. There is no right or wrong answer because it is a subjective perception of yourself. So take five minutes to briefly describe these five elements of your social identity.

Examples:

I am self-confident when I talk in public

I am popular where I study/work

I take care of my look

### ***Personal Identity priming***

Avant de commencer cette enquête, nous allons vous demander de prendre quelques minutes pour réfléchir à cinq éléments de votre identité personnelle qui vous semblent importants pour décrire qui vous êtes et ce qui vous distingue des autres. Décrivez par-exemple des éléments liés à votre personnalité, à vos aspirations et objectifs personnels, à vos croyances, à vos valeurs, à vos émotions, à vos compétences etc. Il n'y a aucune bonne ou mauvaise réponse car il s'agit d'une perception subjective de vous-même. Prenez donc cinq minutes pour décrire brièvement ces cinq éléments de votre identité personnelle.

Exemples :

Je suis unique parce que..

Before starting this survey, we are asking you to take a few minutes to think about five elements of your personal identity which are important to describe who you are and what distinguishes you from others. For example, describe elements related to your personality, your personal aspirations and goals, your beliefs, your values, your emotions, your skills, etc. There is no right or wrong answer because it is a subjective perception of yourself. So take five minutes to briefly describe these five elements of your personal identity.

Examples:

I am unique because

### ***Relational Identity priming***

Avant de commencer cette enquête, nous allons vous demander de prendre quelques minutes pour réfléchir à cinq éléments caractérisant vos relations aux autres et qui vous semblent importants pour décrire qui vous êtes. Décrivez par-exemple des éléments caractéristiques de la façon dont vous vous comportez avec votre entourage proche (famille, amis et confidants, conjoint) et de votre rôle vis-à-vis de ces personnes. Il n'y a aucune bonne ou mauvaise réponse car il s'agit d'une perception subjective de vous-même. Prenez donc cinq minutes pour décrire brièvement ces cinq éléments caractéristiques de vos relations aux autres.

Exemples :

Mon bonheur dépend du bonheur des autres autour de moi

Before starting this survey, we are asking you to take a few minutes to think about five elements characterizing your relationships with others, which are important to describe who you are. Describe, for example, characteristic elements of the way you behave with your close circle (family, friends and confidants, spouse) and your role with regard to these people. There is no right or wrong answer because it is a subjective perception of yourself. So take five minutes to briefly describe these five characteristic elements of your relationships with others.

Examples:

My happiness depends on the happiness of others around me



## IV.B.2. Study 3: Identity Instability

### *PI instability priming*

Avant de commencer cette enquête, pouvez-vous lire ce petit texte et nous résumer son contenu en quelques phrases ? "Les événements de la vie quotidienne changent sensiblement la manière dont les individus décrivent qui ils sont. Cependant, l'identité personnelle, c'est-à-dire, toutes les caractéristiques qui sont liées à nos aspirations et objectifs personnels, vos croyances, vos valeurs, vos émotions, vos compétences etc., est ce qui change [le moins / le plus] chez un individu. L'identité personnelle qui fait de vous la personne que vous êtes aujourd'hui... [est établie au début de la vie et fixée dès la fin de l'adolescence / est susceptible de changer radicalement au cours de la vie] . Plusieurs études menées auprès de jeunes adultes ont en effet révélé que les traits qui composent votre identité personnelle [restent remarquablement stables / sont remarquablement instables.]"

### *RI instability priming*

Avant de commencer cette enquête, pouvez-vous lire ce petit texte et nous résumer son contenu en quelques phrases ? "Les événements de la vie quotidienne changent sensiblement la manière dont les individus décrivent qui ils sont. Cependant, l'identité relationnelle, c'est-à-dire, toutes les caractéristiques qui sont liées au comportement de l'entourage proche de l'individu (la famille, les amis, les confidents, les conjoints) et à son rôle vis-à-vis de ces personnes, est ce qui change [le moins / le plus] chez un individu. L'identité relationnelle qui fait de vous la personne que vous êtes aujourd'hui... [est établie au début de la vie et fixée dès la fin de l'adolescence / est susceptible de changer radicalement au cours de la vie] . Plusieurs études menées auprès de jeunes adultes ont en effet révélé que les traits qui composent votre identité relationnelle [restent remarquablement stables / sont remarquablement instables.]"

Before starting this survey, can you read this short text and summarize its content in a few sentences? "Daily life events change sensibly the way people describe who they are. However, personal identity - all the characteristics that relates to our personal aspirations and goals, our beliefs, our values, our emotions, our skills etc. -, is what change [the less/the most] in an individual. Personal identity, which makes you the person you currently are...[is established between early life and the end of adolescence / can radically change through the course of a life]. Several studies in young adults have revealed that the traits making your personal identity [remains remarkably stable / are remarkably unstable]"

Before starting this survey, can you read this short text and summarize its content in a few sentences? "Daily life events change sensibly the way people describe who they are. However, relational identity - all the characteristics that relates to their relatives and their role vis-à-vis these relatives, is what change [the less/the most] in an individual. Relational identity, which makes you the person you currently are...[is established between early life and the end of adolescence / can radically change through the course of a life]. Several studies in young adults have revealed that the traits making your relational identity [remains remarkably stable / are remarkably unstable]"

## IV.C. Multiple Hypothesis Testing

### IV.C.1. Study 2: Salience Identity

Table IV.C.1: The impact of Personal Identity Salience on Self-Continuity Adjusted for Multiple Hypothesis Testing

		Difference in mean	p-values	
			Bonferroni	Holm
Outcomes				
<b>Self-continuity</b>	1 year	0,289	0,268	0,268
	5 years	0,075	1,000	1,000
	10 years	0,155	1,000	1,000
	20 years	0,077	1,000	1,000
	30 years	0,027	1,000	0,851
	40 years	0,039	1,000	1,000

**Notes:** This table represents the difference in self-continuity level by salience treatment of personal identity. We use a multiple hypothesis testing structure in which the outcomes are self-continuity levels at years 1, 5, 10, 20, 30, 40. The Bonferroni p-value is the adjusted p-value by the total number of null hypotheses. The Holm p-value is calculated by multiplying the smallest p-value by the total number of null hypotheses, the second smallest p-value by the total number of null hypotheses minus one and so on. \*, \*\*, and \*\*\* indicate that the corresponding p-values less than 10%, 5%, and 1%, respectively.

Table IV.C.2: The impact of Relational Identity Salience on Self-Continuity Adjusted for Multiple Hypothesis Testing

		Difference in mean	p-values	
			Bonferroni	Holm
Outcomes				
<b>Self-continuity</b>	1 year	0,374	<b>0,062*</b>	<b>0,062*</b>
	5 years	0,288	0,166	0,138
	10 years	0,249	0,336	0,224
	20 years	0,213	0,746	0,373
	30 years	0,078	1,000	0,560
	40 years	0,102	1,000	0,969

**Notes:** This table represents the difference in self-continuity level by salience treatment of relational identity. We use a multiple hypothesis testing structure in which the outcomes are self-continuity levels at years 1, 5, 10, 20, 30, 40. The Bonferroni p-value is the adjusted p-value by the total number of null hypotheses. The Holm p-value is calculated by multiplying the smallest p-value by the total number of null hypotheses, the second smallest p-value by the total number of null hypotheses minus one and so on. \*, \*\*, and \*\*\* indicate that the corresponding p-values less than 10%, 5%, and 1%, respectively.

Table IV.C.3: The impact of Social Identity Salience on Self-Continuity Adjusted for Multiple Hypothesis Testing

		Difference in mean	p-values	
			Bonferroni	Holm
Outcomes				
<b>Self-continuity</b>	1 year	0,279	0,332	0,055
	5 years	0,257	0,306	0,102
	10 years	0,369	<b>0,028**</b>	<b>0,023**</b>
	20 years	0,407	<b>0,014**</b>	<b>0,014**</b>
	30 years	0,325	0,108	<b>0,072*</b>
	40 years	0,321	0,158	<b>0,079*</b>

**Notes:** This table represents the difference in self-continuity level by salience treatment of public identity. We use a multiple hypothesis testing structure in which the outcomes are self-continuity levels at years 1, 5, 10, 20, 30, 40. The Bonferroni p-value is the adjusted p-value by the total number of null hypotheses. The Holm p-value is calculated by multiplying the smallest p-value by the total number of null hypotheses, the second smallest p-value by the total number of null hypotheses minus one and so on. \*, \*\*, and \*\*\* indicate that the corresponding p-values less than 10%, 5%, and 1%, respectively.

### IV.C.2. Study 3: Stability Identity

Table IV.C.4: The impact of Personal Identity Instability on Self-Continuity Adjusted for Multiple Hypothesis Testing

		Difference in mean	p-values	
			Bonferroni	Holm
Outcomes				
<b>Self-continuity</b>	1 year	0,017	1,000	0,822
	5 years	0,044	1,000	1,000
	10 years	0,063	1,000	1,000
	20 years	0,115	0,858	0,572
	30 years	0,160	0,294	0,294
	40 years	0,159	0,350	0,292

**Notes:** This table represents the difference in self-continuity level by instability treatment of personal identity. We use a multiple hypothesis testing structure in which the outcomes are self-continuity levels at years 1, 5, 10, 20, 30, 40. The Bonferroni p-value is the adjusted p-value by the total number of null hypotheses. The Holm p-value is calculated by multiplying the smallest p-value by the total number of null hypotheses, the second smallest p-value by the total number of null hypotheses minus one and so on. \*, \*\*, and \*\*\* indicate that the corresponding p-values less than 10%, 5%, and 1%, respectively.

Table IV.C.5: The impact of Relational Identity Instability on Self-Continuity Adjusted for Multiple Hypothesis Testing

		Difference in mean	p-values	
			Bonferroni	Holm
<b>Outcomes</b>				
	1 year	0,026	1,000	0,730
	5 years	0,112	0,776	0,259
<b>Self-continuity</b>	10 years	0,159	0,172	<b>0,08*</b>
	20 years	0,176	0,136	<b>0,09*</b>
	30 years	0,250	<b>0,01**</b>	<b>0,01**</b>
	40 years	0,255	<b>0,02**</b>	<b>0,016**</b>

**Notes:** This table represents the difference in self-continuity level by instability treatment of relational identity. We use a multiple hypothesis testing structure in which the outcomes are self-continuity levels at years 1, 5, 10, 20, 30, 40. The Bonferroni p-value is the adjusted p-value by the total number of null hypotheses. The Holm p-value is calculated by multiplying the smallest p-value by the total number of null hypotheses, the second smallest p-value by the total number of null hypotheses minus one and so on. \*, \*\*, and \*\*\* indicate that the corresponding p-values less than 10%, 5%, and 1%, respectively.



# GENERAL CONCLUSION

The ambition of this thesis is to highlight three psychological determinants of intertemporal choices through different methodologies and approaches. As it is outlined in the introduction, this thesis does not pretend to be a general theory of inter-temporal choices since the determinants of such choices are many and varied and differ according to situations and contexts. In contrast, the objective of each chapter is to show that each determinant can be relevant to a particular situation and that public policies can benefit from these new set of evidences. This general conclusion provides an overview of the contribution of each chapter and presents some perspective of research.

An investigation of the underlying mechanisms of self-inflicted penalty is investigated in Chapter I. Using a theoretical model and an experimental study on weight-loss, I showed that goals, when exogenously set, play a major role in the demand of commitment devices. In particular, people with severe present-bias are less likely to use commitment devices when goals are difficult even though these incentive mechanisms are targeted to them. In addition, the inclusion of other behavioural biases in the decision making, such as loss aversion and partial naiveté have negative consequences on both the demand and the efficiency of commitment devices. While loss aversion can alleviate time inconsistent choices, the theoretical model suggests that less people are willing to use self-inflicted penalties: loss-aversion indeed increases the level of penalty that should be set to overcome time inconsistent choices. Partial naiveté has also detrimental effects. This overconfidence in one's own time consistency makes that people might be unaware that they need a commitment device as they systematically believe their future actions will be aligned with their initial plans while it is not the case.

Although the results of chapter I seem to present a pessimistic view of commitment device as too limited to fight time inconsistent behaviour, some nuances should be stated. In particular, we have studied a very specific form of commitment device, in the form of self-imposed penalty, in which goals are exogenously set. Further research studies should be performed to study self-

imposed penalties when goals are chosen by individuals themselves. In that case, it may be that the demand for commitment device is higher when people should simultaneously their penalties and their goals.

A special attention was devoted on self-imposed penalties in this chapter. However, other forms of commitment devices—such as temptation bundling, purchasing vices in small packages, smaller plates and so on—exist.<sup>17</sup> Therefore, further investigation should be lead to examine the demand for different forms of commitments that may be relevant to overcome time inconsistent health behaviours.

In chapter II, evidence was found that the self-control model can be a useful model to examine a deterioration of health behaviours in the field. More specifically, this chapter reconsider the relationship between Body Mass Index (BMI) and night work, which is moderated by self-control. Negative health impacts of irregular evening and night shifts are mostly related to self-control issues as it affects only impulsive individuals. A likely explanation for this result is that individuals with irregular work schedules face specific stresses for organizing their social and family life, and disturbances of the circadian rhythm due to irregular wake/sleep cycles.

This paper still is limited as we cannot be sure that the impact that we have estimated is a true causal effect. To our knowledge, there was no exogenous shock that could have affected evening and night working conditions in Germany in our period of interest. This exogenous shock could have allowed to estimate a more causal effect in such a quasi-experimental setting. Further research should then examine whether a significant improvement in the working conditions of workers in other countries—that would reduce the presence of visceral factors— can be found. That way, we would be able to determine whether poor working condition has a causal effect on health behaviours that is moderated by self-control.

We believe that the investigation of these disturbances in life on health behaviours are important. From a public policy perspective, as some of these disturbances can be the result of in-

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17. A more exhaustive and detailed catalogue of forms of commitment device specifically in health is available in the literature review from (Rogers, Milkman and Volpp, 2014)

stitutional factors, as it is the case for working conditions, it can provide additional evidence for advocating better protection of workers from harmful working conditions.

I believe that this field of research is not limited to the study of a specific visceral factor or a specific health behaviour. Further investigations can be performed to examine different conditions that provoke visceral factors. In particular, social influences and peer-pressure might be a relevant investigation to study as it is likely that this may, through the exhaustion of self-control resources, have an impact on health choices, like smoking, addiction but also savings.

In chapter III, we showed that the French and validated translation of the aspects of identity questionnaire could be a relevant instrument in experimental and surveys studies that tries to open the black box of economic preferences. The questionnaire is indeed short and easy to administer to a French population.

We have shown the good psychometric qualities of the questionnaire that measures the four aspects of identity of the original US version of the questionnaire. Both the exploratory and the confirmatory factor analysis supports that items can be clustered into personal, relational, public and collective aspects of identity. We have also shown that people who are oriented towards relational identity are more likely to be generous in dyadic settings, and people who are oriented towards collective identity are more likely to be benevolent. Potential further investigation should look at the impact of identity orientations for pro-social behaviours in experimental games such as the dictator or the public good games. For instance, we may have good reasons to hypothesize, given our preliminary results, that people who defined themselves in terms of relational identity will contribute more in dictator games; and people who are oriented towards collective identity may be more willing to contribute in public good games.

There is still room for psychometric improvement of the questionnaire. More specifically, such a work should thus be performed in order to improve the factorial structure of the model, by some reformulation of items that tends to load on two factors. Apart from that, this first version of the questionnaire can still be administer in a laboratory or in a survey setting for a better understanding of economic preferences through the prism of personal identity.



Chapter IV shows that personal identity can indeed be relevant to examine the determinant of time preferences. In particular, we have shown, in these three independent studies, that the reconsideration of individual identity matters for self-continuity, which is according to Parfit (1984), a prerequisite for higher consideration for future outcomes. Unlike in previous studies from Frederick (2003), Bartels and Rips (2010), Bartels and Urminsky (2011), we found little evidence that personal identity—which here, refers as self-definition in terms of unique attributes, and the person's sense of unique identity differentiated from others—matters in self-continuity. In contrast, these three studies suggest that relational identity—which here, refers as self-definition derived from interpersonal relationships with significant others—is the most important aspects in self-continuity. In the first study, relational identity is associated with high self-continuity at the cross-sectional level. In the second study, we found that priming manipulation of the salience of relational identity has a significant impact on short-term self-continuity. Finally, the third study shows that increasing the perceived sense of instability of one's own relational identity in the future have an impact on long-term self-continuity and long-term monetary discounting.

This is still a preliminary work. In particular, priming manipulation of the instability of public identity should also be performed to test its effect on self-continuity and monetary discounting. This would potentially allow for new perspectives for investigating the effect of social influences and peer-pressure in choices over time. Above all, although these experiment provide the first set of evidence for the relationship between time discounting and relational identity, this should still be carefully tested in a laboratory setting, in which elicitation techniques to measure time preferences are performed with incentivized choices.

The understanding of this new determinant of time preferences is important. As we have shown that simple manipulation techniques from psychology can restore the sense of self-continuity and time discounting, this methodology can be seen as a relevant alternative to commitment designs to make individuals think of the future. In particular, emphasizing the importance of individuals' relationship could help people to pursue their long-term goals.





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## **On the Economics and Psychology of Intertemporal Choices**

**Abstract:** The objective of this thesis is to contribute to economic literature by analysing three psychological determinants in the way individuals make decisions over time, using approaches and methodologies from economics and psychology. Thus, the first chapter of this thesis theoretically analyses the demand for commitment devices to overcome their own present-bias. This theoretical study is illustrated by a laboratory experiment on weight loss. The second chapter empirically examines the impact of working conditions on individuals' health behaviours in the light of the psychological literature on self-control. The third chapter proposes a translation and validation of the Aspects of Identity Questionnaire and shows that the economic analysis of individual preferences can benefit from the reintroduction of the subjectivity of personal identity. Finally, the last chapter of this thesis explores the extent to which this subjectivity of personal identity can be important in understanding intertemporal choices.

**Keywords:** Intertemporal choices - Time Preferences - Health behaviors - Personal Identity





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## Sur l'Economie et la Psychologie des Choix Intertemporels

**Résumé:** L'objectif de cette thèse est de contribuer à la littérature en économie en analysant trois déterminants psychologiques dans la manière dont les individus prennent des décisions dans le temps en utilisant des approches et des méthodologies issues de l'économie et de la psychologie. Ainsi, le premier chapitre de cette thèse analyse théoriquement la demande des individus pour des dispositifs d'engagement pour lutter contre leur propre préférence pour le présent. Cette étude théorique est illustrée par une expérience en laboratoire sur la perte de poids. Le deuxième chapitre étudie empiriquement l'impact des conditions de travail sur les comportements de santé des individus à la lumière de la littérature en psychologie sur l'autorégulation. Le troisième chapitre propose une traduction et une validation de l'échelle des aspects de l'identité et montre que l'analyse économique des préférences individuelles peut bénéficier de la ré-introduction de la subjectivité de l'identité personnelle. Enfin, le dernier chapitre de cette thèse explore dans quelle mesure cette subjectivité de l'identité personnelle peut être importante pour comprendre les choix intertemporels.

**Mots-clefs:** Choix Intertemporels - Préférences Temporelles - Comportement de Santé - Identité Personnelle