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PhD in Economics, Management and Statistics

CICLO XXXI

How personality traits affect economic outcomes

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Introduction

This thesis is composed by three chapters in behavioral economics.

The first chapter, titled "Personality Psychology and Economics: How Personality Traits Explain Economic Outcomes" is a literature review of the predictive power of personality traits in explaining economic outcomes. A growing body of literature has tried to integrate constructs developed in the field of personality psychology in a economic network in order to better understand subjects' actual decisions and behaviors.

I define personality traits and the most widely accepted taxonomy of personality, the Five Factor Model. I analyze how the issue of the relative stability of personality traits across the lifespan has been addressed in literature and describe how changes in personality traits may be caused by exogenous life events or programmed public interventions, which aim at enhancing individuals personality qualities related to better economic outcomes. Gender differences in personality traits have been found in literature that may help to explain heterogeneity in economic behavior.

I report evidence on the relationship between personality traits and several life outcomes, such as cognitive test scores, political orientation, occupation choice, and saving behavior.

The second chapter is titled "How Personality Traits Affect Economic Decisions: a Laboratory Experiment". We implemented a laboratory experiment on a sample of university students to investigate how and to what extent personality traits relate to two major economic preferences, risk attitudes and time preferences. In this research setting economic preferences of the agents were elicited by means of economically incentivized decision tasks. We measured personality traits using the Ten Item Personality Inventory (TIPI), a short questionnaire structured according to the taxonomy of the Five Factor Model. We distinguished between two treatments to control for potential order effects, in one the risk choice task was administered prior to the Intertemporal choice task, in the other the order of the experimental tasks was inverted. We observed significant order effects on time preferences. In particular, if the risk choice task was administered prior to the Intertemporal choice task, individuals tended to show more impatience than in the other treatment. Moreover, the order effects are mediated by personality traits and gender.

In addition, we investigated whether personality traits may shed light to the rationale of the relationship between risk aversion and time preferences, for which the evidence is mixed. We failed to find a significant relationship between risk aversion and time preferences. Personality traits do not mediate the relationship.

The third chapter is titled "Personality Traits, Field of Study Choice, and Academic Performance". We use original survey data from a cohort of first year university students enrolled in a course of

study at the University of Messina (bachelor's degree or single cycle degree) and investigate whether personality traits may help to explain the field of study choice and causally affect academic performance over the first year of the study program. We use two measures of academic performance: the grade point average and the total academic credits gained in the first academic year. We find evidence that personality traits predict the choice of the field of study, whereas the results for the causal effects of personality traits on the performance outcome are less consistent and depending on which measure of academic performance is used.

Chapter 1

Personality Psychology and Economics:

How Personality Traits Explain Economic Outcomes

Abstract

What are the fundaments of economic choices and behavior? A growing body of economic research attempts to understand the role of personality traits in shaping economic preferences and explaining heterogeneity in economic behavior. Personality traits are "relatively enduring" behavioral patterns that express the subjective way individuals interpret and react to real life situations. A deeper understanding of human personality is related to the possibility of developing public forms of intervention that may enhance economic outcomes. I present a literature review of studies which have investigated the relationship between personality traits and economic outcomes in a perspective challenge of integrating economic models with non-cognitive factors defined in personality psychology.

Everyday individuals make decisions of economic relevance, such as stating consumption patterns, formulating expectations about the future, or making decisions under uncertain conditions. Conventional economic research addressed the issue of the fundaments of economic choices in terms of maximization of the utility function. Economic preferences, expectations, and constraints shape economic behavior. However, a growing body of literature has tried to integrate concepts properly defined by personality psychologists in the classical economic theory in order to better understand subjects' actual decisions and behaviors (e.g. Borghans et al., 2008a; Ferguson et a., 2011; Almlund et al., 2011). Empirical evidence suggests that socioeconomic outcomes are affected by individual differences in cognitive ability and personality traits (e.g. Ben-Ner et al., 2004; Dohmen et al., 2010; Heckman and Kautz, 2012).

Personality psychology is a branch of psychology which investigates the composite structure of personality and how differences in personality characteristics shape behavior. Personality traits are "*the relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances.*" (Roberts [2009, p. 140]). Therefore, personality traits describe the cognitive and emotional responses to external inputs that shape behavior and classify the major differences in psychological qualities that distinguish individuals. Borghans et al. (2008a) argue that "*individual differences in personality and cognition shape the constraints of individuals and hence their choices*".

The most accepted classification method of personality traits is the five-factor model of personality (FFM), also known as "Big Five", in which traits are structured into five basic dimensions: Openness to Experience, Conscientiousness, Extraversion, and Neuroticism (Table 1). The model has its origins in the lexical hypothesis (Allport and Odbert, 1936), which states that the main individual differences are encoded in the language (see Almlund et al., 2011). Each cluster is the polarization between two opposite psychological tendencies (e.g. Neuroticism and Emotional Stability) and includes a range of correlated lower-order facets or sub-dimensions that are descriptive specifications of the general domain. The hierarchical taxonomy of the five-factor model is considered a general and valid representation of the main psychological types, which provides a comprehensive, replicable assessment of the individual personality and permits to correlate measurements of personality with variables of socioeconomic interest (McCrae & Costa, 1987; Goldberg, 1990; McCrae & John, 1992).

An important issue concerns the degree of stability of personality traits, that is how and to what extent personality traits change within the life cycle. A widely sustained position is that personality traits evolve across childhood up to early adulthood and settle at stable levels. Costa and McCrae, using a similitude introduced by William James (1890), state that personality traits are "set like a plaster" by about age 30 and, after that point, mean level changes are "*few and subtle*" and this proposition applies for all the five dimensions of the FFM; patterns of changes can occur with the decrement of

cognitive abilities in old age (Costa and McCrae, 1994). The personality stability theory received large support, claiming that personality traits show a tendency toward stability and individuals become more socially dominant, agreeable, conscientious, emotionally stable, and less open to experience with age: mean-level changes, which measure the average changes in the absolute value of a trait in a population over time, are generally low; the rank-order consistency, which represents the changes in the ordinal positioning of individuals relative to the population, exhibit high test-retest correlations among age intervals (e.g. Soldz and Vaillant, 1999; Cobb-Clark and Schurer, 2012).

McCrae, Costa, Terracciano et al. (2002) trough multiple research designs (longitudinal, cross-sectional and cross-cultural) investigated the personality development from age 12 to the age of majority. This is a life period particularly critical for the biological, psychological and cognitive development of the individual, thus these processes are expected to directly affect the personality development. The authors find that the mean level changes of Agreeableness, Conscientiousness, and Extraversion follow inconsistent age trends, while observed a moderate increment of Openness to experience both in boys and girls and of Neuroticism in girls. Results of mean-level consistency seem to contrast with the common view that the adolescence is a critical period for the development of personality. However, the authors note that changes in personality traits emerge in the rank-order consistency, which reflected effective changes in the ordinal position of individuals relative to the group. The gender differences regarding the patterns of personality traits and their sub-dimensions as a function of age are widely discussed in literature. In a recent study De Bolle, De Fruyt, McCrae et al. (2015) report a cross-sectional analysis conducted across 23 countries and based on observer ratings of boys and girls aged 12 to 17, which aimed at investigating the personality development, accounting for gender and cultural differences, during the adolescence. Results indicate that gender differences rise since the early adolescence, with adolescent girls reporting higher scores than boys in all the domains of the FFM, particularly for Neuroticism, Openness to experience, and Conscientiousness. Specific differentiations in the patterns have been found with respect to single facets, underlining the fact that a more systematic analysis than the framework of the five basic dimensions is required to understand the different aspects of the psychological maturation and the existence of gender differences in the age trends. Interestingly, gender differences in Neuroticism appear significant since age 14 and these results are particularly consistent for the facets of Anxiety, Depression, and Vulnerability. Although the results confirmed the existence of sex differences, they appear modest in magnitude, according to the view that there are moderate mean-level differences between genders in the adulthood. In addition, the age trends of personality traits are not significantly affected by cultural motives, although in less developed countries gender differences are smaller in magnitude.

The assumption of stability, albeit largely sustained, has been questioned by other authors, who pointed out that personality traits are susceptible of changes also beyond age 30 (e.g. Ardelt, 2000;

Roberts and Del Vecchio, 2000) and the patterns are not necessarily linearly shaped or require deeper specifications than the basic framework of the Big five dimensions, such that a "*mounting evidence suggests that the set-like-plaster view is not correct*" (Borghans et al., 2008a). For example, Srivastava, Gosling, and Potter (2003) conduct an analysis of the mean-levels of personality traits in the adulthood by using a sample aged between 21 and 60. They compare their findings with the assumptions of the personality stability theory as proposed by Costa and McCrae. In particular, they distinguished between an original "hard plaster hypothesis", which posits that after age 30 personality traits are fixed or exhibit inconsistent changes; and a "soft plaster hypothesis", which admits for declining small changes after age 30. The findings from a regression of the big five dimensions on age fully rejected the "hard plaster hypothesis" (i.e. the null hypothesis that the slope for ages 31-60 was not significantly different from zero) for all the factors, while "the soft plaster hypothesis" (i.e. the slope for ages 21-30 being stronger than the slope for ages 31-60) appear to be predictable only of the pattern of Conscientiousness. Specifically, Agreeableness increases at decreasing rates by the 40s and the most quantitative effects were in the 30s; Neuroticism stably decreases for women, but not much for men; Openness to experience decreases slowly for both women and men; Extraversion increases slightly for men and followed the opposite pattern for women. Roberts and Del Vecchio (2000) illustrate the findings from a meta-analytic analysis that collected 152 longitudinal studies. The results appear to confirm that the rank-order consistency, measured on age intervals of 6,7 years on average, linearly increases with age. However, the findings suggest that the personality traits still changes in the 30s and the plateau occurs at some point after the 50.

Boyce et al. (2015), argue that the issue of the degree of stability of personality traits over the life cycle is related to the definition of personality. In particular, they suggest a more inclusive representation "*which implies a degree of temporal and cross-situational stability (...), but does not preclude substantive personality change over time*".

A potential issue related to the identification problem of personality traits is that people tend to describe themselves better than their actual profiles. The tendency to self-enhance may affect the way individuals report their self-assessment of personality traits: for example, a person may report to be more self-conscious than her actual condition, because she is aware that this personality facet is positively evaluated by the social environment. For example, Krueger (1998) analyzed the self-enhancement bias and provided evidence that "enhancement is a controllable bias rather than a cognitive illusion".

The basic assumption of the study is that people tend to describe traits that they perceive to be more self-descriptive as more socially desirable, and to describe less self-descriptive traits as less socially desirable. In order to measure the assessment bias, subjects from a sample of undergraduate students were asked to report, for each trait in a list, if the trait was self-descriptive or not. In addition, half of

the participants rated the personal desirability of the trait (how much the trait was socially desirable in their opinion) and another half rated the average social desirability of the trait (how much the trait was socially desirable for the average group). Results indicate that agents rated traits as more socially desirable when they were considered more self-descriptive. However, when the average social desirability was introduced, raters reduced the self-enhancement

Table 1: Five Factor Model of personality.

Domain	Description
Openness	tendency to be open to new aesthetic, cultural, or intellectual experiences
Conscientiousness	tendency to be organized, responsible, and hardworking
Extraversion	orientation of one's interests and energies toward the outer world of people and things
Agreeableness	tendency to act in a cooperative, unselfish manner
Neuroticism	chronic level of emotional instability and proneness to psychological distress

Source: Heckman (2011) reporting the American Psyhology Association Dictionary description

Personality is a plastic interface between the external environment and the subjective processing of information and motivation. Empirical research has demonstrated that changes in the structure of personality can be induced by environmental factors such as parental influence, educational programs, and non normative life events. In this sense, Almlund et al. (2011) state that *" a major contribution of economics to the literature in psychology is to develop and apply a framework to investigate how investment, including education, work experience, and self help, changes traits"*.

For instance, using longitudinal data from the German Socio-Economic Panel (SOEP), Angelini et al. (2015) find that paternal unemployment has a positive causal effect on the children aged 17 to 25, making them more conscientious and less neurotic. Boyce et al. (2015) investigate whether the occurrence of non normative life events such as unemployment is conditioning for personality development in the adulthood by comparing the personality profiles of those individuals that experienced unemployment to the group of those who maintained the employed status across a range of four years between two points of measurements of personality traits in the SOEP data. Findings show significant mean level changes for unemployed relative to the employed group in the traits of

Agreeableness, Openness to Experience, and Conscientiousness. Personality change is differentiated by gender and depending on the duration of unemployment. These effects tended not to be permanently sustained when a subject found a job after the negative period.

Understanding how individual personality influences life outcomes and whether enduring personality changes can be caused to enhance educational performance and labor market outcomes, are research issues that can have relevant implications for the definition and the evaluation of public policies. For instance, Heckman and Kautz (2012) point out that personality traits are a component of influence for life success and provide empirical evidence that a program designed primarily to improve personality traits in disadvantaged black children aged 3-4, the "Perry Preschool Program", positively affected the performance scores of pupils on the California Achievement Test (CAT).

Public forms of interventions can be considered by taking into account the personality framework, specifically to evaluate whether the efficacy of a policy differentiates depending on the different personality profiles of the subjects on treatment, and whether soft skills influence directly or indirectly (through other variables that are conditioned by personality characteristics) the inclusion into the group of subjects who benefited from the program (e.g. Fairlie and Holleran, 2012). In a study on the efficacy of the German new start-up subsidy, a program designed to provide financial support to unemployed to start a business, Caliendo et al. (2016) analyze whether the treatment effects can be overestimated when the model does not control for latent personality factors. The efficacy of the program, evaluated by means of a propensity score matching approach, is strictly positive. The absence of significant differences in the estimates when including a specification of personality measurements suggests that variables potentially conditioned by personality characteristics can drive partly the influence of personality in the outcomes. The conclusion of the authors is that incorporating personality traits might be useful when they are not sufficiently captured by other control variables.

Several studies have addressed the issue of the relationship between personality traits and the willingness to engage in competitive activities, and the choice of starting and maintaining an entrepreneurial business in particular (e.g. Bartling et al., 2009; Espíritu-Olmos and Sastre-Castillo, 2015; Caliendo et al., 2014; Zhao and Seibert, 2006; Zhao et al., 2010). For example, in a meta-analytic review of the relationship between personality traits and the entrepreneurial status, Zhao and Seibert (2006) make a comparison between the Big Five factors of entrepreneurs – defined as "*founder, owner, and manager of a small business and whose principal purpose is growth*"- and managers. They find that entrepreneurs score lower on Neuroticism and Agreeableness than managers. The authors suggest that entrepreneurs face with higher stressful conditions related to the financial benefits and risks of their activity and a less structured work environment. Therefore, the qualities of being emotionally stable and not easily subject to dysfunctional distress are relevant for an entrepreneur. Entrepreneurs work in a competitive environment and may engage in an opportunistic

behavior to take advantages more easily than managers, who are constrained by the social evaluation within the organization. In addition, entrepreneurs score higher on Openness and Conscientiousness. According to the authors' hypotheses, entrepreneurs are more intellectually curious since the ability to consider new strategies and products beyond the rules and procedures to manage the activity, is relevant for the business growth. Since conscientious subjects are hard working, self-disciplined, and dutiful, they are expected to be perceived as more trustworthy by the economic actors than less conscientious subjects, and to be more able to direct a business activity. Extraversion does not show any significant relationship, but the authors observe a high variability over studies. In a follow-up study, Zhao et al. (2010) report that the traits of Openness, Conscientiousness, Emotional Stability, and Extraversion are significantly associated with two major aspects related to the entrepreneurial status: the intention to start an entrepreneurial business and the entrepreneurial firm performance. Caliendo et al., (2014) use data from the GSOEP to explore the relationship between Big Five traits and two salient aspects of the entrepreneurial experience, the decision to enter in an entrepreneurial activity and the survival in the self-employed status. The traits of Openness to experience and Extraversion are positively associated with the entry in the self-employment status and, consequently, the probability of staying self-employed, whereas Agreeableness is positively related to the exit from the entrepreneurial status. In addition, some personality facets are considered. In particular, trust and locus of control are positively related to the engage in an entrepreneurial activity and the probability of staying self-employed; trust is positively related to the probability of self-employment. Interestingly, the authors find that the explanatory contribution of Big Five traits to the model is 13.9 %, which is comparable with the results of the main objective control variables, such as age and past work experience.

Although cognitive abilities provide a distinct contribute to explain economic preferences and outcomes (e.g. Dohmen et al., 2010; Heckman et al., 2006), psychological factors are implied in cognitive outcomes. In a laboratory experiment conducted on a sample of university students, Borghans et al. (2008b) find that non-cognitive skills affect cognitive test scores (IQ questions). Coefficients for "successful" traits related to intrinsic motivation and self-control, in particular performance motivation, curiosity, and internal locus of control are positively associated with the probability of giving the correct answer, whereas the coefficients on Introversion, Agreeableness and Openness are negatively related. Moreover, the effect of personality traits on the probability of giving the correct answer does not significantly enhance when an incentive prize is introduced for each right answer. In addition, the time spent to answer a question is longer for subjects who are more motivated and hard working, i.e. with high intrinsic motivation and internal locus of control, conscientious and emotionally stable, but significantly reduces when the economic incentive is introduced. These results suggest that personality traits condition the effort individuals are willing to put to solve cognitive tests; economic incentives do not condition the effect of successful traits on the performance outcome,

but reduce the time spent to complete the task. In a laboratory experiment, when a spatial ability task was repeatedly conducted under time pressure, low conscientious participants improved faster their performance than high conscientious subjects, whose rate of improvement in performance was limited by the tendency to be reflective and deliberative (Yeol and Neal, 2004).

Big five traits have been applied as a tool of interpretation of heterogeneity in citizens' political behavior in modern democracies. As Gerber et al. (2013) argued, it is a recognized assessment in literature on political processes that "*people respond particularly favorably to objects and ideas - including brands and politicians- that they believe share their personality traits*".

In a study on the relationship between Big 5 traits and validated turnout in US general elections conducted between 2007 and 2008 Gerber et al. (2011) find a positive association between Extraversion, Emotional Stability and Validated Turnout Count (VTC), i.e. the number of times an individual voted in the period considered, and a negative association between Conscientiousness and VTC. Interestingly, more Agreeable individuals were less likely to over-report voting (a significant reduction of 10 percent by two-standard-deviation increase in the score), probably because of their tendency to be modest when representing their own qualities.

Research findings suggest that the Big Five traits of Openness to experience and Agreeableness are positively associated with a preference for left-oriented parties. In fact, Openness to experience describes a favorable disposition to changes, and consequently to programs that are expected to reform the status quo; agreeable subjects are more sensitive to the themes of social inclusion and cooperation. While the trait of Conscientiousness, reflecting a tendency to be self-disciplined and conform to social rules, is positively associated with support to right-wing parties. The evidence on Extraversion and Neuroticism is less consistent (see, for example, Duckitt et al., 2016; Verhulst et al., 2012; Aidt and Rauh 2017; Bakker et al., 2017). Aidt and Rauh (2017) claim that big five personality traits are causally related (although there is not a uniform consensus in literature: see Verhulst et al., 2012; Hatemi and Verhulst, 2015) to political identification by using data on English households from two surveys, the British Household Panel Survey (BHPS) and the UK Household Longitudinal Study (UKHLS). As a key tool for the analysis they disentangle the dynamic component of the individual partisanship -context dependent and relative to events occurring during the lifecycle such as economic crises or changes in a party's political leadership- from the static, personal-related component, which is explained by personality traits and other controls such as individuals' cognitive skills. It resulted that Conservative supporters, in a specular way respect to Labour-oriented voters, show low scores on Agreeableness, Openness to experience, and Neuroticism, and high scores on Conscientiousness. Results about Extraversion, consistent with previous findings in literature, are mixed. Both Conservative and Labour supporters show high scores on Extraversion. Liberal democrats have

similar personality profiles to Labour supporters, although they appear to be more introverted, and Agreeableness does not reach levels of statistical significance.

Different forms of political participation are often represented as the resulting choice from a subjective evaluation between perceived costs and benefits of political involvement. Personality traits influence the way individuals evaluate the trade-off between costs and benefits of political participation and, consequently, how they react to persuasive messages aimed at inducing them to vote. Different types of persuasive messages can have a differentiated impact on citizens depending on their personality profiles, allowing for heterogeneity in treatment effects (see Gerber et al. 2013).

When a subject decides to participate in structural forms of support to political campaigns accounts for the uncertainty of the results and evaluates the perceived benefits of the effort. Using panel data from two Internet surveys, Kam (2012) introduces risk tolerance as a psychological component that influences the decision of participating in political initiatives such as attending a political rally or working as a campaign volunteer and shows that risk acceptance is positively related with political participation, either if already experienced or hypothetical. The risk acceptance index, built on a battery of questions about risk attitudes in life situations, correlated significantly and positively with the Big Five traits of Extraversion and Openness to experience, and the relationship between risk propensity and political participation even when controlling for personality traits remained still significant. Among the reasons reported by respondents surveyed in the study, the search for novelty ("I like doing new things") and excitement ("It's exciting to participate") were the most significantly correlated with Risk acceptance.

Personality traits may help to explain bias in rational thinking, such as dispositional optimism. The optimism bias can be defined as the tendency to overestimate the likelihood of positive outcomes. Several studies investigated how this trait can affect economic behavior. For instance, in a study conducted on a sample of undergraduate students Weinstein (1980) analyze how irrational optimism influences the personal judgments of experiencing positive events. In particular, when subjects perceive a positive event as controllable, they think they can influence the result through their personal effort. This belief lead them to increase the likelihood of success and evaluate their possibilities as better than average. In fact, they have a stereotyped image of the average person, that is "*who does little or nothing to improve his or her prospects*". Muren (2012) conducted an experiment aimed at investigating how the subject's assessment of the likelihood that a certain event occurs is affected by the existence of monetary incentives. The experiment consisted of guessing the result of a future and exogenously determined event, the temperature three days later. Participants were randomly assigned to a control group or a treatment group. In the first case, the reward depended on the precision of the guess; in the second case the reward was conditioned both by how close the guess was to the actual number and how high was the actual number. Since in the treatment group

higher temperature events were associated with higher expected payments, significant differences in the guesses between the groups (i.e. higher guesses in the treatment group) were interpreted as a signal of optimism bias. The results confirm that subjects tended toward optimism in the biased treatment. Using data from the Survey of Consumer Finance, Puri and Robinson (2007) presented evidence of the correlation between optimism and economic choices. The authors measured optimism as the difference between the expected value of respondent's remaining lifespan conditional on a vector of personal characteristics and the life expectancy computed using an actuarial table. Optimists result more likely to have a positive view of future economic conditions, to be self-employed, to work more hours, to remarry, to pick individual stocks and to have a larger expected working life. Analyzing these results we can present a mixed judgment on optimism bias. On the one hand, optimism is a personal trait which can have positive effects on the subject's well-being: for example, it provides an incentive to work to obtain the expected positive outcomes or is associated with a better subjective life expectancy. On the other hand, optimism can lead to make choices which are suboptimal. For example, Gibson and Sanbonmatsu (2004) report the results from three studies on the relationship between dispositional optimism and gambling. Optimistic subjects are more likely to gamble than pessimists and, after the experience of repeated game losses, are more likely to maintain positive expectations. Sharpe, Martin, and Roth (2011) investigate the relationship between optimism and the Big Five factors. They find that optimism is strongly related to four of the five dimensions: Emotional Stability, Extraversion, Agreeableness, and Conscientiousness. Furthermore, it appears that "*individual differences in Neuroticism and Extraversion are responsible for the largest proportion of variance in dispositional optimism*".

Several studies investigated the predictive power of personality traits on different economic outcomes, such as educational attainment, occupational choice, performance, wages, and household savings (e.g. Cubel et al., 2016; Ferguson et al., 2011; Heineck and Anger, 2010; Fletcher, 2013; Schäfer, 2016). For instance, Gerhard et al. (2018) analyze the psychological determinants of household savings behavior using survey data on a representative sample of UK population. They distinguish between two social classes: the "striving class" and the "established class", the latter including households that better respond to the demographic characteristics of being older, married, having an university degree, and higher income. In addition, household savings are defined as liquid savings, that is cash or investments easily convertible into cash. They find that Agreeableness and Extraversion are negatively related to household savings for both the striving and the established category; the traits of Conscientiousness and Openness to experience are negative predictors of savings only for the established class. Possible explanations for these findings are that agreeable subjects show a less opportunistic behavior, such that their altruism and compliance might be a disadvantageous aspect of personality respect to saving decisions. Extraverted subjects are more prone to social interactions and energetic, therefore might be induced to spend more money in leisure activities. In addition, for the

authors a rationale for the apparently surprising negative coefficient for Conscientiousness is that more conscientious individuals tend to invest more in long-term goals, such as savings for retirement. Regarding to the trait of Openness to experience, they argue that the insignificant relationship found within the striving group might be explained by constraints to engage in intellectually stimulating activities. Using data from the Household Income and

Labour Dynamics in Australia (HILDA) survey, Cobb-Clark and Tan (2010) find significant associations between non-cognitive skills (personality traits and locus of control) and the probability of being employed in a certain occupation, with some gender differences. For instance, more extroverted men are less likely to work as managers contrary to women. Particularly, Openness to experience is the most important predictor for women, being positively associated with the probability of being employed as managers, in science- and technology-oriented job activities, and education professionals. Conditional to demographic characteristics related to productivity, noncognitive skills add a small explanation to the gender disparity in relative wages, while almost three-quarters of the gender gap remains unexplained.

Previous psychological literature on gender differences in personality traits within the FFM framework systematically found that women report on average higher scores in the domains of Agreeableness and Neuroticism than men. In particular, they are on average more other-regarding oriented and tender-minded, and more exposed to negative feelings such as anxiety (Chapman et al., 2007). These results have been confirmed by a large study of McCrae et al. (2005), who replicated a cross-cultural analysis of gender differences in personality of Costa et al. (2001) using observer ratings. More subtle differences have been observed with respect to the traits of Openness to new experiences and Extraversion, since they compound different, although complementary, aspects of personality: women are more open to feelings and aesthetics, while men are more open to ideas; women score higher on the Extraversion-related facets of gregariousness, positive emotions, and warmth, but lower on excitement-seeking and assertiveness than men (McCrae et al., 2005). Gender differences in personality traits are consistent with gender stereotypes that associate women with affectivity and emotionality, whereas men with dominance and intellect (Costa et al., 2001, citing Williams and Best, 1990).

References

Aidt, T. S., & Rauh, C. (2017). The Big Five personality traits and partisanship in England.

Allport, G. W., & Odbert, H. S. (1936). Trait-names: A psycho-lexical study. *Psychological monographs*, *47*(1), i.

Almlund, M., Duckworth, A. L., Heckman, J., & Kautz, T. (2011). Personality psychology and economics. In Handbook of the Economics of Education (Vol. 4, pp. 1-181). Elsevier.

Angelini, V., Bertoni, M., & Corazzini, L. (2018). Does Paternal Unemployment Affect Young Adult Offspring's Personality?. *Journal of Human Capital*, *12*(3), 542-567.

Ardelt, M. (2000). Still stable after all these years? Personality stability theory revisited. *Social Psychology Quarterly*, 392-405.

Bakker, B. N. (2017). Personality traits, income, and economic ideology. *Political Psychology*, *38*(6), 1025-1041.

Bartling, B., Fehr, E., Maréchal, M. A., & Schunk, D. (2009). Egalitarianism and competitiveness. *American Economic Review*, *99*(2), 93-98.

Ben-Ner, A., Kong, F., & Putterman, L. (2004). Share and share alike? Gender-pairing, personality, and cognitive ability as determinants of giving. Journal of Economic Psychology, 25(5), 581-589.

Borghans, L., Duckworth, A. L., Heckman, J. J., & Ter Weel, B. (2008a). The economics and psychology of personality traits. Journal of human Resources, 43(4), 972-1059.

Borghans, L., Meijers, H., & Ter Weel, B. (2008b). The role of noncognitive skills in explaining cognitive test scores. *Economic Inquiry*, *46*(1), 2-12.

Boyce, C. J., Wood, A. M., Daly, M., & Sedikides, C. (2015). Personality change following unemployment. *Journal of Applied Psychology*, *100*(4), 991.

Caliendo, M., Fossen, F., & Kritikos, A. S. (2014). Personality characteristics and the decisions to become and stay self-employed. *Small Business Economics*, *42*(4), 787-814.

Caliendo, M., Künn, S., & Weißenberger, M. (2016). Personality traits and the evaluation of start-up subsidies. *European Economic Review*, *86*, 87-108.

Chapman, B. P., Duberstein, P. R., Sörensen, S., & Lyness, J. M. (2007). Gender differences in Five Factor Model personality traits in an elderly cohort. *Personality and individual differences*, *43*(6), 1594-1603.

Cobb-Clark, D. A., & Schurer, S. (2012). The stability of big-five personality traits. *Economics Letters*, *115*(1), 11-15.

Cobb-Clark, D. A., & Tan, M. (2011). Noncognitive skills, occupational attainment, and relative wages. *Labour Economics*, *18*(1), 1-13.

Costa Jr, P. T., & McCrae, R. R. (1994). Set like plaster? Evidence for the stability of adult personality.

Costa Jr, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: robust and surprising findings. *Journal of personality and social psychology*, *81*(2), 322.

Cubel, M., Nuevo-Chiquero, A., Sanchez-Pages, S., & Vidal-Fernandez, M. (2016). Do personality traits affect productivity? Evidence from the laboratory. *The Economic Journal*, *126*(592), 654-681.

De Bolle, M., De Fruyt, F., McCrae, R. R., Löckenhoff, C. E., Costa Jr, P. T., Aguilar-Vafaie, M. E., ... & Avdeyeva, T. V. (2015). The emergence of sex differences in personality traits in early adolescence: A cross-sectional, cross-cultural study. *Journal of personality and social psychology*, *108*(1), 171.

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability?. *American Economic Review*, *100*(3), 1238-60.

Duckitt, J., & Sibley, C. G. (2016). Personality, ideological attitudes, and group identity as predictors of political behavior in majority and minority ethnic groups. *Political Psychology*, *37*(1), 109-124.

Espíritu-Olmos, R., & Sastre-Castillo, M. A. (2015). Personality traits versus work values: Comparing psychological theories on entrepreneurial intention. *Journal of Business Research*, *68*(7), 1595-1598.

Fairlie, R. W., & Holleran, W. (2012). Entrepreneurship training, risk aversion and other personality traits: Evidence from a random experiment. *Journal of Economic Psychology*, *33*(2), 366-378.

Ferguson, E., Heckman, J. J., & Corr, P. (2011). Personality and economics: Overview and proposed framework. Personality and Individual Differences, Volume 51, Issue 3

Fletcher, J. M. (2013). The effects of personality traits on adult labor market outcomes: Evidence from siblings. *Journal of Economic Behavior & Organization*, *89*, 122-135.

Gerber, A. S., Huber, G. A., Doherty, D., Dowling, C. M., & Panagopoulos, C. (2013). Big five personality traits and responses to persuasive appeals: Results from voter turnout experiments. *Political Behavior*, *35*(4), 687-728.

Gerber, A. S., Huber, G. A., Doherty, D., Dowling, C. M., Raso, C., & Ha, S. E. (2011). Personality traits and participation in political processes. *The Journal of Politics*, *73*(3), 692-706.

Gerhard, P., Gladstone, J. J., & Hoffmann, A. O. (2018). Psychological characteristics and household savings behavior: The importance of accounting for latent heterogeneity. *Journal of Economic Behavior & Organization*, *148*, 66-82.

Gibson, B., & Sanbonmatsu, D. M. (2004). Optimism, pessimism, and gambling: The downside of optimism. *Personality and Social Psychology Bulletin*, *30*(2), 149-160.

Goldberg, L. R. (1990). An alternative" description of personality": the big-five factor structure. *Journal of personality and social psychology*, *59*(6), 1216.

Hatemi, P. K., & Verhulst, B. (2015). Political attitudes develop independently of personality traits. *PloS one*, *10*(3), e0118106.

Heckman, J. J., & Kautz, T. (2012). Hard evidence on soft skills. *Labour economics*, *19*(4), 451-464.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor economics*, *24*(3), 411-482.

Heineck, G., & Anger, S. (2010). The returns to cognitive abilities and personality traits in Germany. *Labour economics*, *17*(3), 535-546.

James, William. 1890. The Principles of Psychology. New York, NY: H. Holt and Company.

Kam, C. D. (2012). Risk attitudes and political participation. *American Journal of Political Science*, *56*(4), 817-836.

Krueger, J. (1998). Enhancement bias in descriptions of self and others. *Personality and Social Psychology Bulletin*, *24*(5), 505-516.

McCrae, R. R., Costa Jr, P. T., Terracciano, A., Parker, W. D., Mills, C. J., De Fruyt, F., & Mervielde, I. (2002). Personality trait development from age 12 to age 18: Longitudinal, cross-sectional and cross-cultural analyses. *Journal of personality and social psychology*, *83*(6), 1456.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of personality and social psychology*, *52*(1), 81.

McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of personality*, *60*(2), 175-215.

McCrae, R. R., & Terracciano, A. (2005). Universal features of personality traits from the observer's perspective: data from 50 cultures. *Journal of personality and social psychology*, *88*(3), 547.

Muren, A. (2012). Optimistic behavior when a decision bias is costly: An experimental test. *Economic Inquiry*, *50*(2), 463-469.

Puri, M., & Robinson, D. T. (2007). Optimism and economic choice. *Journal of Financial Economics*, *86*(1), 71-99.

Roberts, B. W. (2009). Back to the future: Personality and assessment and personality development. *Journal of research in personality*, *43*(2), 137-145.

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychological bulletin*, *126*(1), 3.

Schäfer, K. (2016). The influence of personality traits on private retirement savings in Germany.

Sharpe, J. P., Martin, N. R., & Roth, K. A. (2011). Optimism and the Big Five factors of personality: Beyond neuroticism and extraversion. *Personality and Individual Differences*, *51*(8), 946-951.

Soldz, S., & Vaillant, G. E. (1999). The Big Five personality traits and the life course: A 45-year longitudinal study. *Journal of Research in Personality*, *33*(2), 208-232.

Srivastava, S., John, O. P., Gosling, S. D., & Potter, J. (2003). Development of personality in early and middle adulthood: Set like plaster or persistent change?. *Journal of personality and social psychology*, *84*(5), 1041.

Verhulst, B., Eaves, L. J., & Hatemi, P. K. (2012). Correlation not causation: The relationship between personality traits and political ideologies. *American journal of political science*, *56*(1), 34-51.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of personality and social psychology*, *39*(5), 806.

Yeo, G. B., & Neal, A. (2004). A multilevel analysis of effort, practice, and performance: effects; of ability, conscientiousness, and goal orientation. *Journal of Applied Psychology*, *89*(2), 231.

Zhao, H., & Seibert, S. E. (2006). The Big Five personality dimensions and entrepreneurial status: A meta-analytical review. *Journal of applied psychology*, *91*(2), 259.

Zhao, H., Seibert, S. E., & Lumpkin, G. T. (2010). The relationship of personality to entrepreneurial intentions and performance: A meta-analytic review. *Journal of management*, *36*(2), 381-404.

Chapter 2

How Personality Traits Affect Economic Decisions: a Laboratory Experiment

Abstract

In the present study, we analyze the explanatory power of Big Five traits respect to two major economic preferences, risk attitudes and time preferences. We conduct a laboratory experiment on a sample of university students with real choice tasks. We find that individuals become more impatient when the risk choice task is implemented prior to the intertemporal choice task and that these order effects are mediated by differences in personality and gender. We do not detect any significant correlation between personality traits and economic preferences. Additionally, we implement a correlation analysis of the relationship between risk attitudes and time preferences. We find that risk aversion and impatience are not significantly correlated and that the magnitude of the relationship does not depend on the levels of personality traits.

1. Introduction

In the present study, we investigate the predictive validity of personality traits on economic preferences, specifically individual risk attitudes and time preferences.

The research issue of the fundaments of heterogeneity in economic behavior has been addressed both by economists and personality psychologists with different perspectives (see Ferguson et al., 2011). As described for instance by Becker et al. (2012), in the economic approach agents' economic preferences are responses to the utility maximization problem; while personality psychology is a branch of psychology which focuses on the fundamental personality characteristics that affect the different ways subjects interpret and react to external inputs. Economic researchers have examined how constructs developed in the personality psychology field can be integrated in an economic framework.

Almlund et al. (2011) define a subject's expected utility function

$$E(U(X, P, e \mid \psi) \mid I)$$

of a set of final consumption goods X, a vector of productivity P in a set of $j=(1,....,J)$ tasks, and the effort exerted across the tasks $e=(e_1,..., e_J)$, given a preference parameter vector $\psi \in \Psi$. I is the set of known information, whose acquisition and processing may depend on individual psychological traits. An agent maximizes his utility function under the constraints on the level of baseline income Y, the amount of income earned from the tasks R, and the prices associated to the consumption goods W.

A broader definition includes a vector of actions $a_j=(a_{1,j},...,a_{k,j})$ which affect individual productivity, that are "*the styles of behavior*" adopted to carry out the tasks (Almlund et al. [2011, pag. 36]). Actions depend on the endowment of effort exerted in the tasks and the endowment of psychological traits θ of the agent. In this economic model personality traits, which are included in psychological traits, explain individual effort and preferences that, in turn, affect economic behavior.

Borghans et al. (2008) describe personality traits in terms of constraints on choice behavior and posit that "*conventional economic preference parameters can be interpreted as consequences of these constraints*" [pag. 977].

Several researches both in the psychological and economic sectors have explored the relationship between personality traits and economic preferences, however, the evidence is not conclusive.

In order to contribute to a better knowledge of the link between personality traits and two principal economic preferences, risk aversion and time preferences, we conducted a laboratory experiment on a sample of undergraduate students.

We applied experimental methods to infer agents' choice behavior in a well-controlled environment. In this research setting economic preferences of the agents were elicited by means of economically incentivized decision tasks. We measured personality traits using the Ten Item Personality Inventory (TIPI), a short questionnaire structured according to the taxonomy of the Five Factor Model or "Big Five", which organizes personality characteristics in the five hierarchical domains of Openness to new experiences, Conscientiousness, Extraversion, Agreeableness, and Emotional Stability (or Neuroticism).

In addition to the main research question, we further investigated whether personality traits may shed light on the rationale of the relationship between risk aversion and time preferences. The evidence in literature is mixed, with some authors finding a positive and significant relationship (e.g. Anderhub et al., 2001; Andersen et al., 2008), while others a negative and significant relationship (e.g. Ferecatu and Önçüler, 2016; Abdellaoui et al. experiment 1, 2013; Corazzini et al., 2015); finally, other studies fail to identify a significant relationship (Abdellaoui et al. experiment 2, 2013).

In our study, we analyze whether personality traits may mediate the relationship between risk attitudes and time preferences. Therefore, we explore the rule of personality traits as a potential key of explanation of the previous conflicting evidence.

The chapter is organized as follows: section 2 discusses the empirical evidence on the relationship between personality traits and the economic preferences of risk aversion and impatience, and the relationship between risk aversion and impatience. Section 3 describes the experimental design and its implementation. Section 4 reports the main results of the study and section 5 some robustness checks, Section 6 reports the conclusions.

2. Theoretical background

2.1 Personality traits and economic preferences.

The normative description of economic preferences in the conventional economic theory has been reconsidered to integrate findings from personality psychology and revise the model of rational choice (Borghans et al., 2008).

The evidence on the relationship between Big Five traits and economic preferences is mixed. In some studies low to moderate significant associations have been detected; however, in other studies the relationship is not significant. For instance, in an economic study on the predictive power of cognitive ability, Dohmen et al. (2010) find that none of the big five personality traits, included as control

variables in a regression analysis, are significantly related to the experimental measures of willingness to take risks and impatience. Becker et al. (2012) have presented a comprehensive economic study on the association of Big Five traits with risk attitudes and time preferences. They implemented a correlation analysis on three datasets: they obtained experimental and economically incentivized measures of economic preferences from a laboratory experiment conducted on a sample of university students and from a representative sample of German population; in addition, they used survey data from the German Socio Economic Panel. The results showed weak raw correlations both in the experimental and survey data. In the latter case, a larger number of statistically significant correlations were found due to the larger sample size, although some inconsistency emerged in the signs of correlations.

2.1.1 Personality traits and risk attitudes.

The concept of risk attitudes comprises different aspects of individual choice under uncertainty examined in economic and psychological research. An agent who prefers a sum of money rewarded with certainty respect to engaging in a lottery with the same expected value is defined as a risk averse type. In the expected utility theory, risk aversion is described in terms of curvature of the utility function: given a utility function u, an agent is risk averse if and only if u is concave (Eeckhoudt et al., 2005). Psychological research emphasizes how risk aversion is a general attitude that is sensitive to motivational and situational factors and therefore might be affected by individual personality characteristics.

Zaleskiewicz (2001) distinguishes two categories of risk propensity, “Instrumental risk taking” and “Stimulation risk taking”. Instrumental risk taking attains to individuals who consider risks as necessary instruments for goal achievement. They are more future oriented and the risk taking decision involves a rational information processing. On the contrary, a stimulating risk taking behavior is related to the need for stimulating experiences and immediate sensations. This type of risk taking is correlated with sensation seeking, a concept developed by Zuckerman, which describes a general propensity to engage in risky activities in order to satisfy a need for “*varied, novel, complex, and intense sensations and experiences*” (Zuckerman, 1994). Zaleskiewicz points out that an underlying factor related to risk taking, regardless of whether instrumental or stimulation, is impulsivity.

The psychological constructs of sensation seeking and impulsivity have often been associated with risky behavior (e.g. Zuckerman & Kulhman, 2000; Mishra & Lalumière, 2011). Whiteside and Lynam (2001) use the Five Factor framework to shed more light on the composite definition of impulsivity. Based on a factor analysis and the NEO-PI-R proposed by Costa and McCrae (1992) to measure the

five dimensions of personality and its facets, they find that impulsiveness integrates some psychological aspects included in different domains: a lack of self-control (Neuroticism), a lack of self-discipline and ability to planning and being reflective before acting (Conscientiousness), and excitement seeking (Extraversion).

Positive associations have been found in several studies between risk taking and the traits of Openness to experience and Extraversion, and negative associations with the traits of Agreeableness and Neuroticism (e.g. Kowert and Hermann, 1997; Lauriola and Levin, 2001; Nicholson et al., 2005).

Risk propensity has been analyzed as a context-dependent construct other than a general willingness to take risks. Therefore, the relationship between personality traits and risk attitudes has been investigated across different domains (e.g. Zuckerman and Kulhman, 2000; Sween et al, 2017; Weller and Tikir, 2011). For example, Nicholson et al. (2005) propose a new method of elicitation of individual risk propensity, the Risk Taking Index, based on past and current risk behavior in six real-life situations: recreational, health, career, financial, safety, and social risks. The risk questionnaire providing both domain-specific measures of risk taking and an overall risk-taking scale, has been administered together with the NEO-PIR personality questionnaire to investigate the relationship between five dimensions of personality and actual risky behaviors. In a regression analysis, the traits of Extraversion and Openness to experience are positively related to risk taking behavior, while Agreeableness, Conscientiousness, and Neuroticism are negatively related. The relationship is consistent for all the risk domains, with the only exception of the health domain, in which the sign of the coefficient for Neuroticism is positive. A possible explanation proposed by the authors is that individuals with low emotional stability engage in bad behaviors to alleviate negative emotions. When the lower-order facets of the NEO-PIR are included in the analysis, the Extraversion facet of sensation-seeking appears the key factor to explain overall risk taking and is the first component in four (recreational, health, financial, safety risks) of the six domains. The facets permit to specify the main psychological processes that underlie the choices under risk: high sensation seeking and activity (Extraversion), orientation towards actions and openness to values (Openness to experience) are indicators of risk prone behaviors in different domains; high compliance and straightforwardness (Agreeableness), self-discipline and deliberation (Conscientiousness), and anxiety (Neuroticism) are indices of risk aversion. These results suggest that risk tolerance is a trait which combines different personality aspects. Using the HEXACO personality framework, Sween et al. (2017) observe that the trait of Emotionality (similar to Neuroticism in the FFM), and especially the low-order facet of anxiety, Conscientiousness, and Openness to new experiences are negatively correlated with the use of the mobile phone while driving, and that this correlation is partially mediated by a higher risk perception. A large body of literature has investigated the rule of personality traits in explaining health-related risky behaviors (e.g. Trobst et al., 2000; Hoyle et al., 2000; Bogg and Roberts, 2004; Delaney et al., 2008). Findings particularly suggest that the trait of Conscientiousness influences risk

taking in the health domain. Bogg and Roberts (2004) conduct a meta-analysis of the relationship between Conscientiousness-related traits and risky health behaviors in different domains associated with mortality (physical activity, excessive alcohol use, drug use, unhealthy eating, risky driving, risky sexual behavior, smoking, suicide, violence). Conscientiousness is negatively related to bad behaviors, especially self-control and adherence to rules and conventions. Responsibility and strong moral convictions are the best predictors of health-related behaviors.

Personality characteristics are involved in different aspects of life. For instance, in an exploratory study involving a sample of 118 mothers in Germany, Bartling et at. (2009) examine the determinants of competitiveness and find that risk aversion and high scores in the personality trait of Agreeableness are predictors of a lower probability to self-select into competitive environments. These results suggest that a subject with a psychological predisposition to altruism, modesty, compliance, and tender-mindedness is more likely to avoid competitive situations that imply an uncertain outcome, depending on the subject's ability to perform better than the other players.

Josef et al. (2016) consider the risk taking propensity as a trait and examine how it evolves across the adult lifespan. They use longitudinal data from the German Socio Economic Panel, specifically measures of general willingness to take risk, domain specific risk taking (driving, financial, recreational, occupational, health, and social domains), and Big Five traits. Moreover, they investigate whether personality traits may explain individual differences in the evolution of risk attitudes and find that the within-person change in risk-taking propensity is positively associated with the within-person change in Extraversion and Openness to Experience and negatively correlated with the within-person change in Conscientiousness, Neuroticism, and Agreeableness.

2.1.2 Personality traits and time preferences

Frederick et al. (2002) define impatience as "*the preference for immediate utility over delayed utility*" and discuss whether the construct should be studied as a multidimensional rather than a one-dimensional concept, including more basic constituent motives. Borghans et al. (2008), in line with this analysis, argue that the Big five trait of Conscientiousness is conceptually related to time preferences: higher discount rates may be induced by lack of deliberation, inability to delay gratification, and impulsivity.

In an empirical study on psychological and biological foundations of time preferences, Daly et al. (2009) observe weak raw correlations between Big Five traits and time discounting. In particular, they find a negative and significant association with Conscientiousness and a positive, but marginally significant association with Extraversion. Mahalingam et al. (2014) applied a multiple price list task method with hypothetical rewards and different time horizons together with a personality

questionnaire in a large sample of participants to an online survey. Extraverted and neurotic subjects reported a deeper time discounting, while conscientious and open to experiences subjects a lower time discounting. Agreeableness did not show any significant relationship. The authors additionally investigated whether Big five personality traits moderate the impact of the magnitude effect on delay discounting. They compared the discount rates when the multiple choice list is based on a set of binary choices between an immediate but smaller reward and a fixed amount of US$100 in one month to the case when the delayed amount is US$100. Results showed that Openness to experience and Neuroticism mediate the magnitude effect of greater monetary amounts on discount rates, by enforcing the tendencies towards a lower discounting of individuals who are low in Openness and a deeper discounting of individuals who are high in Neuroticism.

Several studies have focused on the psychological constructs of Extraversion and Impulsivity (Ostaszewski, 1996; Manning et al., 2014; Whiteside and Lynam, 2001; Reynolds et al., 2006; Hirsh et al., 2008; Civai et al., 2016). Since extraverted and impulsive subjects are sensitive to rewards, they have a stronger incentive to prefer an immediate over a delayed gratification and tend to have a subjective slower perception of time passing that implies a higher effort of self-control to wait for future rewards. These psychological components provide motivational inputs for a deeper temporal discounting. For instance, in a laboratory experiment on a sample of university students Ostaszewski (1996) inferred discount rates by means of a series of hypothetical choices between an immediate smaller reward and a large fixed reward over different time horizons. He found that extrovert subject become significantly more impatient than introverts when the delayed reward is $1000 than $100, and a positive correlation between impulsivity and rate of discounting. Impulsivity is a multidimensional and complex construct that encompasses different definitions and measurement scales. Using a constant sensitive model that allows parametric measures of pure time discounting (impatience) and time sensitivity to capture consistency of choices over time (impulsivity), Manning et al. (2014) find that higher Conscientiousness correlates positively with lower short-term impatience and more exponential time preferences, whereas higher Neuroticism is associated with higher short-term impatience and less exponential time preferences. Brain areas associated with sensitivity to rewards and cognitive control are activated when subjects with high scores on Conscientiousness and Neuroticism make intertemporal choices contrary to their psychological tendencies. This deliberate effort implies a greater activation of the main areas involved in the decision-making process.

2.2 Relationship between risk aversion and time preferences

There exists a mixed evidence in literature on the relationship between risk attitudes and time preferences. Some authors found a positive relationship, while other studies reported a negative or insignificant relationship (see, for instance, Abdellaoui et al., 2013; Corazzini et al., 2015).

Prelec and Lowenstein (1991) critically analyze a series of behavioral violations to the models of Expected Utility and Discounted Utility, in which the utility of a consumption bundle is given by the sum of utilities weighted by the probabilities of realization of possible outcomes or a constant discount rate over periods, respectively. For instance, the common ratio effect states that subjects are sensitive to the variations in probabilities thus are more risk prone when rewards involve small probabilities than high probabilities to gain a prize. Analogously, one may prefer a sooner, although smaller, reward than a larger reward later in the future; but when a common delay factor is added to both options of an intertemporal choice set, agents become more patient (common difference effect) and are inclined to reverse their preferences. The authors argue that the domains of uncertainty and time are typically correlated each other in real life situations and suggest that the similarity of choice behavior documented in empirical studies possibly reflects their intimate connection, requiring further research (p.784). Some studies investigated the interactions between risk and time preferences, in particular how intertemporal uncertainty influences individual preferences (see Anderson and Stafford, 2009). For instance, Keren and Roelofsma (1995) find that when an external uncertainty is introduced for both options of an intertemporal choice set, the immediacy effect (i.e. individuals overvalue immediate outcomes compared to future outcomes) weakens. If the majority of subjects preferred the sooner option of Fl. 100 to the delayed option Fl. 110 (82%), the percentage reduced to 54% when the probability of receiving the immediate reward was .90 and to 39% in the case of equal probabilities. When two remote future options are presented with the same temporal length of four weeks in between, the majority of participants prefer the more delayed reward regardless of the probability distribution. Therefore, introducing uncertainty has the same effect on individual intertemporal preferences as incrementing the size of the delay for both options. The authors argue that there exists an interconnection between risk and time preferences, which relies on the perception of intrinsic uncertainty of future rewards (see Halevy, 2008). Their findings suggest that more risk averse subjects are expected to be more sensitive to time delay, therefore, discount the future more heavily than risk seeking subjects (see also Anderhub et al. 2001). Weber and Chapman (2005) replicate the experiment of Keren and Roelofsma and do not find that the introduction of external uncertainty (with a probability of .50) reduces the immediacy effect; the interaction between delay and uncertainty is not significant. Their findings suggest the conclusion that "risk and delay are not psychologically equivalent". In a second experiment, they asked subjects to make a series of repeated choices between a safe and immediate monetary amount and a proposed delayed outcome until the certainty equivalent was detected, that is the immediate monetary amount that makes them indifferent between the two options. When individual preferences were inferred by using a response mode that does not allow subjects to ignore the information that an equal probability distribution was added to both options, the introduction of a risky scenario reduced the immediacy effect. In a laboratory experiment with real payoffs, Anderson and Stafford (2009) present subjects with several scenarios in which they are asked to choose between two future options, a lower amount in two weeks or a higher

amount in 2+n weeks, and vary the probabilities associated with the outcomes. Specifically, in some (safe) scenarios both the options return certain outcomes, in the others one or both the options are uncertain, being the expected value relative to the probability distribution in the uncertain option equal to the certain value in the corresponding safe scenario. They observe that when a risky prospect is introduced in either option subjects are more likely to prefer the earlier option; in other words, they become more impatient in the presence of risk. In addition, higher levels of risk increase the probability of choosing the earlier option.

Other studies suggest that utility for risk and for time are different (e.g. Abdellaoui et al., 2013, Andreoni and Sprenger, 2012a). For instance, in a laboratory experiment with undergraduate economics students Andreoni and Sprenger (2012b) use the Convex Time Budget method of elicitation of time preferences (Andreoni and Sprenger, 2012a) to compare economic behavior in different scenarios with real payoffs. In their research subjects are endowed with 100 tokens to allocate between Option A, an earlier payment at time t (7 days), and Option B, a payment in t+k days, in a set of binary choices. Depending on the scenario, payments are certain for both options, certain for one option, or uncertain for both options; in the latter case, different prospects are presented, but with common ratio probabilities. For each decision table, each token values a fixed amount of $.20 in Option B, whereas decreases from $.20 to $.14 running down through the list in Option B, thus the gross interest rate applied to the later payment is increasing. Subjects show in violation of the common ratio expectations, a strong preference for certainty regardless of in which point of time the certain outcome. However, when both options are uncertain their economic behavior is consistent with the Discounted Expected Utility model. Andreoni and Sprenger suggest that present biased behavior may be explained by individual preference for certainty.

Anderhub et al. (2001) provided a first direct investigation of the correlation between risk aversion and impatience. They implemented a laboratory experiment using a sample of undergraduate economics students and applied the Becker-DeGroot-Marschak (BDM) mechanism to elicit the certainty equivalents of three lotteries presented with an identical scenario (two alternative outcomes with equal probabilities), but different future payoffs (today, after four weeks, and after eight weeks). Subjects reported either the corresponding maximum buying price or the minimum selling price for each lottery. The experiment followed an economically incentivized mechanism (one of the lotteries was randomly selected for real payments) to elicit true preferences. The authors find a positive correlation between risk aversion and time preferences regardless of treatments. Since delayed payments were guaranteed by deferred cheques and involved short-term time horizons, an alternative explanation for these results to the intrinsic uncertainty of future outcomes is that risk averse subjects are more sensitive to the delay of gratification and, consequently, are higher discounters than less risk averse subjects. Using experimental data from a representative sample of adult subjects in Denmark, Andersen et al. (2008) propose a method to jointly elicit risk attitudes and time preference based on

multiple price lists formats. The key aspect of their model is that allows for the concavity of the utility function for the measurement of discount rates. When the assumption of risk neutrality is relaxed, the estimates return lower discount rates. The authors report a significant positive rank correlation between risk aversion and impatience (r=.10). They note that the relationship is stronger when discount rates are estimated under the assumption of risk neutrality and compare their findings with those reported in Anderhub et al. (2001). Since in their study discount rates are defined over utility streams than over money streams as in Anderhub et al. (2001), they conclude that this correction reduces also the magnitude of the correlation between risk and time preferences. In a laboratory experiment with hypothetical stakes, Ferecatu and Önçüler (2016) propose a new method to jointly elicit risk attitudes and time preferences that follows the strategy proposed by Andersen et al. (2008) and accounts for the heterogeneity of economic behavior. They find a negative Pearson's correlation between risk aversion and impatience (-0.42). In addition, they cluster together subjects depending on their risk aversion parameter and discount rates estimates and identify three types of decision makers: risk seekers and impatient, moderately risk averse who require a mean interest rate to postpone consumption, and highly risk averse with lower discount rates. They find that the correlation between risk and time preferences is statistically significant for the risk seeking types and not significant for the risk averse groups. Abdellaoui et al. (2013) use an iterative Multiple Price list method and hypothetical time questions in two laboratory experiments with undergraduate students. In both the experiments they report a negative correlation between the measures of risk and impatience, but for one of them the relationship does not achieve standard levels of statistical significance.

3. Experimental design

The experiment was aimed at investigating the predictive value of personality traits in economic behavior and in particular the decision-making processes reflecting individual risk attitudes and time preferences. In order to attain these research objectives, we structured the experimental sessions in a sequence of decision tasks to elicit students' economic preferences and a multi-item personality questionnaire to assess individual personality profiles within the hierarchical taxonomy of the Five Factor Model. We used salient monetary rewards in a controlled economic environment so that students, whose payoffs depended on the decisions made in the tasks, were induced to reveal their true preferences.

We applied the Ten Item Personality Inventory proposed by Gosling et al. (2003) to measure subjects' Big Five Traits. We used the Bomb Risk Elicitation Task (BRET) of Crosetto and Filippin (2013) to infer individual risk attitudes and the Multiple Price List (MPL) method for the elicitation of individual time preferences.

3.1 Experimental tasks and questionnaire

3.1.1 Personality traits.

The Ten Item Personality Inventory. The Ten Item Personality Inventory is a short questionnaire that comprises ten items, each one structured in a pair of adjectives and representing one pole of the Five Factor model dimensions. For each item respondents report a self-evaluation on a 7-point Likert scale (from 1 "strongly disagree" to 7 "strongly agree"). The simplified structure with only two items as descriptors for each Big Five domain determines a reduced internal validity, however the test-retest correlations for the TIPI reliability are substantial (see Gonsling et al. 2013). The TIPI is a flexible and valid instrument for multiple phased experiments as it requires about one minute to complete.

3.1.2 Risk attitudes.

The Bomb Risk Elicitation Task. The dynamic version of the Bomb Risk Elicitation Task (BRET) is a computerized game in which participants are asked to choose how many boxes to collect from a grid of 50x50 cells, i.e. k*=[0,100]. When the process starts one box is collected at each second by following a pre-ordered sequence. Subjects are informed that each collected box values €X, but a time bomb that would reset the monetary amount gained during the process is hidden in one of the boxes of the grid with equal probability. In order to avoid any truncation of the data, the position of the time bomb is not reveled until the experiment is concluded. Therefore, subjects face a sequence of binary choices between two lotteries in which they are asked to decide whether they prefer to retain the number of boxes collected by stopping the process or collect an additional box and increase the risk to reduce the credit to zero. Since safe options are not allowed in the choice set (the only safe options provide with certainty zero gains, i.e. k=0 and k=100), the measure of risk aversion is not conditioned by certainty effects (Crosetto and Filippin, 2013). Assuming a constant relative risk aversion (CRRA) utility function, the optimal choice for a risk-neutral subject would be to set the stop choice at the 50th box.

A comparable computerized task is the Balloon Analogue Risk Task (BART) of Lejuez et al. (2002), in which subjects see on the computer screen a series of 90 uninflated balloons. For each balloon they are asked to choose the number of inflating pumps, given that any additional pump returns a monetary value of €X, but if the balloon explodes the provisional gain will be reset to zero and a new balloon will be displayed on the screen. Subjects do not receive any information on the amount of provisional reserve accumulated at each pump. If they stop the pumping process before the point of explosion, the monetary amount is stored in a permanent bank and the computer generates a new balloon on the screen. The balloons have three different colors and each balloon color is programmed to pop with a fixed probability; participants are not informed that different colors correspond to pre-determined

probabilities of the explosion. Similar to the BRET, any additional increment of units (pumps) in the BART implies an increasing risk for the decision-maker, providing a context in which actual risky behavior can be examined (Lejuez et al., 2002). However, the BRET has the advantage of a shorter duration than the BART, since the latter requires a pattern of multiple trials to be implemented (Charness et al, 2013).

A very popular instrument used by researchers is a version of the multiple price list (MPL) choice method proposed by Holt and Laury (2002). The MPL is an ordered set of choices between two lotteries. In the Holt and Laury version (HL), participants are presented with a set of ten paired choices labeled A or B. In both options, the monetary payoffs associated with the possible outcomes are kept constant. The value difference between the outcomes of the lottery is lower in Option A than in Option B, while the probability distributions of the lotteries vary following an identical ordered scale (from the probabilities [p=1/10, 1-p=9/10] of the first row to the probabilities [p=10/10, 1-p=0/10] of the last row). The expected values of both lotteries increase from the previous to the subsequent row, so that the initial difference in expected values between the options progressively reduces and becomes negative after the fourth row. Therefore, an agent switches from lottery A to lottery B when the expected payoff of lottery B increases enough to make this risky choice more attractive than the alternative lottery A, giving a measure of individual risk aversion. The HL has obtained high popularity and arguments in favor of its implementation are that is simple and context-free (Andersen et al. 2008). A related issue is the possibility of multiple switch points: posit that agents have well-behaved preferences if a subject reverses her preferences switching from lottery A to lottery B and then returns back to Option A, her choices are inconsistent. However, Andersen (2004) argues that multiple switch points could be the result of the subject being indifferent between the options; Holt and Laury (2002) consider the total number of “Option A” choices as an indicator of risk aversion. Crosetto and Filippin (2013) tested the BRET to a large sample of undergraduate students and provided evidence that their method is less complex than the HL. In particular, the percentage of irrational choices in the BRET was lower than the percentage of inconsistent choices in the HL task (0.74% and 17.04%, respectively). In addition, participants in their study were asked to evaluate the perceived difficulty of the BRET and reported on average a low degree of complexity.

Alternative methods of elicitation are based on the assessment of the certain equivalent of a lottery. In the Becker–DeGroot–Marschak (BDM) method (Becker et al., 1964) subjects are asked to indicate the price at which they would be willing to sell (or to buy) a lottery and are informed that they will sell (buy) the lottery or play it out depending on a buying (selling) price randomly selected from a certain range. If the buying price is equal to or larger than the selling (buying) price, the lottery will be sold (bought) at that price. Otherwise, the lottery will be played out. The mechanism of payment behind the task may be misunderstood (Andersen, 2004) and the certain equivalent depends on whether a subject is asked to state a selling price or a buying price. Anderhub et al. (2001) proposed a BDM

version in two different treatments - subjects stated a minimal selling price or a maximal selling price for a lottery- and found that "*subjects' willingness to accept is on average significantly higher than their willingness to pay*".

3.1.3 Time preferences.

The Multiple Price List method of elicitation. The MPL Task is a simple and popular method to measure time preferences. The use of the MPL format to elicit individual discount behavior was introduced by Coler and Williams (1999, see Andersen et al., 2006). In the MPL Task subjects display a Decision Table of paired options and, for each decision row, indicate their preference between a sooner payment at time t (Option A) and a later payment at time t+k (Option B). The decision rows are ordered so that the difference in monetary amounts between the options increases as one moves down the list, that is an increasing interest rate is applied. The switching point from Option A to Option B permits to detect a subject's discount rate interval. One decision row typically is randomly selected and the subject is paid according to her preferences in that row.

Andreoni and Sprenger (2012a) proposed the convex time budget (CTB) as an alternative method to the MPL Task that accounts for interior solutions to the utility maximization problem. In the CTB subjects display a list of decision rows as in the MPL Task, but for each decision row they are provided with 100 tokens to allocate between a sooner option and a later option. Each token converts to a monetary value, that is fixed for the tokens allocated to the later option and decreases going down through the list for the tokens allocated to the sooner option, in order that at each decision row there is an increment in the interest rate. Since empirical studies found high average discount rates under the strong assumption of linear utility (individuals are assumed to be risk neutral), Andreoni and Sprenger argued that the CTB method permits to account for the concavity of the utility function and provides at the same time a single instrument to measure temporal discounting; therefore, they presented the CTB as an alternative method to the "Double Multiple Price List approach" proposed by Andersen et al. (2008). In their research, Andersen et al. (2008) used the MPL method for the elicitation of both risk attitudes and time preferences. In particular, they applied an MPL Task based on Holt and Laury (2002) to obtain a measure of individual risk aversion and correct the estimation biases (see Andreoni and Sprenger, 2012b). Comparing these different methods of elicitation with the MPL task, we argue that the research object of our experiment is the predictive value of personality traits, thus more than the absolute levels of subjects' time discounting we investigate the relative differences in the individual level of impatience. In addition, the CTB method appears more complex than the MPL Task, since subjects have to decide how to split a budget of tokens between two options. Previous findings reported relevant percentages of corner solutions, specifically of .40 (Andreoni and Sprenger, 2012a) and .81 (Andreoni and Sprenger, 2012b). Of course, the Multiple Price List method applied for

the inference of time preferences does not exclude the possibility of inconsistent choices. A possible solution is to constrain subjects to make a single choice, that is to indicate only the point of switch between the options. However, this solution does not solve the problem to distinguish between multiple switching behavior due to indifference between the options proposed and other reasons (oversights, misunderstanding of the task instructions). Therefore, a more reasonable solution would be to allow an explicit "Indifference" option (see Andersen et al., 2006). Another possible limitation to be considered when the MPL method is implemented is that the structure of the task might induce subjects to choose as switch point the middle row of the table, irrespective of their true preferences, i.e. the occurrence of *framing effects* (see Andersen et al., 2006). A third potential limitation of the MPL frame is that allows to infer only interval estimates of subjects' discount rates, rather than point estimates. In order to obtain more precise estimates, it is possible to apply an iterative system to the MPL method. In the iMPL subjects are asked to state their preference between outcome options at different time points, but the switching row from the sooner to the later in time option is used to refine a new set of choices between options within the selected interval. The iterative process continues until a certain threshold (see Andersen et al. 2006). However, the main objective of our experiment it to compare time preferences (and risk preferences) for different personality traits to investigate whether the Five Factor Model may be predictive of economic choices. Therefore, an iterative system that increments the precision of the estimates at the cost of more time spending respect to the effort required in the no-iterative MPL method, does not appear desirable for this research framework.

3.2 Order effects

In our experiment we accounted for potential order effects that may confound the results. Following the definition by Harrison et al. (2005), "*an order effect occurs when prior experience with one task affects behavior in a subsequent task*". It is a common practice in economic research to include in the experimental design different treatments to control for "task effects" and avoid potential misspecification of the phenomena being object of study.

Order effects have been observed to influence economic preferences, especially when a sequence of similar tasks was implemented. For instance, in their seminal study Holt and Laury (2002) implemented a set of binary choices between lotteries by using a multiple price list format to infer subjects' risk attitudes. They found evidence that subjects are generally risk averse and become significantly more risk averse when the lotteries involve prizes scaled up x20 or more respect to the baseline condition of low (x1) prizes, but that this difference turns out to be insignificant in case of hypothetical stakes. Since the real and higher payoffs frame was always subsequent to the low and real payoffs frame, Harrison et al. (2005) demonstrated that the magnitude of these scale effects was increased by order effects (see also Holt and Laury, 2005).

Varying an ordered sequence of risk elicitation tasks with different prizes or time preference tasks with different time horizons may determine changes in the elicited subjects' economic preferences when the experimenter applies a multiple price list method. In an empirical study on the elicitation of risk and time preferences using MPL formats, Andersen et al. (2006) found order effects due to the variation in the sequence of tasks. In particular, for randomized sequences of four risk elicitations tasks with different stakes, subjects exhibited a higher CRRA coefficient on average in the last task respect to the first task. In addition, for randomized sequences of three time preference tasks with different time horizons, subjects showed an increment in the discount rates in the second task respect to the first task. Similarly, Andersen et al. (2014) found that increasing time horizons induced a decrease in the discount rates.

Several psychological factors may be involved in the observed changes in individual economic preferences. For instance, Kowal and Faulkner (2016) used a binary choice setting to elicit time preferences and found that the introduction of an asymmetrically dominated decoy as third delayed option decreased individual discount rates. Order effects mediated the influence of the dominated decoy on subjects' economic preferences. Specifically, the "decoy effects" were significant when the binary choice set was subsequent to the trinary choice set, whereas not significant when the order of choice sets was reversed.

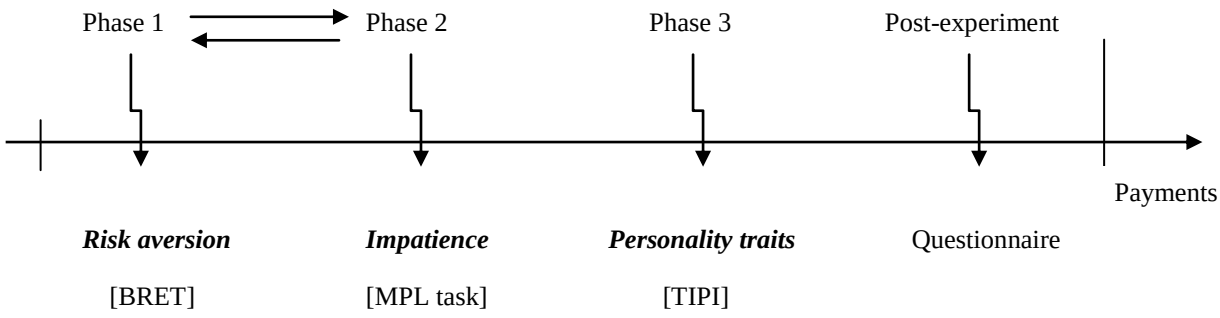
In our experiment, we distinguished between two treatments to control for potential order effects: Treatment 1 ("BRET/TIME"), in which the BRET is administered prior to the Intertemporal choice (or Time) task, and Treatment 2 ("TIME/BRET"), in which the order of the experimental tasks was inverted. Moreover, the collected data on personality traits allow us to explore the psychological factors that are implied in subjects' decision-making, including behavioral responses due to a certain sequence of tasks.

3.3 Subject pool and experimental procedures

An experimental session was organized in three phases (Figure 1): in the first and second phase, the experimental tasks were implemented; in the third phase, participants filled out the TIPI. Finally, a post-experiment questionnaire containing additional information on gender and age of participants, and parents' level of education was administered. Written instructions were provided at each phase and read aloud by the experimenter to facilitate their comprehension. After the third phase was completed, one of the tasks was randomly selected and subjects were paid in cash according to their preferences. If the BRET was drawn, subjects who did not collect the bomb were paid immediately after the end of the session. In the Intertemporal choice task case, for each participant one of the decision rows was randomly selected and they were paid according to the preferred Option in that

row. They received a certificate with indications about the date and place of payment signed by one experimenter as a guarantee of the commitment. In order to minimize the transaction costs, the payments always occurred during the lesson weeks. [1]

Figure 1: Scheme of a session.



In the Bomb risk elicitation task, participants observe a 50x50 grid of grey boxes. They are informed that at each second the computer blackens one box in random order and each blackened box values €0.30. However, the computer has positioned a bomb behind one of the boxes with equal probability and if the box containing the bomb is blackened, all the potential gains will be destroyed. During the process, the computer displays the number of boxes blackened and the related potential gains updated at each second, but no information is provided about if the bomb has been collected to avoid a potential truncation of the data. The blackening process continues until the subject decides to stop it. Participants are asked to choose how many boxes they want to blacken, given that higher potential gains are associated with a greater probability to collect the bomb.

In the Intertemporal choice task, a Decision Table with 20 rows of paired options is displayed to the participants. For each decision row, the subject is asked to indicate whether she prefers Option A, which pays a sum of money tomorrow decreasing from €20 of the first row to €14.30 of the last row, or Option B, which pays €20 in 4 weeks from tomorrow. We introduced a front-end delay of one day to control for the bias toward the immediate payoffs and to avoid differences in the transaction costs between the two options (e.g. Anderson and Stafford, 2009; Ferecatu and Önçüler, 2016). The difference in payoffs between the two options increases as the subject moves down through the list and the switch point from the sooner to the later option provides a measure of the individual level of Impatience.

The experiment took place in the Department of Economics Laboratory at the University of Messina, in October 2017. We recruited a sample of 248 students, most of them enrolled in an undergraduate

[1] The original istructions of the experimental tasks are reported in Appendix A.

program in economics or business management at the University of Messina, as volunteers in a socio-economic experiment. The experiment was computerized using the experimental software Z-Tree (Fischbacher, 2007). For each experimental session, we administered either the BRET/TIME or the TIME/BRET Treatment to the participants. In particular, we conducted a total of 16 experimental sessions distributed in 7 “BRET/TIME” sessions and 9 “TIME /BRET” sessions, respectively. Each session lasted around fifty minutes and the average payoff was EUR 9.16, with a minimum earning of EUR 0 and a maximum earning of EUR 22.80.

4. Results

In order to measure the Big Five traits, we recoded the reversal-scored items to the reference Likert scale and averaged the scores of the two items relative to each domain (Gosling et al., 2003).

A Spearman’s correlation analysis of the TIPI items is reported in Table 1. For each Big Five factor, we generally observed low to moderate internal inter-item correlations, with ρ coefficients ranging from .18 for the items relative to the Agreeableness scale to .39 for the items composing the Extraversion scale. Some correlations between items referring to different factors are stronger in magnitude compared to the correlations between paired items of the same factor. Specifically, the "*critical, quarrelsome*" item of the Agreeableness scale is more correlated with the items "*disorganized, careless*" (ρ=.23) of the Conscientiousness scale and "*calm, emotionally stable*" (ρ=-.24) of the Emotional stability scale than with its paired item "*sympathetic, warm*" (ρ=.18). Analogously, the correlation is stronger in magnitude between the "*dependable, self-disciplined*" item of the Conscientiousness scale and the items "*sympathetic, warm*" of the Agreeableness scale (ρ=.31) and “*calm, emotionally stable*" (ρ=.35) of the Emotionally stable scale than with its reversed statement "*disorganized, careless*" (ρ=.29). The "*open to new experiences, complex*" item of the Openness to experience scale is more correlated with the "*extraverted, enthusiastic*" item of the Extraversion scale (ρ=.27) than with its reversed statement "*conventional, uncreative*" (ρ=.20). We used the Cronbach’s alpha statistics as an index of internal consistency of the scales and obtained low estimates. We found that internal consistency is lower respect to Gosling et al. (2013) and other studies on the TIPI (see Romero et al., 2012). The Cronbach’s alphas are .56, .32, .14, .52, and .33 for the Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to experience scales, respectively. These results are not surprising, since the TIPI was designed to be easy to implement, brief questionnaire for the measurement of the Big Five dimensions of personality. Its simplified structure of two items for each hierarchical dimension of personality provides the experimenter with a flexible instrument at the cost of a reduction in terms of internal efficiency (Gosling et al., 2003).

We evaluated the Spearman's rank correlations between Big Five domains (Table 2) and observed significant and low in magnitude relationships between the traits of Extraversion and Openness to experience (ρ=.31), Agreeableness and Conscientiousness (ρ=.25), and Conscientiousness and Emotional stability (ρ=.26).[2] The correlations between different aspects of personality are consistent with the theoretical definition of each trait within the Five Factor Model framework. Extraverted individuals experience positive emotionality (i.e. are enthusiastic, energetic) and are gregarious in social interactions. These aspects conceptually correlate with the interest for novel experiences and the intellectual curiosity that characterize the Openness to new experiences dimension. The trait of Conscientiousness describes the degree of self-discipline and dutifulness of a person. We can argue that Agreeableness, i.e. the tendency to be warm, altruistic, modest, and sympathetic, correlates positively with Conscientiousness as agreeable individuals tend to be compliant in order to avoid social conflicts. Neurotic individuals are described as subjects who tend to experience negative emotions such as distress and anxiety. Emotionally stable individuals are expected to be more likely than neurotic individuals to be self-disciplined and organized in order to attain their objectives.

Table 3 reports, for each treatment, the summary statistics of the main variables of the dataset. We measured individual risk attitudes as the stopping point of the blackening process of the boxes in the BRET ("Risk choice") and the level of individual impatience as the switch point from the sooner-in-time Option A to the later-in-time Option B in the Intertemporal choice task ("Impatience"). We labelled as decision errors and dropped 45 observations from the Intertemporal choice task, since these subjects exhibited an inconsistent behaviour, switching from Option A to Option B at a certain row and then reversing their preferences. We cannot exclude that the multiple-switching behaviour may reflect subjects` indifference between the proposed options, but we argue that a cautious approach. After a "multiple-switcher" subject confirmed his decisions in the task, he displayed an alert message informing him that at same point of the Table he had reversed his preferences and was therefore asked whether he wanted to modify his choices. The opportunity of confirming the decision limits the possibility of inconsistent choices due to simple careless mistakes. On the contrary, it is not possible to distinguish between subjects who exhibited reversal preferences because they were indifferent between the options, from those who did not sufficiently understand the decision task. Crosetto and Filippin (2013) considered implausible the decisions to stop at k=0, k=1, and k=100 collected boxes in the BRET. However, we did not observe any inconsistent choice in our experiment, thus we did not exclude any estimate of Risk choice from the sample. We found significant gender differences both in risk attitudes and time preferences. In particular, a two-sample Wilcoxon rank-sum (Mann-Whitney) test rejected the null hypothesis that women and men do not significantly differ in Risk aversion (p-value= .000) and Impatience (p-value= .037).

[2] Appendix B reports the Spearman's correlations between Big Five traits by treatment. The results are similar to the pooled sample, with the exception of the relationship between Extraversion and Openness to new experiences, which is stronger in magnitude in the BRET/TIME Treatment (.42) relative to the TIME/BRET Treatment (.20).

We analysed whether the order of the experimental tasks influences subjects´ economic preferences. Figures 2 and 3 show the Kernel density distributions of the stopping point in the BRET and the switch point in the Intertemporal choice task by treatment, respectively. The density features of the switch points in the BRET/TIME Treatment are more concentrated on the right side of the distribution respect to the TIME/BRET Treatment, meaning that less subjects are likely to prefer the delayed Option at each switch point compared to the distribution of choices in the TIME/BRET Treatment. The last column of Table 3 reports for each variable a Mann-Witney test of equality in distribution between treatments. The null hypothesis that Risk choice in the BRET is equal between the treatments could not be rejected (P>|t|=.297). Instead, we found a significant difference in distribution for levels of Impatience in the Intertemporal choice task (P>|t|=.010). An OLS regression of the level of Impatience on the order of the tasks confirms that when the Intertemporal choice task is administered prior to the BRET subjects tend to be less impatient, switching from Option A to Option B two rows down respect to the BRET-TIME Treatment (P>|t|=.010). Since participants were not informed about the results of the Risk elicitation task before the Intertemporal choice task was implemented to avoid providing any reference point (wealth effects) and the experimental tasks were independent to each other, these findings are consistent with a behavioural rather than rational response of the subjects to the order of the tasks.

The kernel density distributions of the scores for each Big Five trait are reported in Appendix B. There are not significant differences in distribution across treatments. These results are supported by a battery of two-sample Wilcoxon rank-sum (Mann-Whitney) tests (last column of Table 3).

4.1 Order effects

We investigated whether differences in personality traits may explain how the order of the tasks conditions individual discount rates. For each Big Five domain we split subjects' scores in quartiles and organized the data in two categories: "*low scores*", corresponding to the values included in the 1st and 2nd quartiles, and "*high scores*", corresponding to the values included in the 3rd and 4th quartiles. We argue that the strategy of clustering individual scores is preferable since factor values have high variability in literature, that can reflect higher measurement errors in the estimates and reduced statistical significance. Our exploratory study focuses on personality categories to understand whether the influence of the order of the tasks on individual time preferences varies when different levels of personality traits relative to the population distribution of the scores are considered.

For our analysis we used an Ordinary Least Square (OLS) estimator with robust standard errors. The first column of Table 4 reports a set of univariate regressions of Impatience on the order of the tasks ('dtreatment' is a dummy variable which is equal to 1 if the treatment is "TIME-BRET") conditional

to the level of a personality trait[3]. The results suggest a tendency of individuals scoring lower on a Big Five trait respect to the population distribution, to be subject to order effects. In particular, the relationship is significant for those individuals who are less open to new experiences, less conscientious, less extraverted, and less agreeable, and is not significant at .05 level for lower scores on Emotional stability (P>|t|=.062).[4] Subjects who are closer to the low pole of the Big Five domains, i.e. are less prone to novelty and intellectually curious, less self-disciplined, less tender minded, more introverted, and more anxious, tend to be particularly affected by negative emotional responses when they are exposed to a sequence of choices under risk, becoming more impulsive when they are asked to compare a safe monetary option in the near future with a higher amount of money, but at the cost of an additional fixed delay.

We analyzed how personality traits mediate order effects when gender differences are considered. For this purpose, we counted for possible differences in the gender distribution of the factor scores and computed the quartiles for females and males separately.[5] The findings support the hypothesis that gender effects mediate the influence of the order of tasks on individuals' intertemporal choices (Table 4, columns 2 and 3)[6]. Specifically, women whose scores in the traits of Openness, Conscientiousness, and Agreeableness are ordered up to the second quartile of the distribution appear more affected by the sequence of tasks than women ranked above the median of the scores. Analogously, less extraverted men are more conditioned by order effects than men who score higher on this trait. The relationship is not significant at .05 level (P>|t|=.080) for the male "low score" subgroup of Agreeableness. Higher levels of Neuroticism are a less efficient predictor of order effects: the relationship between Impatience and dtreatment is significant at .10 level both for women (P>|t|=.080) and men (P>|t|=.053). These results suggest that Big Five traits are a stronger predictor among women of the increment in the level of Impatience following a risk elicitation task respect to men.

[3] As a proxy for family income, we asked students to report the highest level of education attained by parents. We used two measures of education: a categorical variable of the father's (mother's) highest level of education and an education dummy which takes value 1 if the father (mother) has at least a high school diploma. We regressed Impatience on the level of education (categorical variable or education dummy) allowing for robust standard errors and we did not find any significant marginal effect. In addition, a battery of mean-comparison tests failed to reject the null hypothesis of a significant mean difference in distribution between the treatments. Analogously, we regressed Impatience as a linear function of students' age and we did not find any significant relationship. In addition, a t-test on the equality of means did not detect any significant difference between the mean age in the BRET/TIME Treatment respect to the TIME/BRET Treatment. Therefore, we did not include these measures as control variables in the regressions.

[4] We replicated the regression analysis by dropping from the sample the observations relative to subjects who reported inconsistent choices in the MPL task to control for disturbing factors due to a possible lack of attention when they filled out the personality questionnaire. However, we obtained similar estimates.

[5] A battery of t-tests on the equality of mean indicated that the gender distribution was not balanced across all the levels of Big Five traits. In particular, in the "low scores" subgroups of Openness, Conscientiousness, Agreeableness, and Emotional Stability the percentage of men was significantly higher than women.

[6] Regressions including an interaction effect of a personality trait and the gender dummy return similar marginal effects and are omitted.

4.2 Relationship between Big Five traits and economic preferences

We implemented a Spearman's correlation analysis of the relationship between Big Five traits and our experimental measures of risk attitudes and time preferences. Table 5 illustrates the raw correlations including also treatment and gender conditions. We did not detect any clear tendency of significant relationships between Big Five traits and the measures of Risk aversion and Impatience.

4.3 Relationship between Risk aversion and Impatience

The rank correlation between Risk attitudes and Impatience is not significant in our experiment (Table 6).

We tested the hypothesis that "high scores" on personality traits mediate the relationship by conditioning the Spearman´s correlation analysis to the level of each trait. Since subjects who score below or at the median of the distribution of a Big Five domain are more likely to exhibit a behavioral response to the order of the tasks, we hypothesize that this statistical distortion can explain why we do not find any significant correlation between the measures of risk aversion and time preferences. Therefore, we expect to find a significant relationship when the analysis is restricted to higher scores on the personality traits, while to find no significant correlations for lower scores. Results are summarized in Table 7. We did not find support to our hypothesis, in particular the correlation between Risk aversion and Impatience is not statistically significant for either "low scores" or "high scores" of each trait.

5. Robustness checks

A total of 45 subjects reported an inconsistent behavior in the Intertemporal choice task. Our results are in line with previous literature using the MPL method to elicit time preferences and the percentage of inconsistent choices is not statistically different across treatments, as results from a two-sample test of proportions. When we looked at the gender composition of choices, we rejected the null hypothesis of equality in proportion between women and men (p=.032). In detail, women exhibit a higher percentage of inconsistent behavior (27 women exhibit inconsistent choices) respect to men.

For each Big Five trait, we investigated whether the percentage of inconsistent choices in the "low scores" category of subjects ranked up to the median of the population distribution of the scores, was significantly higher than the percentage of inconsistent choices in the "high scores" sub-group. Are "inconsistent" subjects more likely to score lower on the Big Five traits? Table 3 in Appendix B illustrates the proportion of inconsistent and consistent choices respect to the total number of subjects

in the categories of “low scores” and “high scores” of each personality trait. Overall, we can see that the percentage of inconsistent subjects looks similar between levels of the factor scores, except for the Agreeableness domain (21.6% subjects who scored lower on the trait of Agreeableness reported a multiple switching behavior compared to the 11.63% of “high scores” subjects). In a battery of two-sample tests of proportions, we could not reject the null hypothesis that the difference in percentage of inconsistent choices between the categorical groups was significantly different from zero. In the domain of Agreeableness only, the difference is not significant at .05 level (p=.052). We further investigated whether the proportion of inconsistent choices for different levels of the big five traits was driven by gender differences. We ran a battery of two-sample tests of proportions limited to the gender distribution of the personality scores and found that the difference in percentage of inconsistent subjects between “low scores” and “high scores” sub-groups of the Agreeableness trait is significant only among women (p=.004).

We did not detect any clear tendency of significant relationships between Big Five traits and the measures of Risk aversion and Impatience. Since we found the order of experimental tasks significantly conditioned subjects’ intertemporal preferences for “low scores” of Big Five traits, we restricted the analysis to those subjects whose economic behavior was not altered by order effects, i.e. subjects whose personality scores were ranked upper the median of the distribution. We implemented a battery of Spearman’s rank correlations between “high scores” of personality traits and the measures of Impatience and Risk aversion. In order to categorize the factor scores accounting for gender differences in the distribution, we computed the quartiles within the female and the male gender group separately. The results suggest that high scores on personality traits are not predictive of subjects´ economic preferences (see Table 4 in Appendix B).

5.1 A model averaging approach

We implemented a battery of univariate regressions to investigate how the treatment dummy relates to the measure of impatience when different levels of a personality trait indicator are considered. A potential limitation of using this approach is based on the argument that the personality traits indicators are likely to be correlated, hence the reported estimates may reflect spurious correlations. A possible solution for this issue is to apply a multiple regression model which includes the personality traits indicators and allows for possible interaction effects with the treatment dummy. We considered the suggestion of a referee that the multivariate specification may lead to inflated standard errors due to the correlation among the personality traits indicators and the small sample size, therefore that the uncertainty in model selection could be addressed by adopting a model averaging approach to economic modeling.

In the standard econometric analysis, a model specification is implemented among the set of possible candidate models and the property of an additional explanatory variable, which is supposed to improve the estimate of a focus explanatory variable in the given model, is tested against a reference threshold for a certain significance level. The diagnostic test returns a pretest estimator that solves the choice between a "restricted" model (without the control variable) and an "unrestricted" model (which includes the control variable) and provides an interpretation of the estimates on the parameters of interest conditional to the selected model. Thus, this estimation process does not take into account the uncertainty relative to the selection of the empirical model and returns indeed conditional estimates (Magnus et al., 2010). The uncertainty about the choice of the covariates that arises in a linear regression model can be described in terms of a trade-off between bias and precision: when an additional explanatory variable is excluded from the model, the estimator of the parameter on the variable of interest can be more precise respect to the unrestricted estimator, but also subject to omitted variable bias (De Luca and Magnus, 2011). Model averaging techniques incorporate jointly the uncertainty due to both model selection and estimation procedure by providing an unconditional estimate of the parameters of interests calculated as a weighted average of the parameter estimates conditional on each candidate model of the model space (De Luca and Magnus, 2011).

The statistical framework (described, among others, by Magnus et al., 2010) is a linear regression model of the form:

$$y = X_1\beta_1 + X_2\beta_2 + \varepsilon = X\beta + \varepsilon, \qquad \varepsilon \sim N(0, \sigma^2),$$

where y (n × 1) is the vector of observations, X_1 (n × k_1) and X_2 (n × k_2) are matrices of nonrandom regressors, ε is a random vector of unobservable disturbances, and β_1 and β_2 are vectors of unknowns parameters. The model satisfies the assumptions that $k_1 \geq 1, k_2 \geq 0, k := k_1 + k_2 \leq n - 1$ and the design matrix X is a full column-rank. The explanatory variables in the X_1 matrix are always included in the model because of research objectives, while the X_2 matrix contains explanatory variables whose inclusion in the model is less certain. The k_1 columns of the X_1 matrix are called *focus* regressors and the k_2 columns of the X_2 matrix are called *auxiliary* regressors. Therefore, the set of candidate models is $I = 2^{k_2}$.

We implemented two model averaging techniques that are based on a Bayesian approach: the Bayesian model averaging (BMA) and the Weighted-average least squares (WALS).

In the BMA estimation method proposed by Magnus et al. (2010) and De Luca and Magnus (2011), the posterior distribution of parameters is calculated for all possible models conditional on the dependent variable and the model of interest, after the definition of prior beliefs about the parameters through a likelihood function. Then, the full posterior distribution of the parameters across the set of possible models is calculated as the sum of each conditional posterior distribution of the parameters

weighted by the corresponding posterior probability of the candidate model. Given $\widehat{\beta_{1i}}$ and $\widehat{\beta_{2i}}$ the conditional estimates of the parameters for the i-th model, the unconditional BMA estimates are

$$\widehat{\beta_1} = E(\beta_1|y) = \sum_{i=1}^{I} \lambda_i \widehat{\beta_{1i}}, \qquad \widehat{\beta_2} = E(\beta_2|y) = \sum_{i=1}^{I} \lambda_i T_i \widehat{\beta_{2i}},$$

where T_i is a k_2 x k_{2i} matrix that sets to zero the variables that are excluded from the i-th model and λ_i the non-zero weight for the ith model, under the condition that the model weights sum up to one.

Therefore, the BMA framework requires the definition of prior beliefs about the parameter distributions and is subject to the computational burden given by the dimension of the model space (Moral-Benito, 2015).

The WALS method introduced by Magnus et al. (2010) is "*a Bayesian combination of frequentist estimators"* (Magnus and De Luca, 2016). First, an orthogonalization of the columns of the X_2 matrix is implemented in order to obtain restricted OLS estimators of the parameters of interest and define, under some regularity conditions about the model weights, the WALS estimators. Second, a neutral Laplace prior that accounts for the ignorance about the sign of the auxiliary parameters and whether the inclusion of auxiliary regressors improves the property of the estimated focus parameters is used by Magnus et al. (2010) to implement the optimal WALS estimators in a mean squared error sense. Contrary to the BMA method in which the computational burden exponentially increases with the number of auxiliary regressors, the computational burden of the WALS estimator is of the order k_2. In addition, the use of a neutral prior "*attempts to capture the vague notion of ignorance in an explicit and applicable form*" (Magnus and De Luca, 2016).

In our study, we defined the focus regressors that are the primary object of the empirical research and a set of auxiliary regressors that are included as control variables to improve the estimation of the focus regressors. We implemented two model averaging specifications, Model 1 and Model 2: Model 1 contains six focus regressors, namely the treatment dummy and the personality traits indicators, and five auxiliary regressors, in order to capture the interactions between the treatment dummy and the personality traits indicators. Model 2 analyzes potential gender effects and adds the gender dummy to the set of focus regressors. Then, interaction terms of the gender dummy with the treatment dummy and the big five traits indicators and two variables for the parents' level of education (proxies of the socio-economic status) are included in the matrix of auxiliary regressors. We performed two sets of OLS regressions corrected for robust standard errors, a restricted model that contains only focus explanatory variables and an unrestricted model that includes both focus and auxiliary regressors. We compared the estimation results of the OLS regressions with the estimates from the two model averaging techniques, BMA and WALS. The tables are reported in Appendix B.

The first column of Table 4 shows the OLS estimates for the restricted Model 1 including only the focus explanatory variables. The order of the experimental tasks is significantly correlated with the level of impatience (|t|>2.60). On average, when the Time task precedes the Bomb risk elicitation task the participants switch from Option A to Option B two rows up respect to the alternative treatment. The Big Five traits are not significant predictors of Impatience. The coefficients for Openness, Conscientiousness, and Extraversion, whose signs respect the hypothetical predictions, approach the marginal 0.10 alpha level. Column 2 illustrates the OLS estimates for the unrestricted Model 1. We can see that the magnitude of the robust standard errors is considerably increased respect to the corresponding restricted model and the coefficients for the interaction terms are not statistically significant, which suggests that the estimates are conditioned by multicollinearity. The standard errors of the model averaging estimates reported in columns 3 and 4 are lower in magnitude respect to the OLS estimates and the reduction is more relevant in BMA than in WALS. The estimated coefficients are higher in absolute value for WALS than for BMA, but lower relative to the OLS estimates. In both cases, the results support the statement that the interaction terms are not robust auxiliary regressors. In fact, the t-ratios associated with the coefficients are lower than one in absolute value and the corresponding two-standard error bands include the zero value. In addition, the posterior inclusion probabilities reported in BMA (i.e. the posterior probability that a variable is included in the model) are below the threshold of 0.5, which roughly corresponds to a t-value equal to one in absolute value, following the guidelines of De Luca and Magnus (2011) that report the suggestions of Raftery (1995) and Masanjala and Papageorgiou (2008).

Table 5 illustrates the estimation results for Model 2. The OLS estimates of the restricted model are reported in column 1. The gender dummy (which takes value one if female) and the TIME-BRET treatment are negatively associated with the level of impatience. In addition, the trait of Extraversion results a positive predictor (|t|= 2.05) of the outcome variable. Similarly to Model 1, when additional variables are included in the OLS regression analysis (column 2) the standard errors consistently increase respect to the restricted model. Consequently, the previous findings of significant relationships are not supported in this model specification. However, the trait of Openness is associated with lower levels of impatience for men under the BRET-TIME treatment. These results are compared with the BMA and the WALS estimates which are reported in columns 3 and 4. The magnitude of the standard errors lowers and the reduction is greater in BMA compared to WALS. None of the auxiliary regressors is robust in the BMA framework, as the posterior inclusion probabilities are lower than 0.20 and the t-ratios are consistently lower than one in absolute value. The estimates for WALS resembles the findings of BMA, excepts that the interactions terms of the gender dummy with the traits of Openness and Agreeableness are slightly higher than one in absolute value.

We extended our robustness check to the analysis of the correlation between risk propensity and Big Five traits, accounting for possible order effects. The only difference respect to the previous analysis is that now the outcome variable of interest is risk propensity. The implementation of Model 1 does not lead to interestingly results for all the specifications and methods of estimation. In Model 2, the magnitude of the standard errors slightly decreases when the model averaging techniques are applied. The OLS multivariate regression for the unrestricted model specification reports that a one-unit increase in the trait of Extraversion is associated with a decrease of risk propensity conditional to the TIME-BRET treatment for men, while the opposite effect is found for the trait of Emotional stability. These results are supported by the WALS estimates, but not by BMA. None of the auxiliary regressors is robust with the BMA estimation method. Instead, the findings that the father's level of education is positively related to risk propensity and the coefficients for the interactions of the gender dummy with the traits of Extraversion (with negative sign) and Emotional stability (with positive sign) are statistically significant at the conventional level in the OLS estimates are supported by WALS. In particular, the order of importance of the auxiliary regressors when we consider the WALS t-ratios in absolute value is the interaction term of the gender dummy and Emotional stability (2.03), the interaction term of the gender dummy and Extraversion (1.93), and the father's level of education (1.60). In addition, the interactions of the treatment dummy with the traits of Agreeableness and Emotional stability report WALS t-ratios slightly higher than one in absolute value.

We performed BMA and WALS estimates to further analyze the relationship between risk aversion and impatience. In this case, our dependent variable of interest is the measure of risk propensity and the level of impatience is a focus explanatory variable. We firstly included the personality traits indicators among the auxiliary covariates and performed a OLS multivariate regression of risk propensity on both the focus and auxiliary variables and compared the results with the BMA and WALS parameter estimates. We did not observe a significant relationship between the economic preferences and the auxiliary regressors appear to not be robust for all the specifications. A modest result is that the WALS parameter estimate of the auxiliary variable Agreeableness reports a t-ratio of 1.20 in absolute value. Then, we included the gender dummy and the parents' level of education among the auxiliary regressors. If we consider the OLS regression analysis, women appear to be more risk averse than men and this result is supported by the robustness of both the BMA ($|t|=2.68$ and pip= 0.95) and WALS parameter estimates ($|t|=2.67$). In dept, the stopping point of the blackening process in the risk-preference elicitation task is around eight boxes for BMA estimation and six boxes for WALS estimation ahead than men. The WALS estimates of the auxiliary regressors for the variables Emotional stability ($|t|=1.24$) and father's level of education ($|t|=1.13$), with negative and positive sign respectively, have t-ratios that exceed one in absolute value, while an analogous result is not found for the BMA estimates.

5.2 Multiple imputation

In our experiment 45 participants did not exhibit a clear pattern of behavior useful to identify a measure of the level of impatience. In order to address the issue we applied the conventional method of listwise deletion (or complete case analysis), in which the observations containing missing values are excluded from the model of interest.

However, the strategy of considering only complete cases is associated with two potential problems (Allison, 2001): first, the listwise deletion may ignore potentially useful information incorporated in the observations with missing values; second, if the data are missing at random the parameter estimates may be biased. The concept of missingness at random refers to the mechanisms that lead to missing data and is part of a classification structure theorized by Rubin (1976). Let consider the case of univariate missing data in which a single variable Y contains missing values and define X a vector of observed variables and M a missing-data indicator which takes value one if Y is missing. Following the definition provided by Allison (2001) and Little and Rubin (2014), the missing-data mechanism is said to be missing completely at random (MCAR) when the probability that the variable of interest is missing does not depend on the values of the complete data X neither on the values of the possibly missing values of Y. The missing at random (MAR) mechanism is less restrictive and requires that the probability that Y is missing does not depend on Y, once we control for X. Therefore, under the MAR condition missingness depends only on observed data. The mechanism is defined not missing at random (NMAR) if the MAR assumption is violated as missingness depends on the missing values in the variable Y.

Since in our study 18.15 percent of the sample has missing values on the variable Impatience, we considered whether the results would be sensitive to the imputation of the missing data. The imputation approach to missing data permits to estimate plausible values for the missing components of the variable of interest and implement the standard analysis on a complete dataset. In order to handle the missing data, we adopted a multiple imputation technique rather than a single imputation technique. Single imputations methods threat the imputed values as if they would represent with certainty the true values. In particular, they tend to underestimate variances and do not take into account the "uncertainty and sampling variability in the imputed values" (Allison 1999). The multiple imputation technique generates a vector of $M \geq 2$ plausible values for each missing value by introducing a random variation in the imputation process and obtains M complete datasets. Then, the standard analysis is implemented for each of the complete datasets and the results are averaged to obtain a single multiple-imputation result (Allison 1999 and Little and Rubin, 2014). The multiple imputation procedure assumes that the missing data satisfy the MAR condition.

We preliminary performed a logistic regression analysis of the missingness variable to account for any variables in the data that may predict missingness. We found that the gender dummy is

significantly correlated with missingness. A critical point is the imputation of Impatience as a dependent variable. Unless there exist auxiliary variables that are strongly correlated with the dependent variable, multiple imputations on the dependent variable is not recommended as adds unnecessary sampling variability (Allison, 2001). Since we did not detect good auxiliary regressors for the dependent variable, we inferred only the relationship between risk aversion and impatience. The imputation model is a linear regression of Impatience on a set of covariates (gender dummy, personality traits indicators, parents' level of education) and the dependent variable of the complete-data analysis (risk aversion). We considered M=20 the number of imputations. We performed a multiple regression model of risk aversion on impatience, the Big five traits, and the socio-demographic factors and a battery of univariate regressions of risk aversion on impatience conditional to the order of the tasks and gender. The results are not dissimilar from that obtained without imputing the missing values.

6. Discussion and conclusion

We elicited individual risk attitudes and time preferences in a sequence of experimental tasks in order to investigate whether and to what extent "Big Five" personality traits are predictive of individual economic behaviour. We randomized the order of the tasks to account for possible order effects. We found that the order of the tasks does not affect individual risky choices. On the contrary, when the Risk choice task is administered prior to the Intertemporal choice task order effects are detected, in the sense that individuals show a tendency to prefer more smaller but sooner rewards than greater but later in the future rewards than if they were under the other treatment. Differences in personality traits mediate the correlation, in particular subjects who are categorized at lower levels of a Big Five factor score are more affected by order effects than those who self-report higher scores of the same trait. Moreover, the magnitude of the relationship between treatment and Impatience is influenced by gender effects: especially women who score low on the domains of Agreeableness, Conscientiousness, and Openness to new experiences relative to the female distribution of the factor scores, and men who are less extraverted within the male gender group, are significantly more subject to order effects. The correlations are generally more predictive for the female "low score" subgroups and suggest a tendency for women with low personality scores to be particularly reactive to the emotional inputs of the risk elicitation task respect to men.

In a Spearman's correlation analysis we found that personality traits are not significantly correlated with the measures of risk aversion and impatience. We did not find any significant correlation between risk aversion and time preferences. In addition, personality traits do not moderate the relationship.

We consider some limitations to our study. Our experiment has been implemented on a sample of university students aged between 18 and 32. It is possible that the findings on the relationship between personality traits and economic preferences would change depending on the sample characteristics (level of education, age, wealth, ...). In addition, the Ten-Item-Personality-Inventory is a flexible and widely used instrument that provides a broader definition of personality traits by means of two items for each Big Five dimension, at the cost of lower inter-item correlations than longer personality questionnaires. Therefore, in our experiment we did not take into account the possibility of a significant relationship between facets of personality traits, i.e. narrow specifications of personality, and economic preferences (see Becker et al., 2012).

References

Abdellaoui, M., Bleichrodt, H., l'Haridon, O., & Paraschiv, C. (2013). Is there one unifying concept of utility? An experimental comparison of utility under risk and utility over time. *Management Science*, *59*(9), 2153-2169.

Allison, P. D. (1999). Missing data. Thousand Oaks, CA: Sage

Allison, P. D. (2001). Missing data (Vol. 136). Sage publications

Almlund, M., Duckworth, A. L., Heckman, J., & Kautz, T. (2011). Personality psychology and economics. In Handbook of the Economics of Education (Vol. 4, pp. 1-181). Elsevier.

Anderhub, V., Güth, W., Gneezy, U., & Sonsino, D. (2001). On the interaction of risk and time preferences: An experimental study. *German Economic Review*, *2*(3), 239-253.

Andersen, S. (2004). Eliciting Risk and Time Preferences Using Multiple Price List Formats. *Institute of Economics, University of Copenhagen*.

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2008). Eliciting risk and time preferences. *Econometrica*, *76*(3), 583-618.

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2006). Elicitation using multiple price list formats. *Experimental Economics*, *9*(4), 383-405.

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2014). Discounting behavior: A reconsideration. *European Economic Review*, *71*, 15-33.

Anderson, L. R., & Stafford, S. L. (2009). Individual decision-making experiments with risk and intertemporal choice. *Journal of Risk and Uncertainty*, *38*(1), 51-72.

Andreoni, J., & Sprenger, C. (2012a). Risk preferences are not time preferences. *American Economic Review*, *102*(7), 3357-76.

Andreoni, J., & Sprenger, C. (2012b). Estimating time preferences from convex budgets. *American Economic Review*, *102*(7), 3333-56.

Bartling, B., Fehr, E., Maréchal, M. A., & Schunk, D. (2009). Egalitarianism and competitiveness. *American Economic Review*, *99*(2), 93-98.

Becker, A., Deckers, T., Dohmen, T., Falk, A., & Kosse, F. (2012). The relationship between economic preferences and psychological personality measures. *Annu. Rev. Econ.*, *4*(1), 453-478.

Becker, G. M., DeGroot, M. H., & Marschak, J. (1964). Measuring utility by a single-response sequential method. *Behavioral science*, *9*(3), 226-232.

Bogg, T., & Roberts, B. W. (2004). Conscientiousness and health-related behaviors: a meta-analysis of the leading behavioral contributors to mortality. *Psychological bulletin*, *130*(6), 887.

Borghans, L., Duckworth, A. L., Heckman, J. J., & Ter Weel, B. (2008a). The economics and psychology of personality traits. Journal of human Resources, 43(4), 972-1059.

Charness, G., Gneezy, U., & Imas, A. (2013). Experimental methods: Eliciting risk preferences. *Journal of Economic Behavior & Organization*, *87*, 43-51.

Civai, C., Hawes, D. R., DeYoung, C. G., & Rustichini, A. (2016). Intelligence and extraversion in the neural evaluation of delayed rewards. *Journal of Research in Personality*, *61*, 99-108.

Corazzini, L., Filippin, A., & Vanin, P. (2015). Economic behavior under the influence of alcohol: an experiment on time preferences, risk-taking, and altruism. *PLoS one*, *10*(4), e0121530.

Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological assessment*, *4*(1), 5.

Crosetto, P., & Filippin, A. (2013). The "bomb" risk elicitation task. *Journal of Risk and Uncertainty*, *47*(1), 31-65.

Daly, M., Harmon, C. P., & Delaney, L. (2009). Psychological and biological foundations of time preference. *Journal of the European Economic Association*, *7*(2-3), 659-669.

Delaney, L., Harmon, C., & Wall, P. (2008). Behavioral economics and drinking behavior: preliminary results from an Irish college study. *Economic Inquiry*, *46*(1), 29-36.

De Luca, G. and Magnus, J.R. (2011). Bayesian model averaging and weighted average least squares: Equivariance, stability and numerical issues, Stata Journal, 11, 518{544.

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are risk aversion and impatience related to cognitive ability?. *American Economic Review*, *100*(3), 1238-60.

Eeckhoudt, L., Gollier, C., & Schlesinger, H. (2005). *Economic and financial decisions under risk*. Princeton University Press.

Ferecatu, A., & Önçüler, A. (2016). Heterogeneous risk and time preferences. *Journal of Risk and Uncertainty*, *53*(1), 1-28.

Ferguson, E., Heckman, J. J., & Corr, P. (2011). Personality and economics: Overview and proposed framework. Personality and Individual Differences, Volume 51, Issue 3

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental economics*, *10*(2), 171-178.

Frederick, S., Loewenstein, G., & O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, *40*(2), 351-401.

Gosling, S. D., Rentfrow, P. J., & Swann Jr, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in personality*, *37*(6), 504-528.

Halevy, Y. (2008). Strotz meets Allais: Diminishing impatience and the certainty effect. *American Economic Review*, *98*(3), 1145-62.

Harrison, G. W., Johnson, E., McInnes, M. M., & Rutström, E. E. (2005). Risk aversion and incentive effects: Comment. *American Economic Review*, *95*(3), 897-901.

Hirsh, J. B., Morisano, D., & Peterson, J. B. (2008). Delay discounting: Interactions between personality and cognitive ability. *Journal of Research in Personality*, *42*(6), 1646-1650.

Holt, C. A., & Laury, S. K. (2002). Risk aversion and incentive effects. *American economic review*, *92*(5), 1644-1655.

Holt, C. A., & Laury, S. K. (2005). Risk aversion and incentive effects: New data without order effects. *American Economic Review*, *95*(3), 902-912.

Hoyle, R. H., Fejfar, M. C., & Miller, J. D. (2000). Personality and sexual risk taking: A quantitative review. *Journal of personality*, *68*(6), 1203-1231.

Josef, A. K., Richter, D., Samanez-Larkin, G. R., Wagner, G. G., Hertwig, R., & Mata, R. (2016). Stability and change in risk-taking propensity across the adult life span. *Journal of personality and social psychology*, *111*(3), 430.7

Keren, G., & Roelofsma, P. (1995). Immediacy and certainty in intertemporal choice. *Organizational Behavior and Human Decision Processes*, *63*(3), 287-297.

Kowal, B. P., & Faulkner, J. L. (2016). Delay discounting of hypothetical monetary rewards with decoys. *Behavioural processes*, *122*, 26-35.

Kowert, P. A., & Hermann, M. G. (1997). Who takes risks? Daring and caution in foreign policy making. *Journal of conflict Resolution*, *41*(5), 611-637.

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., ... & Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: the Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied*, *8*(2), 75.

Lauriola, M., & Levin, I. P. (2001). Personality traits and risky decision-making in a controlled experimental task: An exploratory study. *Personality and individual differences*, *31*(2), 215-226.

Little, R. J., & Rubin, D. B. (2014). Statistical analysis with missing data (Vol. 333). John Wiley & Sons

Magnus, J. R., & De Luca, G. (2016). Weighted-average least squares (WALS): a survey. Journal of Economic Surveys, 30(1), 117-148.

Magnus, J. R., Powell, O., & Prüfer, P. (2010). A comparison of two model averaging techniques with an application to growth empirics. Journal of Econometrics, 154(2), 139-153.

Mahalingam, V., Stillwell, D., Kosinski, M., Rust, J., & Kogan, A. (2014). Who can wait for the future? A personality perspective. *Social Psychological and Personality Science*, *5*(5), 573-583.

Manning, J., Hedden, T., Wickens, N., Whitfield-Gabrieli, S., Prelec, D., & Gabrieli, J. D. (2014). Personality influences temporal discounting preferences: Behavioral and brain evidence. *NeuroImage*, *98*, 42-49.

Mishra, S., & Lalumière, M. L. (2011). Individual differences in risk-propensity: Associations between personality and behavioral measures of risk. *Personality and Individual Differences*, *50*(6), 869-873.

Moral-Benito, E. (2015). Model averaging in economics: An overview. Journal of Economic Surveys, 29(1), 46-75.

Nicholson, N., Soane, E., Fenton-O'Creevy, M., & Willman, P. (2005). Personality and domain-specific risk taking. *Journal of Risk Research*, *8*(2), 157-176.

Ostaszewski, P. (1996). The relation between temperament and rate of temporal discounting. *European Journal of Personality*, *10*(3), 161-172.

Prelec, D., & Loewenstein, G. (1991). Decision making over time and under uncertainty: A common approach. *Management science*, *37*(7), 770-786.

Reynolds, B., Ortengren, A., Richards, J. B., & de Wit, H. (2006). Dimensions of impulsive behavior: Personality and behavioral measures. *Personality and individual differences*, *40*(2), 305-315.

Romero, E., Villar, P., Gómez-Fraguela, J. A., & López-Romero, L. (2012). Measuring personality traits with ultra-short scales: A study of the Ten Item Personality Inventory (TIPI) in a Spanish sample. *Personality and Individual Differences*, *53*(3), 289-293.

Rubin, D.B. (1976). Inference and missing data (with discussion), Biometrika 63, 581–592.

Sween, M., Ceschi, A., Tommasi, F., Sartori, R., & Weller, J. (2017). Who is a Distracted Driver? Associations between Mobile Phone Use while Driving, Domain-Specific Risk Taking, and Personality. *Risk analysis*, *37*(11), 2119-2131.

Trobst, K. K., Wiggins, J. S., Costa, Jr, P. T., Herbst, J. H., McCrae, R. R., & Masters, III, H. L. (2000). Personality psychology and problem behaviors: HIV risk and the five-factor model. *Journal of Personality*, *68*(6), 1233-1252.

Weber, B. J., & Chapman, G. B. (2005). The combined effects of risk and time on choice: Does uncertainty eliminate the immediacy effect? Does delay eliminate the certainty effect?. *Organizational Behavior and Human Decision Processes*, *96*(2), 104-118.

Weller, J. A., & Tikir, A. (2011). Predicting domain-specific risk taking with the HEXACO personality structure. *Journal of Behavioral Decision Making*, *24*(2), 180-201.

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and individual differences*, *30*(4), 669-689.

Zaleskiewicz, T. (2001). Beyond risk seeking and risk aversion: Personality and the dual nature of economic risk taking. *European journal of Personality*, *15*(S1), S105-S122.

Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. Cambridge university press.

Zuckerman, M., & Kuhlman, D. M. (2000). Personality and risk-taking: common bisocial factors. *Journal of personality*, *68*(6), 999-1029.

Tables and figures

Table 1: Spearman rank correlation between TIPI items.

	it1	**it2**	**it3**	**it4**	**it5**	**it6**	**it7**	**it8**	**it9**	**it10**
it1	-									
it2	0.171*** (0.007)	-								
it3	0.057 (0.373)	-0.058 (0.361)	-							
it4	-0.099 (0.121)	0.040 (0.532)	-0.044 (0.492)	-						
it5	0.278*** (0.000)	-0.044 (0.488)	0.219*** (0.001)	-0.150*** (0.018)	-					
it6	-0.385*** (0.000)	-0.008 (0.900)	0.091 (0.152)	0.146*** (0.021)	-0.170*** (0.007)	-				
it7	0.136*** (0.032)	-0.178*** (0.005)	0.311*** (0.000)	0.111 (0.008)	0.204*** (0.001)	-0.020 (0.754)	-			
it8	-0.003 (0.962)	0.225*** (0.000)	-0.295*** (0.000)	0.166*** (0.009)	-0.073 (0.255)	0.177*** (0.005)	-0.152*** (0.017)	-		
it9	0.019 (0.766)	-0.236*** (0.000)	0.350*** (0.000)	-0.361*** (0.000)	0.183*** (0.004)	-0.033 (0.601)	0.122 (0.055)	-0.187*** (0.003)	-	
it10	-0.081 (0.204)	-0.040 (0.532)	0.128*** (0.044)	0.076 (0.235)	-0.202*** (0.001)	0.271*** (0.000)	0.124 (0.051)	0.020 (0.749)	0.088 (0.168)	-

NOTES. Spearman's correlation coefficients. P-values are reported in parentheses. TIPI scale scoring (‘‘R’’ denotes reverse-scored items): Extraversion: it1, it6(R); Agreeableness: it2(R), it7; Conscientiousness; it3, it8(R); Emotional Stability: it4(R), it9; Openness to Experiences: it5, it10(R). Significance levels * .10 **.05 ***.01.

Table 2: Spearman's rank correlations between TIPI Big five scales.

	O	**C**	**E**	**A**	**ES**
O	-				
C	0.059 (0.352)	-			
E	0.312*** (0.000)	0.064 (0.319)	-		
A	0.010 (0.872)	0.253*** (0.000)	-0.050 (0.434)	-	
ES	0.107* (0.092)	0.256*** (0.000)	0.103 (0.106)	0.086 (0.178)	-

NOTES. Spearman’s correlation coefficients. P-values are reported in parentheses.

Significance levels * .10 **.05 ***.01.

Table 3: Summary statistics.

Variable	Description	Treatment	N	mean	sd	min	max	p-value
age	Age	T1	120	20.38	1.992	18	32	0.965
		T2	128	20.37	1.915	18	29	
female	Female=1	T1	120	0.48	0.502	0	1	0.398
		T2	128	0.43	0.497	0	1	
Risk choice	Stopping point in BRET	T1	120	31.67	14.530	8	91	0.297
		T2	128	34.10	17.610	3	99	
Impatience	Switch point in TIME Task	T1	95	10.87	5.819	0	20	0.010
		T2	108	8.86	5.694	0	20	
Openness	Open to new experiences, complex	T1	120	4.81	1.152	2	7	0.836
		T2	128	4.82	1.219	1.5	7	
Conscientiousness	Dependable, self-disciplined	T1	120	5.65	1.141	1.5	7	0.243
		T2	128	5.52	1.129	1.5	7	
Extraversion	Extraverted, enthusiastic	T1	120	4.10	1.590	1	7	0.376
		T2	128	4.27	1.335	1.5	7	
Agreeableness	Sympathetic, warm	T1	120	5.43	1.040	2	7	0.088
		T2	128	5.17	1.171	1.5	7	
Emotional stability	Calm, emotionally stable	T1	120	4.59	1.356	1	7	0.760
		T2	128	4.60	1.584	1	7	

NOTES. For each variable, summary statistics are reported by treatment. T1 refers to the BRET/TIME Treatment, T2 to the TIME/BRET Treatment. In the last column, p-values from a Mann-Whitney test of equality in distribution are reported.

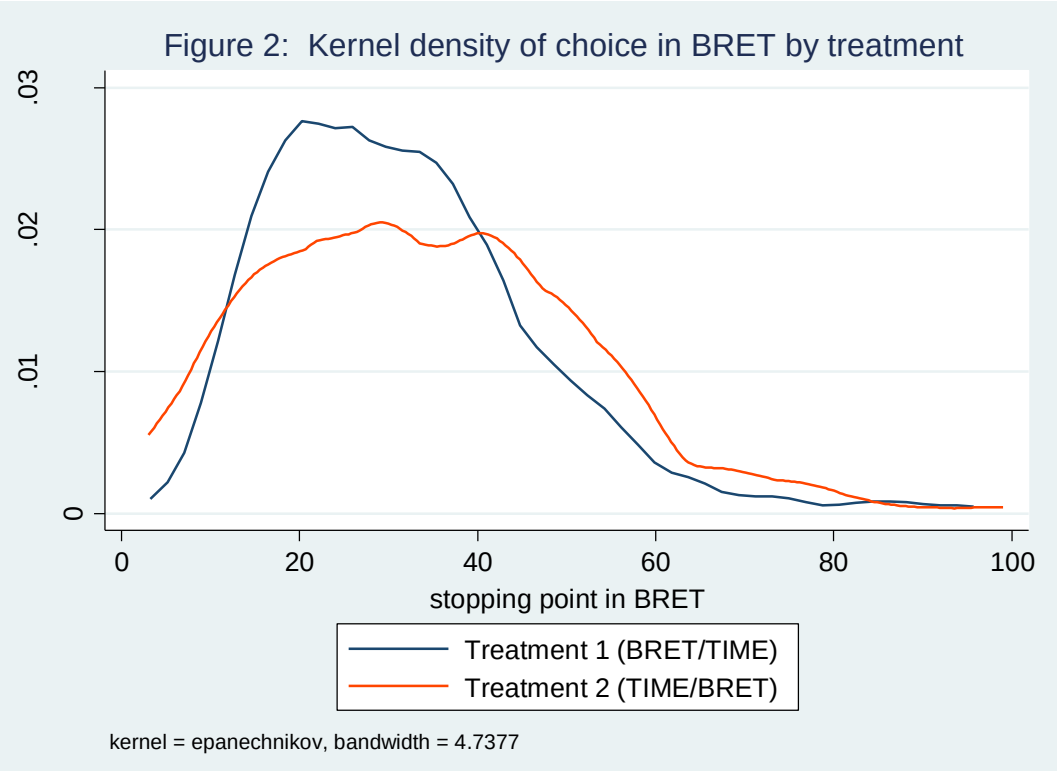


Figure 2: Kernel density of choice in BRET by treatment
0
.01
.02
.03
0
20
40
60
80
100
stopping point in BRET
Treatment 1 (BRET/TIME)
Treatment 2 (TIME/BRET)
kernel = epanechnikov, bandwidth = 4.7377

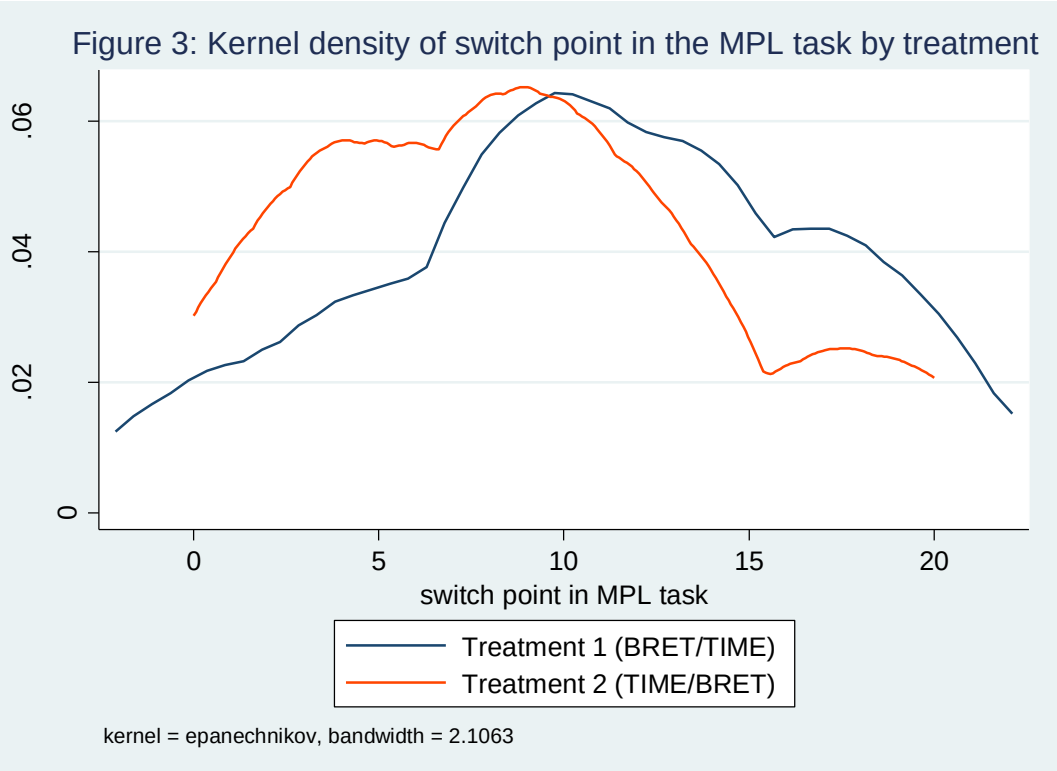


Figure 3: Kernel density of switch point in the MPL task by treatment
0
.02
.04
.06
0
5
10
15
20
switch point in MPL task
Treatment 1 (BRET/TIME)
Treatment 2 (TIME/BRET)
kernel = epanechnikov, bandwidth = 2.1063

Table 4: Order effects on the level of Impatience by gender and level of Big five traits.

	(1)	(2)	(3)
	Impatience (All)	**Impatience (Females)**	**Impatience (Males)**
low scores Openness			
dtreatment	-2.148**	-3.206**	-1.771
	(1.02)	(1.57)	(1.29)
high scores Openness			
dtreatment	-1.921	-0.977	-2.720
	(1.33)	(1.85)	(1.93)
low scores Conscientiousness			
dtreatment	-2.992***	-3.877**	-2.179
	(0.92)	(1.53)	(1.33)
high scores Conscientiousness			
dtreatment	-0.314	-0.316	-1.490
	(1.54)	(1.87)	(1.71)
low scores Extraversion			
dtreatment	-3.466***	-2.199	-3.654***
	(1.04)	(1.46)	(1.37)
high scores Extraversion			
dtreatment	-0.609	-2.219	-0.256
	(1.22)	(1.99)	(1.66)
low scores Agreeableness			
dtreatment	-2.825***	-3.532**	-2.351*
	(0.99)	(1.48)	(1.33)
high scores Agreeableness			
dtreatment	-0.662	-1.212	-1.033
	(1.39)	(2.00)	(1.91)
low scores Emotional Stability			
dtreatment	-1.906*	-2.979*	-2.572*
	(1.01)	(1.67)	(1.30)
high scores Emotional Stability			
dtreatment	-2.119	-1.474	-1.020
	(1.39)	(1.71)	(1.79)

NOTES. OLS regressions. Impatience is the switching row from the sooner option to the later option in the intertemporal choice task. dtreatment is a dummy variable for treatment (1=TIME/BRET). Regressions in (1) are implemented for the full sample of students , in (2) and (3) for the female subsample and male subsample, respectively. For each trait, scores are split into two categories: lower scores (included in the 1st and 2nd quartiles) and higher scores (included in the 3rd and 4th quartiles). Personality categories for (2) and (3) are defined over the subsample of women and men, respectively. Robust standard errors are reported in parentheses. Levels of significance * p<0.1, ** p<0.05, *** p<0.01.

Table 5: Spearman's rank correlations between Risk aversion and Impatience.

	Risk choice								
	(Full sample)			(Female)			(Male)		
	T1	T2	All	T1	T2	All	T1	T2	All
Impatience	0.053	-0.039	0.017	-0.010	-0.115	-0.032	0.052	-0.043	0.005

NOTES. Spearman's correlations. . "Impatience" (1) is the switching row along the multiple price list in the Intertemporal choice task. "Risk choice" (2) is the number of boxes blackened in the risk choice task. Correlations are analyzed for women only, men only, and both genders jointly. Sample is restricted to Treatment 1 (BRET/TIME), Treatment 2 (TIME/BRET), or is the full sample. Levels of significance * p<0.1, ** p<0.05, *** p<0.01

Table 6: Spearman's rank correlations between Big Five traits and the experimental measures of Risk aversion and Impatience.

		Risk aversion			Impatience		
		T1	T2	All	T1	T2	All
Openness	Female	-0.016	0.090	0.041	-0.048	0.117	0.047
	Male	0.243*	-0.026	0.097	-0.145	-0.124	-0.134
	All	0.114	0.011	0.061	-0.126	-0.056	-0.079
Conscientiousness	Female	0.107	0.065	0.083	-0.187	0.226	0.026
	Male	-0.002	-0.063	-0.016	-0.120	-0.090	-0.125
	All	-0.004	-0.007	-0.011	-0.201	0.016	-0.093
Extraversion	Female	0.036	-0.089	-0.028	0.072	0.169	0.148
	Male	0.126	0.307***	0.214	0.033	0.127	0.066
	All	0.067	0.117	0.093	0.025	0.137	0.085
Agreeableness	Female	0.002	-0.008	-0.003	-0.300	-0.089	-0.142
	Male	0.053	-0.208*	-0.103	0.065	0.107	0.084
	All	-0.010	-0.123	-0.081	-0.125	0.036	-0.023
Emotional Stability	Female	0.223*	0.012	0.112	-0.010	0.028	0.043
	Male	-0.201	-0.240**	-0.209	-0.167	-0.111	-0.145
	All	-0.005	-0.087	-0.043	-0.079	-0.047	-0.058

NOTES. Spearman's correlations. "Impatience" (1) is the switching row along the multiple price list in the Intertemporal choice task. "Risk aversion" (2) is the number of boxes blackened in the risk choice task. Correlations are analyzed for women only, men only, and both genders jointly. Sample is restricted to Treatment 1 (BRET/TIME), Treatment 2 (TIME/BRET), or is the full sample. Levels of significance * p<0.1, ** p<0.05, *** p<0.01

Table 7: Spearman's rank correlations between Risk aversion and Impatience by level of Big Five traits.

	Full sample			Female			Male		
	T1	**T2**	**All**	**T1**	**T2**	**All**	**T1**	**T2**	**All**
low Openness	-0.008	0.034	0.031	-0.137	-0.014	-0.045	0.097	-0.006	0.032
high Openness	0.147	-0.165	0.007	0.172	-0.257	-0.036	0.058	-0.083	0.019
low Conscientiousness	-0.041	0.134	0.057	-0.075	0.065	0.010	0.007	-0.099	-0.071
high Conscientiousness	0.256	-0.332**	-0.053	0.230	-0.363	-0.071	0.185	-0.045	0.047
low Extraversion	-0.103	-0.146	-0.077	-0.036	-0.108	-0.032	-0.107	-0.095	-0.071
high Extraversion	0.216	0.035	0.105	0.048	-0.095	0.032	0.346	-0.064	0.061
low Agreeableness	0.086	-0.046	0.026	-0.055	-0.017	0.037	0.148	-0.095	0.003
high Agreeableness	-0.004	-0.018	0.005	0.014	-0.210	-0.085	-0.177	0.112	0.027
low Emotional Stability	-0.036	0.025	0.023	-0.361*	0.082	-0.054	-0.239	-0.107	-0.123
high Emotional Stability	0.225	-0.144	0.003	0.446*	-0.405*	0.003	0.159	-0.019	0.062

NOTES. Spearman's correlations between Risk choice in the BRET and Impatience in the MPL task. The relationship is analyzed by level of a personality trait. For each trait, scores are split into two categories: lower scores (included in the 1st and 2nd quartiles) and higher scores (included in the 3rd and 4th quartiles). Correlations are analyzed for women only, men only, and both genders jointly. Sample is restricted to Treatment 1 (BRET/TIME), Treatment 2 (TIME/BRET), or is the full sample.

Appendix A

Experimental instructions

Original experimental instructions for the BRET/TIME Treatment.

Fase 1

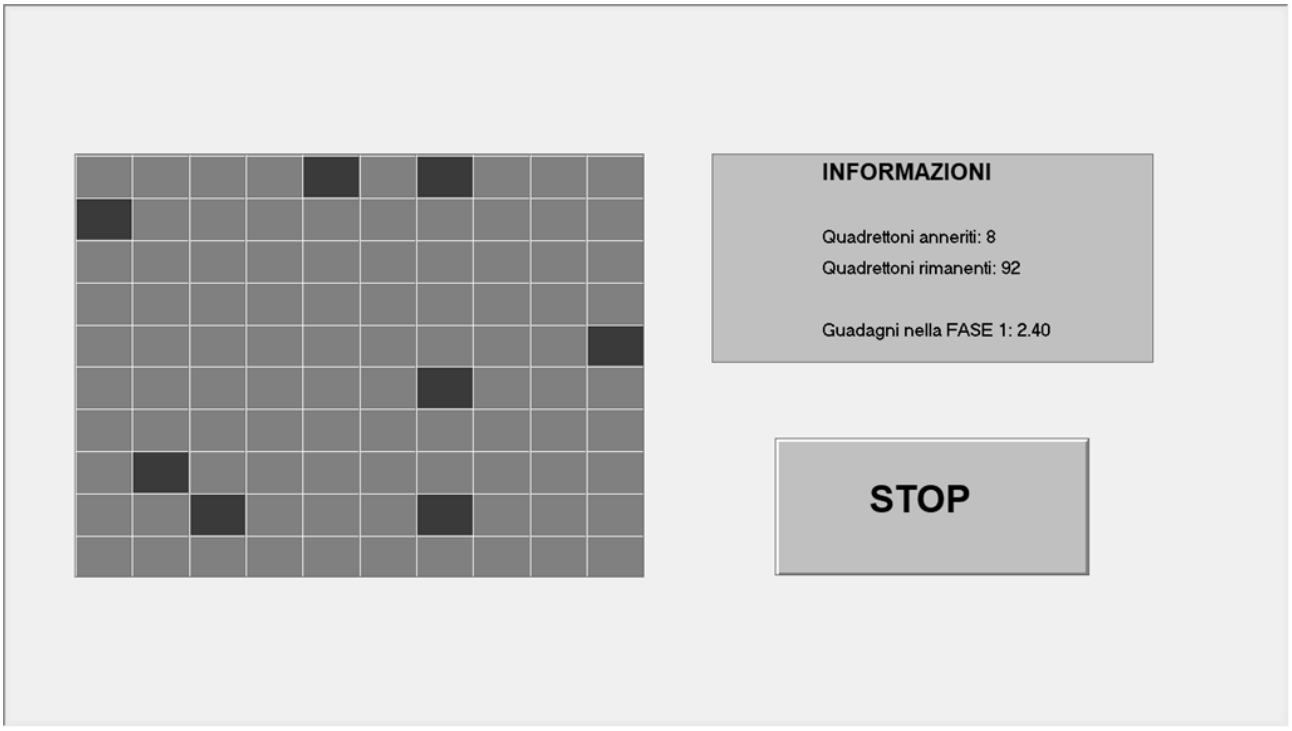
In questa fase il computer ti mostrerà una griglia suddivisa in 100 quadrettoni grigi della stessa grandezza. Il computer assegnerà ad uno dei 100 quadrettoni una bomba. Non hai alcuna informazione sulla posizione della bomba nella griglia; sai solo che può trovarsi in uno qualsiasi dei 100 quadrettoni con la stessa probabilità.

Il computer annerirà un quadrettone al secondo selezionandolo in maniera casuale tra quelli non ancora anneriti. Il processo proseguirà in automatico finché non cliccherai sul tasto "Stop".

Qualora tra i quadrettoni anneriti fosse compreso quello con la bomba, i tuoi guadagni della fase 1 saranno pari a 0. Altrimenti, i tuoi guadagni saranno dati da €0,30 per ogni quadrettone annerito. Quindi, più a lungo attendi prima di fermare il processo, maggiore è il numero di quadrettoni anneriti e maggiori saranno i tuoi guadagni qualora tra i quadrettoni anneriti non fosse incluso quello con la bomba. Tuttavia, maggiore è il numero di quadrettoni anneriti, maggiore è la probabilità che tra di essi sia incluso quello con la bomba.

Il pagamento

Alla fine dell'esperimento, se la fase 1 sarà selezionata per i pagamenti finali, riceverai una somma di denaro in contanti pari ai guadagni da te ottenuti sulla base delle tue scelte nella fase 1.



Riproduzione della griglia di quadrettoni. Ogni secondo, un quadrettone viene annerito in base ad un ordine casuale. Il riquadro accanto alla griglia mostra in tempo reale il numero di quadrettoni anneriti, il numero di quadrettoni rimanenti e i guadagni potenziali corrispondenti. Decidi quando terminare il processo cliccando su “Stop”.

Fase 2

In questa parte dell'esperimento ti verrà chiesto di esprimere una serie di scelte, presentate sullo schermo in forma di tabella, tra due opzioni di pagamento, denominate A e B, da effettuare in date differenti.

Osserva la Tabella delle decisioni. La Tabella contiene 20 righe, ciascuna delle quali si riferisce ad una scelta che dovrai compiere tra l'Opzione A e l'Opzione B. Per ogni riga di decisione ti verrà chiesto di scegliere se ricevere una certa somma domani (Opzione A) oppure una somma maggiore tra 4 settimane a partire da domani (Opzione B). Per illustrare meglio questo punto osserva, per esempio, la riga corrispondente alla Scelta 3. In questa riga la tua scelta è tra l'Opzione A, che ti dà diritto a ricevere €19,40 domani, e l'Opzione B, che ti dà diritto a ricevere €20 tra 4 settimane a partire da domani.

L'Opzione B è uguale per tutte le righe di decisione e consiste nel pagamento di €20 in 4 settimane a partire da domani.

L'Opzione A, al contrario, non è costante. L'importo parte da €20 nella riga corrispondente alla Scelta 1 e decresce scorrendo le righe verso il basso fino alla cifra di €14,30.

Per ognuna delle 20 righe di decisione ti verrà chiesto di esprimere una scelta tra queste due opzioni di pagamento, selezionando l'opzione preferita.

Questa situazione decisionale richiede che tu prenda 20 decisioni, una per ogni riga nella Tabella delle decisioni. Alla fine dell'esperimento, se questa fase verrà estratta, una delle 20 righe di decisione verrà selezionata casualmente e verrai pagato secondo la tua scelta in quella riga. Questo significa che ogni tua scelta potrebbe essere rilevante per il pagamento con uguale probabilità.

Il pagamento

Alla fine dell'esperimento, se la fase 2 sarà selezionata per i pagamenti finali, il computer individuerà in maniera casuale e con uguale probabilità una delle 20 righe della tabella. I tuoi guadagni verranno determinati sulla base della scelta da te effettivamente compiuta tra l'Opzione A e l'Opzione B in corrispondenza della riga selezionata. Per esempio, se venisse selezionata la riga 6, i tuoi guadagni saranno pari a €18,50 domani se hai scelto l'Opzione A oppure €20 tra 4 settimane a partire da domani se hai scelto l'Opzione B. Ti rilasceremo un certificato di pagamento che dovrai presentare presso il Dipartimento di Economia - via dei Verdi, n° 75, domani o tra 4 settimane a partire da domani sulla base delle scelte da te compiute nella fase 2.

FASE 2

Nella FASE 2 dell'esperimento, ti chiediamo di indicare l'opzione da te preferita in corrispondenza di ciascuna scelta.

Numero Scelta	Opzione A	Opzione B	Esprimi la tua scelta
1	Ricevi € 20.00 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
2	Ricevi € 19.70 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
3	Ricevi € 19.40 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
4	Ricevi € 19.10 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
5	Ricevi € 18.80 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
6	Ricevi € 18.50 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
7	Ricevi € 18.20 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
8	Ricevi € 17.90 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
9	Ricevi € 17.60 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
10	Ricevi € 17.30 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
11	Ricevi € 17.00 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
12	Ricevi € 16.70 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
13	Ricevi € 16.40 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
14	Ricevi € 16.10 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
15	Ricevi € 15.80 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
16	Ricevi € 15.50 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
17	Ricevi € 15.20 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
18	Ricevi € 14.90 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
19	Ricevi € 14.60 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B
20	Ricevi € 14.30 domani	Ricevi € 20.00 tra 4 settimane a partire da domani	Opzione A ○ ○ Opzione B

Ti preghiamo di cliccare su CONTINUA dopo aver compiuto le tue scelte!

Continua

Riproduzione della Tabella delle decisioni. Per ognuna delle 20 scelte, decidi se preferisci l'Opzione A, ricevere una certa somma domani, oppure l'Opzione B, ricevere 20 euro tra quattro settimane a partire da domani. Dopo aver compiuto le tue scelte, clicca su "Continua".

Appendix B

Table 1: Spearman's rank correlations between TIPI "Big five" scales in the BRET/TIME treatment.

	O	C	E	A	ES
O	-				
C	0.058 (0.531)	-			
E	0.417*** (0.000)	0.051 0.579	-		
A	-0.066 (0.474)	0.238*** (0.009)	-0.085 (0.355)	-	
ES	0.065 (0.478)	0.255*** (0.005)	0.144 (0.115)	0.020 (0.827)	-

NOTES. Spearman's correlation coefficients. P-values are reported in parentheses.
Significance levels * .10 **.05 ***.01.

Table 2: Spearman's rank correlations between TIPI "Big five" scales in the TIME/BRET treatment.

	O	C	E	A	ES
O	-				
C	0.051 (0.570)	-			
E	0.204*** (0.021)	0.096 (0.284)	-		
A	0.089 (0.316)	0.252*** (0.004)	0.008 (0.931)	-	
ES	0.129 (0.147)	0.260*** (0.003)	0.070 (0.433)	0.151* (0.089)	-

NOTES. Spearman's correlation coefficients. P-values are reported in parentheses.
Significance levels * .10 **.05 ***.01.

Figure 1: Kernel density estimates of Big five traits by treatment

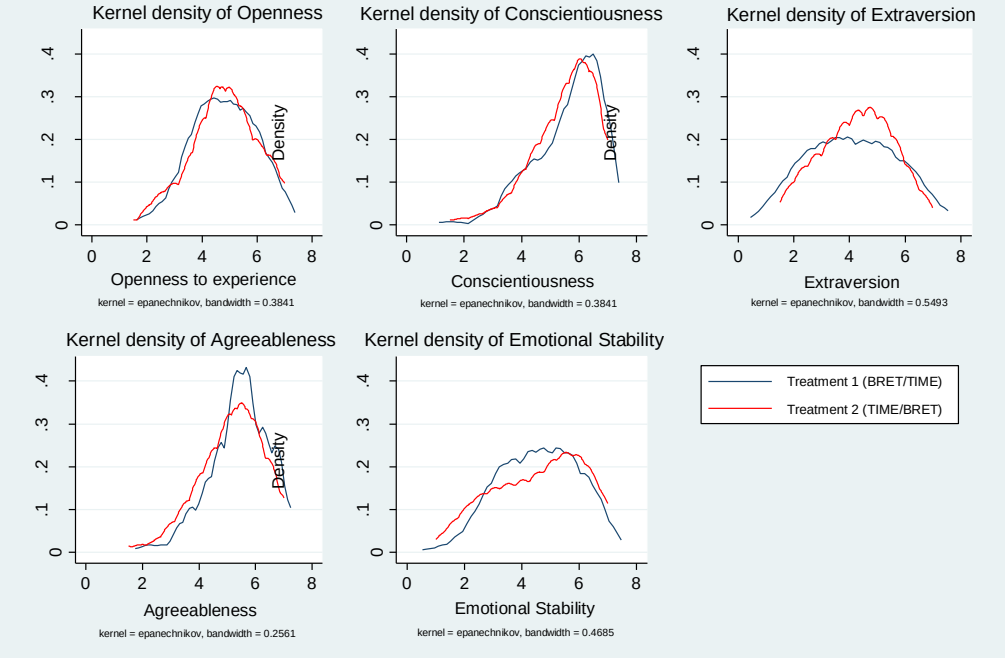


Table 3: Proportion of inconsistent and consistent choices in the Intertemporal choice task by level of Big Five trait.

	inconsistent choices	**consistent choices**	**Total choices**
	perc.	**perc.**	**perc.**
low Openness	26 16.56	131 83.44	157 100.00
high Openness	19 20.88	72 79.12	91 100.00
low Conscientiousness	33 20	132 80	165 100.00
high Conscientiousness	12 14.46	71 85.54	83 100.00
low Extraversion	23 18.55	101 81.45	124 100.00
high Extraversion	22 17.74	102 82.26	124 100.00
low Agreeableness	35 21.60	127 78.40	162 100.00
high Agreeableness	10 11.63	76 88.37	86 100.00
low Emotional stability	28 17.95	128 82.05	156 100.00
high Emotional stability	17 18.48	75 81.52	92 100.00

NOTES. Number and percentages of inconsistent and consistent choices in the Intertemporal choice task. For each trait, scores are split into two categories: lower scores (included in the 1st and 2nd quartiles) and higher scores (included in the 3rd and 4th quartiles).

Table 4: Spearman's rank correlations between Big Five traits and experimental measures of Risk aversion and Impatience for high scores on the traits.

		Risk aversion			Impatience		
		T1	**T2**	**All**	**T1**	**T2**	**All**
high scores Openness	Female	0.128	0.303	0.236	0.041	0.133	0.142
	Male	0.158	0.025	0.108	-0.012	-0.348	-0.194
	All	0.122	0.215	0.179*	0.019	-0.094	-0.025
high scores Conscientiousness	Female	-0.172	0.200	0.031	-0.050	0.407*	0.119
	Male	-0.025	-0.006	-0.026	-0.026	0.092	0.047
	All	-0.061	0.003	-0.009	0.054	0.190	0.087
high scores Extraversion	Female	-0.246	0.119	-0.066	-0.153	0.057	-0.045
	Male	-0.459***	0.299*	-0.026	0.074	-0.161	-0.081
	All	-0.140	0.039	-0.051	0.075	-0.125	-0.038
high scores Agreeableness	Female	0.132	0.330	0.212	-0.199	0.299	-0.004
	Male	0.085	-0.129	-0.074	-0.069	0.127	0.088
	All	0.055	-0.016	0.013	-0.170	0.095	-0.034
high scores Emotional Stability	Female	-0.035	0.131	0.035	0.592***	-0.130	0.247
	Male	-0.014	-0.318*	-0.191	-0.040	-0.123	-0.092
	All	-0.078	-0.222	-0.163	0.002	-0.212	-0.113

NOTES. Spearman's correlations between Big Five traits and experimental measures of Risk aversion and Impatience. For the analysis we considered only subjects who reported scores ranging from the 3rd to the 4th quartile of the distribution. When correlations are analyzed conditional to gender, the personality categories are defined over the subsample of women or men. Sample is restricted to Treatment 1 (BRET/TIME), Treatment 2 (TIME/BRET), or is the full sample.
Significance levels * .10 **.05 ***.01.

Table 5: Estimates $\hat{\beta}$ and standard errors (in parentheses), Model 1.

	(1)	(2)	(3)	(4)
	Restricted	**Unrestricted**	**BMA**	**WALS**
Focus regressors				
constant	14.660 (5.26)	20.428 (4.72)	15.638 (4.42)	18.452 (4.33)
dtreatment	-2.097 (-2.60)	-12.273 (-2.15)	-3.809 (-1.12)	-8.77 (-1.67)
Openness	-0.615 (-1.78)	-0.899 (-1.63)	-0.658 (-1.64)	-0.797 (-1.61)
Conscientiousness	-0.635 (-1.67)	-0.955 (-1.72)	-0.696 (-1.55)	-0.843 (-1.60)
Extraversion	0.545 (1.90)	0.37 (0.83)	0.523 (1.62)	0.435 (1.11)
Agreeableness	0.115 (0.33)	-0.255 (-0.42)	0.062 (0.14)	-0.126 (-0.22)
Emotional stability	-0.031 (-0.11)	0.002 (0.01)	-0.042 (-0.14)	-0.024 (-0.06)
Auxiliary regressors				
dtreatment*Openness		0.518 (0.72)	0.077 (0.24)	0.33 (0.58)
dtreatment*Conscientiousness		0.641 (0.81)	0.12 (0.30)	0.416 (0.66)
dtreatment*Extraversion		0.37 (0.62)	0.046 (0.20)	0.234 (0.49)
dtreatment*Agreeableness		0.553 (0.74)	0.08 (0.24)	0.361 (0.56)
dtreatment*Emotional stability		-0.091 (-0.16)	0.011 (0.07)	-0.035 (-0.07)

Table 6: Estimates $\hat{\beta}$ and standard errors (in parentheses), Model 2.

	(1)	(2)	(3)	(4)
	Restricted	**Unrestricted**	**BMA**	**WALS**
Focus regressors				
constant	14.432	22.565	15.797	19.432
	(5.10)	(4.07)	(4.14)	(3.96)
female	-1.662*	-2.238	-2.289	-1.917
	(-2.07)	(-0.35)	(-0.69)	(-0.38)
dtreatment	-2.132	-11.339	-3.621	-7.869
	(-2.67)	(-1.86)	(-1.13)	(-1.56)
Openness	-0.581	-1.331	-0.688	-1.042
	(-1.69)	(-2.36)	(-1.57)	(-1.90)
Conscientiousness	-0.531	-1.031	-0.587	-0.838
	(-1.36)	(-1.54)	(-1.29)	(-1.34)
Extraversion	0.591	0.607	0.577	0.604
	(2.05)	(1.19)	(1.78)	(1.32)
Agreeableness	0.208	0.36	0.188	0.313
	(0.61)	(0.55)	(0.41)	(0.48)
Emotional stability	-0.136	-0.291	-0.175	-0.245
	(-0.50)	(-0.59)	(-0.53)	(-0.51)
Auxiliary regressors				
dtreatment*Openness		0.54	0.081	0.338
		(0.71)	(0.25)	(0.56)
dtreatment*Conscientiousness		0.912	0.11	0.566
		(1.04)	(0.29)	(0.85)
dtreatment*Extraversion		0.162	0.026	0.098
		(0.26)	(0.14)	(0.19)
dtreatment*Agreeableness		0.262	0.056	0.156
		(0.35)	(0.19)	(0.23)
dtreatment*Emotional stability		-0.094	0.013	-0.047
		(-0.16)	(0.08)	(-0.09)
dtreatment*female		-0.935	-0.005	-0.569
		(-0.56)	(-0.01)	(-0.41)
female*Openness		1.006	0.132	0.61
		(1.31)	(0.32)	(1.01)
female*Conscientiousness		0.239	0.019	0.143
		(0.28)	(0.09)	(0.21)
female*Extraversion		-0.244	0.008	-0.154
		(-0.39)	(0.05)	(-0.30)
female*Agreeableness		-1.29	-0.095	-0.814
		(-1.76)	(-0.26)	(-1.19)
female*Emotional stability		0.644	0.082	0.414
		(1.14)	(0.28)	(0.80)
father'level of education		-0.31	-0.023	-0.186
		(-0.54)	(-0.14)	(-0.40)
mother's level of education		-0.323	-0.038	-0.204
		(-0.59)	(-0.20)	(-0.45)

Chapter 3

Personality Traits, Field of Study Choice, and Academic Performance

Abstract

In this study, we use original survey data from first year students at the University of Messina to investigate the rule of Big Five traits in the field of study choice. We organize the study programs in three broad research fields: Social sciences and Humanities, Physical sciences and Engineering, and Life sciences. We find evidence that personality traits are related to the probability of choosing a certain field of study. We use two measures of academic performance: the grade point average and the total number of academic scores. We do not find clear evidence of consistent relationships between certain personality traits and academic performance across the measures of performance outcomes and the groups. Some evidence is found of a positive relationship between Conscientiousness and both measures of academic performance.

1. Introduction

In the present study, we analyze the relationship between personality traits and academic performance at the post-secondary level. In particular, the aim of the paper is to explore whether the individual choice of a certain field of study is associated with own personality characteristics and whether personality traits may help to explain individual differences in academic performance.

The choice of a certain field of study involves the evaluation of personal aptitudes, interests, and ambitions. As personality traits are, following the definition of Roberts (2009), the "*relatively enduring patterns of thoughts, feelings, and behaviors*" reflecting the way individuals act in different circumstances, it is expected that some personality characteristics may be associated with a higher probability of preferring a certain field of study respect to others. In addition, personality traits may shape behaviors through motivational aspects, emotional reactions, intellective curiosity, and social interactions that have a causal effect on academic performance. Since significant relationships have been found in economic literature between personality traits and job outcomes (e.g. Cobb-Clark and Tan, 2010), the role of personality traits in academic tracks - which prepare for future job careers- is of importance.

We conducted a survey study on a cohort of first year undergraduate students at the University of Messina and gathered information on the choice of the course of study and the total number of exams successfully passed at the end of the first year under investigation. In the period of time elapsed after the choice of the study program and the beginning of courses attendance we assessed students' personality traits. We used broad measures of personality traits corresponding to the highest level of hierarchy within the Five Factor Model, i.e. the dimensions of Agreeableness, Conscientiousness, Emotional stability, Extraversion, and Openness to experience.

If there is more consistent evidence in the literature that Conscientiousness is an important predictor of academic performance (e.g. Poropat, 2009), findings relative to the other domains are mixed. In order to shed more light on this relationship, we focused our analysis on young adults who completed a secondary education, therefore whose major personality traits are largely shaped and defined (e.g. McCrae et al., 2002), and explored how personality traits influence the adaptive and learning processes in the first year of the academic experience. In addition, we analyzed whether gender differences may account in the relationship.

2. Theoretical background

Several studies have analyzed the relationship between personality traits and academic performance, but with different methodological approaches. If the most widely accepted conceptual personality

framework is the Five Factor Model with, in particular, the use of super-factors (i.e. broad personality dimensions), different academic levels (primary to post-secondary education) have been considered and several performance outcomes (for instance class attendance, course grade or GPA) have been used to study the relationship. The most used measure of academic performance is the grade point average (or GPA), a weighted average of the marks earned by the student along a certain period of time. The GPA is considered a valid and consistent measure over time of academic performance; however, some limitations have been found in the potential phenomenon of grade inflation, that is a tendency to assign higher average grades than previous evaluations of the academic result, and institutional grading differences (see Richardson et al., 2012). For instance, in a meta-analysis of the relationship between Big Five traits and academic performance Poropat (2009) finds that the effect size of personality traits reduces from the primary to the tertiary academic level except for the trait of Conscientiousness and concludes that the academic level is a moderator of the relationship.

The evidence on the relationship between Big Five traits and academic performance is not conclusive (e.g. meta-analyses of FFM and post-secondary academic performance by O'Connor & Paunonen, 2007 and Richardson et al, 2012). Conscientiousness is the most associated factor with academic performance (e.g. Burks et al., 2015; Chamorro-Premuzic & Furnham, 2003; Conard, 2006; O'Connor & Paunonen, 2007; Poropat, 2009). Conscientious individuals are self-disciplined, organized, hard-workers and achievement-behavior oriented, therefore motivational reasons are expected to count in the performance outcome. For instance, O'Connor & Paunonen (2007) highlight that Conscientiousness is the most important determinant of academic performance in their analysis and the mean population correlation has a strong variation from a small to very substantial effect size. Poropat (2009) confirms this conclusion and observes that controlling for the secondary level of GPA, the trait of Conscientiousness adds "*slightly more to the prediction of tertiary GPA than did intelligence*". Richardson et al. (2012) argue that among Big Five traits, Conscientiousness only results a significant predictor of GPA.

With respect to the other Big Five traits, results are mixed. In a big meta-analysis study on the correlates of tertiary GPA, Richardson et al. (2012) find that among the Big Five traits Conscientiousness only is an important predictor, confirming the prior results reported by Poropat (2009) when controlling for the high school GPA. 'Connor and Paunonen (2007) have conducted a meta-analysis study restricted to the correlations between Big Five traits and post-secondary academic performance as reported "*in the major paper available on this topic*". Openness to experience has been generally considered positively correlated with academic performance since open individuals are intellectually curious and therefore showing higher abilities in the learning processes, while other studies have not identified any significant correlation. O'Connor and Paunonen find a very weak relationship and high variability in the magnitude of the effect sizes, suggesting the existence of possible moderator factors. In this sense, Openness has been associated with intelligence (e.g.

Poropat, 2009). Extraversion has been mainly negatively associated with academic performance, in that students who are more extrovert tend to spend more time in social activities and, therefore, are less able to stay concentrated on the academic goals than introvert students; while other studies have found a positive or insignificant relationship. In a stepwise regression analysis on the determinants of academic performance conducted using a sample of junior and senior students in Management and Economics, Hakimi et al. (2011) find that Extraversion is a negative predictor and accounts for around 7 percent of the variance in academic achievement. O'Connor and Pauponen (2007) find a rather small and negative average population correlation. Some studies observed a positive relationship between Emotional stability and academic performance. Neurotic people have a tendency to experience anxiety and emotional distress, which may impede students to maintain a regular effort, reduce class attendance and, consequently, lead to lower performance outcomes. However, some studies have found a negative relationship between Emotional stability and academic performance (e.g. Komarraju et al., 2009). It is possible that at certain levels anxiety is a positive stimulus to hard-working for students who are perfectionists in nature and worry for possible failures (Hakimi et al., 2011, citing Bratko et al., 2006). Kaiser and Ozer (1997) find that Emotional stability among first-year college students is significantly related to reactive stress –i.e. the stress that students reported to have actually experienced and associated with the effort due to the achievement of their academic goals-, but unrelated to anticipatory stress – i.e. the stress that students expected to experience in case of failure of their objectives, therefore in a prior uncertain scenario-. Agreeableness is expected to be positively associated with academic performance, although the evidence is mixed (e.g. Burks et al., 2015). A possible rationale is that agreeable students are cooperative and compliant, therefore are more comfortable in social interactions than less agreeable subjects and benefit from a higher class attendance (Farsides & Woodfield, 2003).

We argue that the choice of the course of study requires the evaluation of several aspects which may count for academic success and job perspectives such as individual interests, cognitive abilities, motivation, and scopes. Therefore, personality traits are expected to be associated with the field of study choice. Vedel (2016) presents a review of the literature on the relationship between Big Five traits and academic majors in tertiary education. Of the twelve studies examined, most reported significant differences in Big Five traits across fields of study and the effect sizes were mainly moderate in magnitude. In dept, the Art and Humanities category is associated with lower Emotional stability than the Economics category, lower Extraversion than the fields of study in Economics, Law, Political science, and Medicine, and lower Conscientiousness than other fields of study. In addition, Arts and Humanities, Psychology, and Political sciences score higher on Openness to experience than other fields of study. Lower scores on Agreeableness are associated with Law and Business and Economics studies. In a longitudinal study conducted on a cohort of Danish students, Humburg (2017) provides evidence of significant average marginal effects of Big Five traits on the choice of the

field of study for subjects who enrolled in a university study program one year after the conclusion of the school cycle, and consistent to the inclusion of control variables in a multiple logistic regression analysis. In particular, extroverted individuals are more likely to prefer fields of study that involve more social interactions and personal achievements, like Law and Business and Economics studies. Possible explanations for the negative relationship between emotional stability and the probability of choosing a Humanities field of study are higher career indecision, that may induce individuals who are less emotionally stable to prefer fields of study in which career perspectives are less defined, and a preference for less structured environments, for which emotionally stable individuals are more likely to choose a STEM field of study. Regarding the traits of Openness to experience and Conscientiousness, the strongest associations are found with the groups of Humanities and Medical studies, respectively. Subjects who are more intellectually curious and imaginative have a higher probability of choosing a Humanities field of study. Positive average marginal effects of Conscientiousness on the probability of choosing Medical studies may be explained with the selective access to these disciplines in the Danish university system.

3. Data

We collected data from 5,653 students enrolled in the first year of a course of study at the University of Messina and registered in the academic year 2016-2017. We integrated three sources of data: a questionnaire that students filled out together with the online enrollment procedure; socio-economic information (gender, date of birth, wealth) and educational background (type of high school attended and final high school grade); information about exams passed at the end of the first academic year of the study program. Apart from the questionnaire, all the sources of data were not self-reported but delivered upon request by the administrative offices of the University.

Since the aim of our research is to study the relationship between personality traits and the choice of the field of study and how personality traits affect academic performance, we restricted our sample to 4,675 undergraduate students who enrolled in a Bachelor or Diploma (single cycle) program.

In order to fix the amount of tuition fees to be paid due to the academic year, students submit an ISEE-U declaration ("Indicatore della situazione economica equivalente- universitario", literally "Equivalent economic situation index – University"). Subjects who do not declare an ISEE-U economic condition or declare an ISEE-U value of at least € 60,001, are subject to the maximum amount of tuition fees. We imputed to subjects who did declare the amount of ISEE-U the average of the values of the subjects who submitted an ISEE-U declaration and were assigned to the highest amount of tuition fees.

In order to analyze data on a potentially homogenous sample of students, we truncated the data at the 90th percentile of the age distribution, that is we excluded from the analyses 498 subjects older than 24. In addition, we dropped 75 observations for which the data about the high school final mark and/or the type of high school attended were not available. The resulting sample collects 4,102 observations. The main variables of the dataset are illustrated in Table 1.

Among the information asked in the questionnaire, responders specified their parents' educational attainment and answered some questions about the autonomy in the choice of the course of study. Moreover, they filled out an Italian version of the Ten Item Personality Inventory (TIPI) proposed by Gosling et al. (2003) to infer the Big Five traits.

The Five Factor Model is the most common taxonomy of personality traits and is based on the lexical hypothesis that the main personality characteristics of individuals are encoded in the language (Allport and Odbert,1936). Personality traits are organized in five broad domains: Agreeableness, Conscientiousness, Extraversion, Emotional stability (or Neuroticism), and Openness to experience. The TIPI is a short questionnaire in which a trait is explained by two items, each one representing an opposite pole of the trait and scored on a scale from 1 (disagree strongly) to 7 (agree strongly). The measures of Big Five traits are obtained by averaging the pairs of items, after having recoded the reverse-scored items.

Subjects in our sample were asked to what extent, on a scale from 1 to 10, they perceived the choice of the study program was free from conditioning and autonomous. Since about 70 percent of respondents reported the maximum score on autonomy, we did not include this measure in our analysis. Students were asked whether family members, other relatives, and friends or acquaintances tried to condition their choice on a scale ranging from 1 (did not absolutely try) to 7 (absolutely tried). A large percentage of respondents reported they did not receive any attempt of influence from brothers (67.20), relatives (69.09), and friends/acquaintances (59.13). Regarding parents, subjects reported in most cases none or weak attempts of influence on the choice. In more depth, 43.47% of respondents reported that the mother did not absolutely try to influence their decision and the average value of the distribution is 2.97; the percentage raises up to 50.60% for the father's attempt of influence, with an average value of 2.66. We included two dummies for the parents' attempt of influence on the choice of the study program, which take value 1 if an individual reported a degree equal or more than 4, and 0 otherwise.

The educational background of a student is described by the type of high school attended - which typically lasts five years- and the final grade obtained. We considered the main distinction between the Lyceum, more theoretical and university-oriented, and the technical and professional institutes, which provide pupils with vocational training for different job profiles. At the end of the high school

cycle students who pass the final examinations obtain a diploma, whose score ranges from 60 to 100. In our sample, 75 percent of students attended a lyceum and 59 percent are women (Table 1).

For each student, we gathered data on the exams passed with the relative university credits and marks and we derived two measures of academic performance: the Grade Point Average (or GPA) and the total number of academic credits. The GPA is a weighted average of grades and is calculated as the sum of a student's grades (ranging from a minimum value of 18 for passing the exam to a maximum value of 30) weighted with the relative academic credits over the total number of academic credits gained in the first academic year of the study program. GPA is the preferred measure in the studies on the determinants of academic performance (see, for instance, the meta-analysis by Poropat, 2009). The main advantage of this measure is that it accounts for the effort required for each course of a study program, measured in terms of academic credits. As reported in Table 1, the variable GPA contains 860 missing values relative to subjects who did not pass any exam in the academic year considered. In the European university system, one academic credit conventionally is equivalent to an individual effort of 25 hours. The total number of academic credits is a measure of productivity which includes also those students who did not pass any exam during the first academic year and thus are excluded from any comparison due to weighted average grades.

We mapped the study courses in three broad categories corresponding to the three main fields of research classified by the European Research Council: Social sciences and Humanities (Group 1), Physical sciences, Informatics, and Engineering (Group 2), and Life sciences (Group 3).

Group 1 encompasses all disciplines concerning to the study of society and its structures, culture, and human mind and behavior, such as Economics, Political sciences, Law, Education studies, Communication science, Literature, Languages, Psychology, Philosophy, and Arts. Group 2 includes the branches of physical sciences (Mathematics, Physics, Chemistry, Hearth science), computer science, and Engineering. Group 3 represents all the fields of research that concern to the study of living organisms and their pathologies, including microbiological units, plant and animal species, and human beings, such as (applied) biological sciences, Medical studies, Healthcare professions, and Pharmacy. The three fields of study are illustrated in Table 2. We can see that only 9,65% of students enrolled in a course of study of the Physical sciences, Informatics and Engineering group. Figure 1 shows the gender distribution of students within groups: 68.43 % of students who enrolled in a study program of the Physical sciences, Informatics, and Engineering category are males. In contrast, 69.06 % of students in the Social sciences and humanities field of study are females. The gender distribution across groups is not surprising: there is strong evidence that women choose less frequently highly science- and technology-oriented disciplines than men. The study programs of Group 2 are traditionally included within the STEM acronym, introduced in 2001 by the U.S. National Science Foundation to identify education programs in the fields of Science, Technology, Engineering, and

Mathematics. For instance, Buser et al. (2014) argue that "*math and science intensity is one of the most significant dimensions of gender differences in educational choices*". The authors implemented a laboratory experiment with real effort tasks and find evidence that competitiveness is positively correlated with the choice of more prestigious studies, suggesting that a lower willingness to compete of women relative to men influences the academic track choice. We investigated whether personality characteristics correlate with the choice of the academic field.

4. Results

4.1 Choice of the academic field of study

Before presenting the results relative to the determinants of academic performance, we investigate whether the choice of the academic field is related to individual personality traits and schooling. Therefore, we use a categorical variable for the type of high school attended by distinguishing: classic lyceum, in which particular attention is given to humanistic disciplines (ancient Greek, Latin, Italian literature, History, and Philosophy); scientific lyceum, with more hours dedicated to 'hard' sciences such as Mathematics and Physics; other lyceum types (linguistic, artistic, music, and human science); technical and professional studies.

We apply a multinomial logistic regression model with robust standard errors to predict the likelihood that one of the three fields of studies is selected.

Table 3 displays a multinomial logistic regression of the field of study categories on the Big Five traits, without control variables. A positive change in Emotional Stability is associated with a 0.318 increase in the log-odds for choosing a Physical sciences and Engineering field of study relative to choosing a Social sciences and Humanities field of study given the other variables in the models held constant, while the relationship is negative for the traits of Extraversion (- 0.09) and Conscientiousness (-0.148). When looking at the Life sciences group, a positive change in Emotional Stability is associated with a 0.235 increase in the relative log odds, while an increase in Openness with a decrease of -0.111.

Column 1 of Tables 5-7 reports the average marginal effects of personality traits on the probability of choosing a certain Group. As for Social sciences and Humanities and Life sciences, we observe the average marginal effects of Openness to experiences are significant, but the direction of the relationship is different for the two groups. In fact, a one-point increase of Openness increases of 2.5 percentage points the likelihood of choosing a Social sciences and Humanities field of study, while reduces of 2.4 percentage points the likelihood of choosing a Life sciences field of study. Since the percentage of individuals who enrolled in a course of study of Group 1 is 45.85% and 44.49% for

Group 2, a one unit increase in Openness decreases of 5.45% the probability of choosing a Social sciences and Humanities field of study and increases of 5.39% the probability of choosing a Life sciences field of study. A possible explanation for these results is that the Social sciences and Humanities category is attractive for subjects who are more intellectually curious, because it involves the critical study of the fundaments and dynamics of societies and its institutions, the analysis of human mind and behaviors, and the study of rational thinking and human culture (Philosophy, Literature, Languages, and Arts).

The trait of Emotional Stability is the main factor for all groups since it is a negative predictor of the probability of choosing a Social sciences and Humanities field of study and conversely a positive predictor of the probability of preferring the study of physical sciences. In particular, a one-unit increase in Emotional stability decreases of 13.20% the likelihood of choosing a Social sciences and Humanities field of study (-6.05 percentage points) and increases of 17.93% (1.73 percentage points) and of 9.73% (4.33 percentage points) the likelihood of enrolling in a study program of the Physical sciences and Engineering Group and Life sciences Group, respectively. A possible explanation is that Emotional stability is perceived as a positive quality for medical and healthcare professions, in which individuals are expected to be reactive under stressful conditions and they would not be conditioned by emotional responses in their decisions and actions. In addition, physical sciences and engineering are related to an empirical and rigorous approach that might be not appealing for less emotionally stable subjects, whereas a higher emotional sensitivity might be more consistent with the choice of a Social sciences and Humanities field of study.

The traits of Conscientiousness and Extraversion are significantly related to the probability of choosing the Physical sciences and Engineering Group. The average marginal effect of being more conscientious decreases of 1.3 percentage points the probability of choosing Group 2. The average marginal effect of being more extroverted is also negative, with a -0.81 percentage points decrease.

Table 4 reports the multinomial logistic regression of the categorical response outcome on the high school category and final grade. Regarding to high school category, the logit of the Physical sciences and Engineering response outcome relative to the reference group of Social sciences and Humanities increases by 1.47 unit if the type of high school attended moves from the classic lyceum to the scientific lyceum, reduces of -1.02 unit if moving from the classic lyceum to other lyceum types (a part from the scientific lyceum), and increases of 1.20 unit if moving from the classic lyceum to technical/professional studies. We can observe analogous results for the relative log-odds of choosing a Life sciences field of study respect to a Social sciences and Humanities field of study. These results support the statement that individuals tend to choose a field of study that is consistent with their prior educational background.

Column 2 of Tables 5-7 shows the average marginal effects of the high school background on the probability of choosing a certain field of study. The average probability of choosing a Social sciences and Humanities field of study decreases of over 20 percentage points if a student attended scientific lyceum respect to a classic lyceum, is over 11 percentage points higher for other lyceum types, and decreases of 12 percentage points for technical/professional studies. Conversely, the discrete difference between attending a scientific lyceum and a classic lyceum is positive with respect to the probability of choosing a Physical sciences and Engineering field of study (8.47 percentage points increase) or a Life sciences field of study (12.09 percentage points increase). The probability of choosing Life sciences is on average lower for subjects who attended other types of lyceum (apart from scientific lyceum) respect to the classic lyceum, that is -.08 unit. Similarly, the probability on average of choosing Physics and Engineering decreases of .03 unit moving from a classic lyceum to other lyceum types. Average marginal effects of technical and professional studies are significant only for the probability of enrolling in a study program of the Physical sciences and Engineering group. In particular, if a subject attended a technical or professional institute than a classic lyceum, the average probability of choosing an academic course of Group 2 increases of 7.94 percentage points.

When looking at the high school final mark, a one-unit increase of the predictive variable raises of .03 unit the log-odds for choosing a Physical sciences and Engineering field of study relative to choosing a Social sciences and Humanities field of study. A one-point increase in high school diploma grade increases the average probability of choosing a Physical sciences and Engineering field of study of .24 percentage points. Conversely, a one-point increase in diploma grade lowers the average probability of choosing a Life sciences field of study - that is mainly health science-oriented study programs- by .24 percentage points. Therefore, individuals who performed better at school are more likely to choose physical sciences and technology-oriented study programs.

Columns from 3 to 5 of Tables 5-7 report the results of multinomial logistic regressions of the categorical choice of the field of study on the Big Five traits when control variables are included. The average marginal effects of Big Five traits are consistent across the specifications, except for the average marginal effects of Extraversion and Emotional stability on the predicted probability of choosing a Physical sciences and Engineering field of study, in which significant regressors become non-significant, and the average marginal effect of Conscientiousness on the predicted probability of choosing a Life sciences field of study, in that the magnitude and level of statistical significance of the relationship changes over different regressions. These results do not allow to establish clear evidence about the state of the relationships. We can argue that the results are conditioned by explanatory variables that are correlated with both the dependent variable and the personality trait. For instance, since Extraversion is negatively related to the high school grade in our sample, a possible explanation is that the high school grade partly captures the effect of Extraversion on the probability of choosing Group 2 and thus the relationship turns out to be insignificant.

Gender differences affect the choice of the field of study. The probability of choosing a Social sciences and Humanities field of study is on average 11.95 percentage points higher for women than men (Table 5 column 6). Conversely, women are, on average, 9.35 percentage points less likely to choose a Physics and Engineering field of study than men. Indeed, women enrolled in a course of study of Group 2 are one-third only.

We further consider whether parents' education attainment affects the probability of choosing a certain field of study. We construct two categorical variables which take value: 1 if the parent did not attain a high school diploma, 2 if he is a high school graduate, 3 if he attained a university degree, and 4 if the highest level of education is a postgraduate degree. Column 5 of Tables 5-7 reports the average marginal effects when other demographic variables are included: the probability of choosing a Social sciences and Humanities field of study on average increases of 3.68 percentage points if the father's highest level of education moves from not having a high school diploma to being high school graduate and of 5.44 percentage points when moving to a university degree. The average probability of choosing a Life sciences field of study is 4.34 percentage points lower if the father's highest level of education moves from no high school diploma to high school diploma. Mother's level of education is not a significant predictor of the probability of choosing any category of academic studies.

Subjects in our sample were asked about parents' influence on the choice of the study program. In particular, respondents evaluated if the father (mother) tried to influence their decision about the study program on a scale ranging from 1 (did not absolutely try) to 7 (absolutely tried). Subjects reported in most cases none to weak attempts to influence their choice. In more depth, 43.47% of respondents reported that the mother did not absolutely try to influence their decision and the average value of the distribution is 2.97; the percentage raises up to 50.60% for the father's attempt of influence, with an average value of 2.66. We include two dummies for the attempt of influence on the choice of the study program which takes value 1 if an individual reported a degree equal or more than 4. We can see in the last column of Tables 5-7 that the average marginal effects of both father's and mother's pressure on the probability of choosing a certain field of study are not significant.

We find evidence that personality traits are related to the probability of choosing a certain field of study. However, the nature of the relationship is of a correlation instead of a causal effect, as students filled in the TIPI questionnaire after that the choice of the study program was already done. For these reasons, a potential problem of endogeneity (reverse causality) might arise if the choice of the field of study indeed had an impact on the personality traits.

4.2 Academic performance

If individuals with some psychological attitudes have a tendency to enroll in certain courses of study and therefore significant differences emerge on average in personality types among the courses, it might result an identification problem of the effects of personality traits on academic performance.

If individuals with some psychological attitudes have a tendency to enroll in certain courses of study and therefore significant differences emerge on average in personality types among the courses, it might result an identification problem of the effects of personality traits on academic performance.

The sample selection problem can be described with the following framework (see Bourguignon et al., 2007):

$$y_1 = x\beta_1 + u_1$$
$$y_j^* = z\gamma_j + \eta_j, \qquad j = 1 \ldots M$$

Where y_1 is the outcome variable of interest. u_1 is the disturbance term, which is not parametrically specified and verifies $E(u_1|x, z) = 0$ and $V(u_1|x, z) = \sigma^2$. j is a categorical variable which corresponds to the set of possible choices based on 'utilities' y_j^*. In our study, the set of possible choices is defined by the three field of study groups (Social sciences and Humanities for category 1, Physical sciences, Informatics and Engineering for category 2, and Life sciences for category 3).

The observation of the outcome variable of interest, academic performance, depends on the student's choice of enrolling in one among the set of possible study programs offered by the University. Therefore, academic performance for, say, Group 1 is observed if and only if the student selects category 1, which is the condition

$$y_1^* > \max_{j \neq 1} (y_j^*)$$

The sample selection bias arises when there exists a correlation between the explanatory variables x and the error term u_1 through the correlation between u_1 and η_j.

Different techniques have been proposed to handle sample selection bias that are based on two-step procedures (e.g. Vella, 1998). First, under certain regularity conditions and distributional assumptions, a selectivity correction is introduced in order to specify the selection problem. Second, the selectivity correction is included in the outcome regression to obtain consistent parameter estimates.

We addressed the issue by implementing the parametric approach to model selection proposed by Bourguignon et al. (2007). The authors present a modified version of the Dubin and McFadden (1984) approach, which is based on two fundamental assumptions:

- The linearity assumption

$$E(u_1 | \eta_1 \dots \eta_M) = \sigma \frac{\sqrt{6}}{\pi} \sum_{j=1\dots M} r_j \ (\eta_j - E(\eta_j))$$

where r_j is a correlation coefficient between u_1 and η_j.

- The restriction

$$\sum_{j=1\dots M} r_j = 0$$

The disturbances $(\eta_j)s$ are independent and identically distributed following a Gumbel distribution.

Bourguignon et al. (2007) propose to transform the $(\eta_j)s$ in standard normal disturbances η_j^* so that u_1 is linear on a set of normal distributions, with u_1 allowed also to be normal, and obtain the following normalized linearity assumption

$$E(u_1 | \eta_1 \dots \eta_M) = \sigma \sum_{j=1\dots M} r_j^* \eta_j^*$$

Finally, the outcome equation to be estimated is

$$y_1 = x_1\beta_1 + \sigma \left[r_1^* \, m(P_1) + \sum_{j=2\dots M} r_j^* \ m(P_j) \frac{P_j}{(P_j - 1)} \right] + w_1$$

where

$$E\left(\eta_1^* \,|\, y_1^* > \max_{s \neq 1} (y_s^*), \Gamma\right) = m(P_1)$$
$$E\left(\eta_j^* \,|\, y_1^* > \max_{s \neq 1} (y_s^*), \Gamma\right) = m(P_j) \frac{P_j}{P_j - 1}, \qquad \forall j > 1$$

and w_1 is a residual mean independent from the regressors.

For our analysis, we use two measures of performance outcomes: the grade point average (GPA) and the total academic credits attained in the first academic year. We distinguish three categories for the selection model corresponding to the three ERC groups: Social sciences and Humanities for category 1, Physical sciences, Informatics and Engineering for category 2, and Life sciences for category 3. We analyze how and to what extent measures of Big Five traits affect students' performance outcomes and include in our analysis a set of control variables. In particular, we add information about the high school background of the student, specifically the high school final grade and a categorical variable for the type of high school attended (1 if classical lyceum, 2 if scientific lyceum, 3 if other lyceum, and 4 if technical/professional institute). Demographic information (i.e. gender, age, and wealth). A set of categorical variables for parents' highest educational achievement, which is ordered: 1 if without a high school diploma, 2 if having a high school diploma, and 3 if graduated/with a

postgraduate degree. The selection model includes the explanatory variables of the most extended specification of the outcome model and the dummy variables for the father's and the mother's attempt to influence the choice of the course of study. For the selection model, we apply a multinomial logistic regression with robust standard errors. We use the selection bias correction method proposed by Bourguignon et al. (2014) to perform LS linear regressions of the outcome of interest under selectivity, with bootstrapping samples for the estimation of the parameter standard errors to take into account the two-step nature of the estimation process.

The GPA variable contains 860 missing values due to students that did not pass any exam in the academic year. However, the field of study choice in the selection model is observed for the whole sample of students (4,102). Therefore, we drop from the sample data the observations with missing values of the dependent variable GPA. In particular, the number of observations after the deletion process is 1,450 for Social sciences and Humanities category, 276 for the Physical sciences, Informatics and Engineering category, and 1,526 for the Life sciences category.

Subjects in our study filled in the personality questionnaire after the completion of the school cycle and immediately before they started to attend courses as students in their first academic year at university. These settings imply that measures of Big Five traits could not have been endogenously influenced by educational achievements by construction and thus may be treated as baseline instruments to infer causal effects of personality traits on performance outcomes. However, this assumption must be taken with caution. A potential limit relies in the fact that since we have a posterior information on students' performance in terms of weighted average of the scores and total amount of credits at the end of the first academic year, we cannot exclude that students' personality traits may be influenced by the performance experience in previous exams, affecting the causal impact on the subsequent exams. In that case, the estimates would be subject to endogeneity in the average of causal effects across the exams.

Table 9 reports the effects of Big Five traits on the grade point average for students of the Social sciences and Humanities group. The first specification in column 1 includes only the personality traits indicators among the explanatory variables. None of the traits is significantly related at the conventional 0.5 level with GPA. If we observe all the specifications from column 1 to 6, there is a tendency of the trait of Openness to being positively correlated with this measure of academic performance, although the parameter estimates are not significant for all the linear regressions. A possible explanation is that subjects who are more intellectually curious and open to new experiences perform better in research sectors that attain the study of the psychological and behavioral aspects of human nature, human culture, and the rules that govern social institutions. Subjects who attended a technical or professional institute perform generally worse than those who attended a classical lyceum, which offers a more comprehensive study of the humanistic disciplines.

We examine whether personality traits affect the total number of academic credits attained in the first year of the study program in the Social sciences and Humanities category (Table 10). Regarding the effects of personality traits on the number of academic credits attained in the first year of the study program, the results are puzzling. A linear regression of Big Five traits on the outcome variable (column 1) shows that the trait of Conscientiousness positively affects the number of academic credits. Conscientiousness is the trait most consistently associated with academic performance in the literature (e.g. O'Connor & Paunonen, 2007). Conscientious subjects are considered to be more motivated to attain academic goals since they are self-disciplined, dutiful, and achievement-oriented. When the high school diploma score is included in the set of control variables the relationship is not more significant. A possible explanation is that the high school diploma grade – which is a highly associated with the performance outcome - is strictly correlated both with the trait of Conscientiousness and the GPA, therefore Conscientiousness is an endogenous variable. Among the control variables, age and the measure of wealth (the logarithm of the economic situation index) appear negatively related to the performance outcome.

Table 11 reports the estimates of a battery of linear regressions of the grade point average for the Physical sciences, Informatics, and Engineering group. A linear regression of Big Five traits on the performance outcome without control variables shows a positive and significant relationship between Conscientiousness and the dependent variable (column 1). However, the magnitude and significance of the marginal effect change over the linear additive models with control variables (columns from 2 to 5). In particular, when the high school diploma grade is considered as an additional control variable, the coefficient for Conscientiousness become non-significant. If we consider all the specifications in the Table, we fail to detect clear tendencies in the estimates.

Table 12 shows the results of a battery of OLS regressions on the total number of academic credits for students in the Physical sciences, Informatics, and Engineering category. In a simple regression of the outcome variable on the personality traits indicators (column 1), the parameter estimate for the trait of Conscientiousness shows a positive relationship with academic performance. Analogously to the previous cases, when the high school diploma score is added to the regression model, the relationship becomes non-significant. Some evidence is found that the trait of Agreeableness is negatively related to the performance outcome. However, the parameter estimates are not robust across all the specifications. Analogously, the trait of Emotional stability is positively related to the measure of academic performance in a regression model including the high school diploma grade as control variable, but the parameter estimate is generally non-significant when looking at the other regression analyses. Among the control variables, the measure of wealth exhibits a negative relationship with the outcome variable.

Table 13 illustrates the LS regressions on GPA for students in Life sciences. The linear regression of GPA on the personality traits indicators that are reported in Column 1 describes a positive and significant relationship between the trait of Conscientiousness and the outcome variable. The magnitude of the parameter estimate consistently reduces when the high school diploma grade- which is strongly correlated with GPA- is included as control variable (column 2), but is still statistically significant. In addition, the relationship is confirmed across all the specifications except for the regression reported in the last column of the Table, in which interaction terms of the gender dummy with the Big Five traits are included in the estimation model.

We do not find evidence that personality traits affect the number of academic credits attained for students in Life sciences (Table 14). The high school diploma grade is not significantly associated with the dependent variable. Some evidence is found that men tend to perform better than women, but there is not a clear pattern of significance in the estimates across the specifications. In addition, subjects who attended a professional or technical institute tend to perform better respect to the students with a classical lyceum background. The measure of wealth is negatively related to the outcome variable.

5. Discussion and conclusion

In this study, we investigate the relationship between personality traits and the choice of the field of study using survey data from a cohort of university students enrolled in the first year of a (Bachelor or single cycle) study program. For this purpose, we organize the fields of study in three groups: Social sciences and Humanities, Physical sciences and Engineering, and Life sciences. We find that personality traits are significantly related to the probability of choosing a certain field of study: Openness to experiences and Neuroticism increase the probability of choosing a Social sciences and Humanities field of study; Emotional stability increases the probability of choosing a Physical sciences and Engineering field of study whereas the traits of Conscientiousness and Extraversion are negative predictors; Openness to experiences decreases and Emotional stability increases the probability of choosing a Life sciences field of study. Agreeableness is not significantly associated with the choice of the field of study.

We then analyze whether personality traits have causal effects on the performance outcomes, measured as grade point average and number of academic credits gained in the first academic year of a study program. In order to account for a potential self-selection bias related to the choice of the field of study, we applied the parametric approach proposed by Bourguignon et al, (2014) for selectivity correction. We find that the marginal effects of personality traits vary depending on which measure of performance outcome is used, but no clear tendencies generally emerge across the estimates. Some

evidence is found that Conscientiousness positively affects academic performance, especially for the estimation of the GPA in the Life sciences field of study. However, when the measure of high school performance is included in the set of control variables, the parameter estimate tends to become non-significant.

References

Allport, G. W., & Odbert, H. S. (1936). Trait-names: A psycho-lexical study. *Psychological monographs*, *47*(1), i.

Bratko, D., Chamorro-Premuzic, T., & Saks, Z. (2006). Personality and school performance: Incremental validity of self-and peer-ratings over intelligence. *Personality and Individual Differences*, *41*(1), 131-142.

Bourguignon, F., Fournier, M., & Gurgand, M. (2007). Selection bias corrections based on the multinomial logit model: Monte Carlo comparisons. Journal of Economic Surveys, 21(1), 174-205.

Burks, S. V., Lewis, C., Kivi, P. A., Wiener, A., Anderson, J. E., Götte, L., ... & Rustichini, A. (2015). Cognitive skills, personality, and economic preferences in collegiate success. *Journal of Economic Behavior & Organization*, *115*, 30-44.

Buser, T., Niederle, M., & Oosterbeek, H. (2014). Gender, competitiveness, and career choices. *The Quarterly Journal of Economics*, *129*(3), 1409-1447.

Chamorro-Premuzic, T., & Furnham, A. (2003). Personality traits and academic examination performance. *European journal of Personality*, *17*(3), 237-250.

Cobb-Clark, D. A., & Tan, M. (2011). Noncognitive skills, occupational attainment, and relative wages. *Labour Economics*, *18*(1), 1-13.

Conard, M. A. (2006). Aptitude is not enough: How personality and behavior predict academic performance. *Journal of Research in Personality*, *40*(3), 339-346.

Farsides, T., & Woodfield, R. (2003). Individual differences and undergraduate academic success: The roles of personality, intelligence, and application. *Personality and individual differences*, *34*(7), 1225-1243.

Gosling, S. D., Rentfrow, P. J., & Swann Jr, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in personality*, *37*(6), 504-528.

Hakimi, S., Hejazi, E., & Lavasani, M. G. (2011). The relationships between personality traits and students' academic achievement. *Procedia-Social and Behavioral Sciences*, *29*, 836-845.

Humburg, M. (2017). Personality and field of study choice in university. *Education Economics*, *25*(4), 366-378.

Kaiser, R. T., & Ozer, D. J. (1997). Emotional stability and goal-related stress. *Personality and Individual Differences*, *22*(3), 371-379.

Komarraju, M., Karau, S. J., & Schmeck, R. R. (2009). Role of the Big Five personality traits in predicting college students' academic motivation and achievement. *Learning and individual differences*, *19*(1), 47-52.

McCrae, R. R., Costa Jr, P. T., Terracciano, A., Parker, W. D., Mills, C. J., De Fruyt, F., & Mervielde, I. (2002). Personality trait development from age 12 to age 18: Longitudinal, cross-sectional and cross-cultural analyses. *Journal of personality and social psychology*, *83*(6), 1456.

O'Connor, M. C., & Paunonen, S. V. (2007). Big Five personality predictors of post-secondary academic performance. *Personality and Individual differences*, *43*(5), 971-990.

Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and academic performance. *Psychological bulletin*, *135*(2), 322.

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. *Psychological bulletin*, *138*(2), 353.

Roberts, B. W. (2009). Back to the future: Personality and assessment and personality development. *Journal of research in personality*, *43*(2), 137-145.

Vedel, A. (2016). Big Five personality group differences across academic majors: A systematic review. *Personality and individual differences*, *92*, 1-10.

Vella, F. (1998). Estimating models with sample selection bias: a survey. Journal of Human Resources, 127-169.

Tables and figures

Table 1: Summary statistics.

Variables	Description	N	mean	sd	min	max
female	female=1	4,102	0.586	0.493	0	1
age	age at 30 december 2016	4,102	20.00	1.186	17.97	24
dummy_liceo	high school diploma: lyceum=1	4,102	0.750	0.433	0	1
diploma_score	high school diploma score	4,102	80.67	11.93	60	100
e	Extraversion	4,102	4.082	1.346	1	7
a	Agreeableness	4,102	5.392	1.065	1	7
c	Conscientiousness	4,102	5.516	1.116	1	7
n	Emotional stability	4,102	4.627	1.256	1	7
o	Openness to experience	4,102	4.773	0.944	1	7
total_cfu	total number of academic credits	4,102	26.90	20.02	0	133
gpa	grade point average (GPA)	3,242	25.07	2.614	18	30
log_iseeu	logarithm of Equivalent Economic Situation Index - University	4,102	10.04	1.537	0	11.59
dummy_drivefat	father's attempt to influence choice of study program	4,102	0.227	0.419	0	1
dummy_drivemot	mother's attempt to influence choice of study program	4,102	0.272	0.445	0	1

Table 2: Summary statistics of the three field of study groups.

	Group 1 **Social sciences and Humanities**	**Group 2** **Physical sciences and Engineering**	**Group 3** **Life sciences**
number of students	1881	396	1825
percentage	45.86	9.65	44.49
high school diploma (percent)			
classic lyceum	21.53	10.35	15.95
scientific lyceum	28.92	53.79	45.75
other lyceum	26.16	4.04	13.04
technical/professional institute	23.39	31.82	25.26
average high school diploma grade	80.90	83.63	79.80

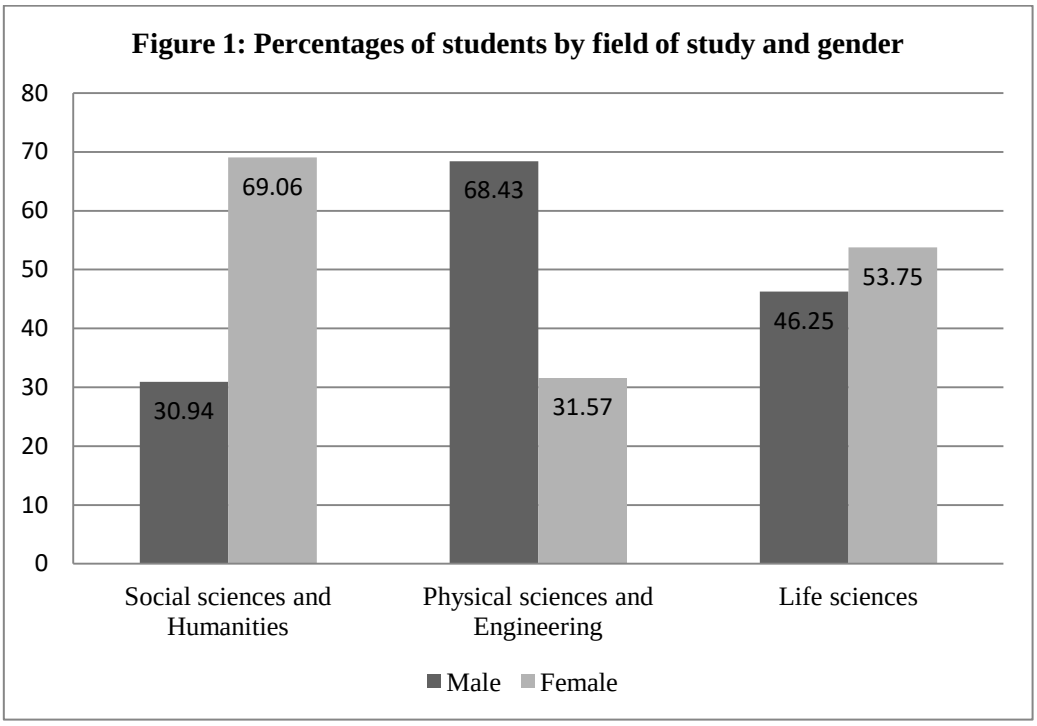


Table 3: Multinomial logistic regressions of the choice a certain field of study on Big Five traits.

Baseline outcome: Group 1	**Group 2** **Physical sciences and Engineering**	**Group 3** **Life sciences**
Extraversion	-0.090** (0.04)	0.008 (0.03)
Agreeableness	-0.077 (0.06)	-0.039 (0.03)
Conscientiousness	-0.148*** (0.05)	0.005 (0.03)
Emotional stability	0.318*** (0.05)	0.235*** (0.03)
Openness to experience	-0.07 (0.06)	-0.111*** (0.04)
constant	-1.116** (0.45)	-0.433 (0.27)

NOTES. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 4: Multinomial logistic regressions of the choice a certain field of study on school background.

Baseline outcome: Group 1	**Group 2**	**Group 3**
	Physical sciences and Engineering	**Life sciences**
high school diploma score	0.025***	-0.005*
	(0.00)	(0.00)
scientific lyceum	1.467***	0.733***
	(0.18)	(0.10)
other lyceum	-1.026***	-0.419***
	(0.30)	(0.11)
technical/professional institute	1.204***	0.342***
	(0.20)	(0.10)
constant	-4.460***	0.13
	(0.45)	(0.25)

NOTES. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 5: Average marginal effects on the probability of choosing a Social sciences and Humanities field of study.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	0.002		0.001	0.001	0.000	0.001
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Agreeableness	0.011		0.006	0.005	0.000	0.000
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Conscientiousness	0.005		0.003	0.002	-0.005	-0.004
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Emotional stability	-0.061***		-0.050***	-0.049***	-0.034***	-0.034***
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Openness	0.025***		0.022***	0.022***	0.020**	0.020**
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
high school diploma grade		0.000	-0.000	-0.000	-0.001	-0.001*
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High school diploma category						
Scientific lyceum		-0.206***	-0.201***	-0.207***	-0.185***	-0.185***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Other lyceum		0.112***	0.100***	0.091***	0.087***	0.088***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Technical/Professional institute		-0.120***	-0.114***	-0.125***	-0.078***	-0.076***
		(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Father's level of education						
High school diploma				0.029	0.037**	0.038**
				(0.02)	(0.02)	(0.02)
Academic degree				0.039	0.054**	0.057**
				(0.03)	(0.03)	(0.03)
Postgraduate degree				-0.042	-0.024	-0.022
				(0.04)	(0.04)	(0.04)
Mother's level of education						
High school diploma				-0.039**	-0.036*	-0.036*
				(0.02)	(0.02)	(0.02)
Academic degree				-0.035	-0.030	-0.031
				(0.03)	(0.03)	(0.03)
Postgraduate degree				-0.084**	-0.073*	-0.075*
				(0.04)	(0.04)	(0.04)
female					0.119***	0.120***
					(0.02)	(0.02)
age					-0.013*	-0.013**
					(0.01)	(0.01)
logarithm of ISEEU					-0.005	-0.005
					(0.00)	(0.00)
father's influence						-0.034
						(0.03)
mother's influence						0.004
						(0.02)

NOTES. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 6: Average marginal effects on the probability of choosing a Physical sciences and Engineering field of study.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.008**		-0.006	-0.006*	-0.006*	-0.006*
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Agreeableness	-0.005		-0.002	-0.001	0.003	0.003
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Conscientiousness	-0.013***		-0.018***	-0.017***	-0.011**	-0.011**
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Emotional stability	0.017***		0.014***	0.013***	0.002	0.002
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Openness	-0.001		-0.001	-0.001	0.000	-0.000
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
high school diploma grade		0.002***	0.003***	0.003***	0.003***	0.003***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High school diploma category						
Scientific lyceum		0.085***	0.084***	0.084***	0.071***	0.072***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Other lyceum		-0.028***	-0.027***	-0.024**	-0.024**	-0.023**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Technical/Professional institute		0.079***	0.078***	0.085***	0.053***	0.054***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Father's level of education						
High school diploma				0.015	0.007	0.006
				(0.01)	(0.01)	(0.01)
Academic degree				0.006	-0.011	-0.011
				(0.02)	(0.02)	(0.02)
Postgraduate degree				-0.013	-0.033*	-0.033*
				(0.02)	(0.02)	(0.02)
Mother's level of education						
High school diploma				0.017	0.014	0.014
				(0.01)	(0.01)	(0.01)
Academic degree				0.024	0.018	0.018
				(0.02)	(0.02)	(0.02)
Postgraduate degree				0.064**	0.052*	0.052*
				(0.03)	(0.03)	(0.03)
female					-0.093***	-0.093***
					(0.01)	(0.01)
age					0.005	0.005
					(0.00)	(0.00)
logarithm of ISEEU					0.011**	0.011**
					(0.00)	(0.00)
father's influence						-0.001
						(0.02)
mother's influence						-0.010
						(0.02)

NOTES. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 7: Average marginal effects on the probability of choosing a Life sciences field of study.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	0.006		0.005	0.005	0.006	0.005
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Agreeableness	-0.006		-0.004	-0.004	-0.003	-0.003
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Conscientiousness	0.008		0.015**	0.015*	0.016**	0.015**
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Emotional stability	0.043***		0.036***	0.036***	0.032***	0.033***
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Openness to experience	-0.024***		-0.021**	-0.021**	-0.021**	-0.020**
	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
high school diploma grade		-0.002***	-0.003***	-0.003***	-0.002***	-0.002***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High school diploma category						
Scientific lyceum		0.121***	0.117***	0.123***	0.114***	0.113***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Other lyceum		-0.084***	-0.073***	-0.067***	-0.063**	-0.065**
		(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Technical/Professional institute		0.040*	0.036	0.040	0.025	0.021
		(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Father's level of education						
High school diploma				-0.044**	-0.043**	-0.044**
				(0.02)	(0.02)	(0.02)
Academic degree				-0.045*	-0.044	-0.046*
				(0.03)	(0.03)	(0.03)
Postgraduate degree				0.055	0.057	0.055
				(0.04)	(0.04)	(0.04)
Mother's level of education						
High school diploma				0.022	0.022	0.022
				(0.02)	(0.02)	(0.02)
Academic degree				0.012	0.012	0.014
				(0.03)	(0.03)	(0.03)
Postgraduate degree				0.020	0.021	0.023
				(0.04)	(0.04)	(0.04)
female					-0.025	-0.026
					(0.02)	(0.02)
age					0.008	0.008
					(0.01)	(0.01)
logarithm of ISEEU					-0.006	-0.006
					(0.01)	(0.01)
father's influence						0.035
						(0.03)
mother's influence						0.006
						(0.02)

NOTES. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 8: OLS regressions of the field of study variable on the Big Five traits.

	(1)	(2)	(3)	(4)	(5)
	Extraversion	**Agreeableness**	**Conscientiousness**	**Emotional stability**	**Openness**
Physical sciences and Engineering	-0.086	-0.036	-0.102	0.372***	-0.063
	(0.08)	(0.06)	(0.06)	(0.07)	(0.05)
Life sciences	0.050	0.028	0.070*	0.340***	-0.066**
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)
Constant	4.068***	5.383***	5.495***	4.440***	4.808***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)

NOTES. OLS univariate regressions. Dependent variable is a Big Five trait ((1) to (5)). Independent variable is a categorical variable for the field of study. The Social sciences and Humanities group is omitted. Robust standard errors in parentheses. Significance levels * .10 **.05 ***.01.

Table 9: OLS linear regressions of GPA for the Social sciences and Humanities category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.013	-0.012	-0.013	0.009	0.001	-0.059
	(0.08)	(0.05)	(0.05)	(0.05)	(0.06)	(0.14)
Agreeableness	-0.145	-0.037	-0.024	-0.054	-0.056	-0.056
	(0.09)	(0.07)	(0.07)	(0.07)	(0.08)	(0.17)
Conscientiousness	0.164*	-0.079	-0.055	-0.049	-0.039	0.038
	(0.08)	(0.06)	(0.06)	(0.07)	(0.07)	(0.21)
Emotional stability	0.158*	-0.024	-0.061	-0.042	-0.014	-0.007
	(0.08)	(0.07)	(0.07)	(0.08)	(0.10)	(0.18)
Openness	0.032	0.127*	0.164**	0.178**	0.159	0.190
	(0.10)	(0.07)	(0.07)	(0.08)	(0.10)	(0.27)
high school diploma grade		0.094***	0.088***	0.081***	0.080***	0.077***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Type of high school diploma						
scientific lyceum			-0.027	-0.284	-0.094	0.103
			(0.24)	(0.35)	(0.45)	(1.00)
other lyceum			0.074	0.098	0.152	0.081
			(0.21)	(0.22)	(0.25)	(0.46)
technical/professional institute			-1.222***	-1.451***	-1.256***	-1.153*
			(0.23)	(0.28)	(0.37)	(0.61)
female				0.547*	0.495	0.779
				(0.30)	(0.35)	(1.54)
age				0.126	0.159	0.194
				(0.09)	(0.10)	(0.20)
logarithm of ISEEU				-0.029	-0.036	-0.012
				(0.04)	(0.06)	(0.12)
Father's level of education						
high school diploma					0.016	-0.042
					(0.20)	(0.35)
academic degree					-0.025	-0.137
					(0.31)	(0.57)
postgraduate degree					0.448	0.459
					(0.34)	(0.43)
Mother's level of education						
high school diploma					-0.017	0.016
					(0.16)	(0.26)
academic degree					0.354	0.398
					(0.24)	(0.30)
postgraduate degree					0.176	0.279
					(0.46)	(0.60)
Extraversion*female						0.080
						(0.16)
Agreeableness*female						-0.023
						(0.30)
Conscientiousness*female						-0.085
						(0.20)
Emotional stability*female						0.050
						(0.22)
Openness*female						-0.077
						(0.28)
constant	26.499***	18.538***	17.633***	15.027***	14.643***	14.345***
	(1.03)	(1.17)	(1.26)	(1.96)	(1.97)	(2.22)

NOTES. Standard errors in parentheses. Levels of statistical significance *** p<0.01, ** p<0.05, * p<0.1.
Number of observations: 1,450.

Table 10: OLS linear regressions of the total number of academic credits for the Social sciences and Humanities category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	0.472	0.371	0.443	0.717*	0.662*	0.535
	(0.46)	(0.41)	(0.43)	(0.39)	(0.37)	(0.69)
Agreeableness	0.250	0.795	0.668	0.901*	0.996**	-0.147
	(0.56)	(0.50)	(0.52)	(0.46)	(0.48)	(1.17)
Conscientiousness	2.442***	-0.175	0.266	0.805	0.923	-0.054
	(0.58)	(0.59)	(0.62)	(0.52)	(0.57)	(1.21)
Emotional stability	0.332	-0.660	0.756	0.395	0.303	-0.040
	(0.59)	(0.60)	(0.89)	(0.65)	(0.75)	(0.92)
Openness	-0.963	0.013	-0.638	-0.568	-0.536	1.481
	(0.68)	(0.55)	(0.65)	(0.54)	(0.62)	(1.21)
high school diploma grade		0.759***	0.673***	0.490***	0.477***	0.485***
		(0.06)	(0.07)	(0.07)	(0.07)	(0.09)
Category of high school diploma						
scientific lyceum			7.996***	5.469*	5.612*	-0.186
			(3.00)	(3.04)	(3.28)	(6.87)
other lyceum			-1.338	-1.172	0.107	2.732
			(2.25)	(1.78)	(2.01)	(3.28)
technical/professional institute			-2.529	-5.186**	-4.133*	-5.961*
			(2.13)	(2.06)	(2.17)	(3.38)
female				0.018	0.745	3.692
				(2.42)	(2.51)	(10.93)
age				-1.568***	-1.495***	-1.939***
				(0.49)	(0.51)	(0.70)
logarithm of ISEEU				-3.533***	-3.737***	-3.788***
				(0.40)	(0.46)	(0.52)
Father's level of education						
high school diploma					0.849	2.234
					(1.40)	(1.88)
academic degree					4.060*	5.907**
					(2.08)	(2.84)
postgraduate degree					3.312	1.885
					(2.79)	(3.34)
Mother's level of education						
high school diploma					0.175	-0.921
					(1.28)	(1.85)
academic degree					0.476	-0.163
					(1.79)	(1.99)
postgraduate degree					2.656	0.688
					(3.49)	(4.73)
Extraversion*female						0.167
						(0.77)
Agreeableness*female						1.781
						(1.72)
Conscientiousness*female						0.975
						(1.42)
Emotional stability*female						-1.336
						(1.65)
Openness*female						-1.822
						(1.29)
constant	24.918***	-31.508***	-21.792	47.340***	43.677***	37.062*
	(7.22)	(9.46)	(13.27)	(14.19)	(16.31)	(19.09)

NOTES: Standard errors in parentheses. Levels of significance *** p<0.01, ** p<0.05, * p<0.1.
Number of observations: 1,881.

Table 11: OLS linear regressions of GPA for the Physical sciences, Informatics, and Engineering category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.061	-0.071	-0.058	0.033	0.071	0.049
	(0.15)	(0.12)	(0.13)	(0.15)	(0.18)	(0.37)
Agreeableness	-0.240	-0.162	-0.139	-0.235	-0.307	-0.227
	(0.22)	(0.17)	(0.17)	(0.17)	(0.21)	(0.48)
Conscientiousness	0.895***	0.292	0.314	0.411*	0.337	0.480
	(0.21)	(0.20)	(0.22)	(0.24)	(0.28)	(0.67)
Emotional stability	0.148	-0.088	-0.033	0.033	-0.198	0.101
	(0.20)	(0.19)	(0.16)	(0.18)	(0.25)	(0.45)
Openness	0.091	0.186	0.198	0.209	0.414	0.334
	(0.24)	(0.15)	(0.17)	(0.20)	(0.27)	(0.65)
high school diploma grade		0.146***	0.123***	0.074	0.078	0.016
		(0.03)	(0.03)	(0.05)	(0.06)	(0.12)
Category of high school diploma						
scientific lyceum			0.225	-0.541	-2.078	-2.637
			(0.60)	(1.05)	(1.79)	(3.71)
other lyceum			-0.739	-0.093	0.682	1.457
			(1.54)	(1.74)	(1.73)	(2.62)
technical/professional institute			-0.964	-1.507*	-2.481*	-3.087
			(0.75)	(0.90)	(1.38)	(2.69)
female				1.387	2.597*	6.202
				(1.02)	(1.46)	(6.90)
age				0.115	-0.167	-0.155
				(0.18)	(0.27)	(0.56)
logarithm of ISEEU				-0.150	-0.304	-0.246
				(0.13)	(0.21)	(0.36)
Father's level of education						
high school diploma					0.805	0.514
					(0.62)	(0.96)
academic degree					1.185	0.799
					(0.93)	(1.47)
postgraduate degree					0.164	0.455
					(1.34)	(1.83)
Mother's level of education						
high school diploma					-0.863*	-0.912
					(0.48)	(0.90)
academic degree					-1.020*	-1.138
					(0.62)	(1.18)
postgraduate degree					-1.152	-1.459
					(1.23)	(2.02)
Extraversion*female						0.286
						(0.51)
Agreeableness*female						-0.560
						(0.82)
Conscientiousness*female						0.254
						(0.67)
Emotional stability*female						-0.425
						(0.76)
Openness*female						-0.051
						(0.72)
constant	34.321***	16.611***	18.613***	24.482***	34.276***	39.355
	(3.68)	(4.41)	(3.92)	(8.73)	(12.08)	(26.09)

NOTES: standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1.
Number of observations: 276.

Table 12: OLS linear regressions of the total number of academic credits for the Physical sciences, Informatics, and Engineering category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.825	-1.228*	-1.119	-0.593	-0.368	2.285
	(0.78)	(0.71)	(0.73)	(0.70)	(0.84)	(1.53)
Agreeableness	-1.308	-1.612**	-1.466*	-1.294*	-1.799*	-3.505
	(0.86)	(0.78)	(0.84)	(0.74)	(1.00)	(2.53)
Conscientiousness	2.662***	-0.530	-0.340	0.684	1.478	3.579
	(0.83)	(1.04)	(0.99)	(0.92)	(1.15)	(2.26)
Emotional stability	-0.778	-2.054**	-1.771*	-0.849	-1.339	-0.524
	(0.91)	(0.93)	(1.00)	(0.83)	(1.38)	(2.33)
Openness	-0.379	0.560	0.257	-0.806	-0.329	-0.138
	(1.04)	(0.98)	(1.16)	(1.04)	(1.19)	(2.32)
high school diploma grade		0.763***	0.727***	0.603***	0.367	-0.510
		(0.10)	(0.10)	(0.15)	(0.22)	(0.52)
Category of high school diploma						
scientific lyceum			2.078	6.039	-1.207	-28.661
			(3.50)	(4.82)	(7.46)	(18.04)
other lyceum			1.236	-1.332	1.980	14.197
			(4.04)	(4.30)	(5.64)	(12.72)
technical/professional institute			-0.485	-1.093	-5.962	-24.968**
			(3.09)	(3.74)	(5.01)	(11.34)
female				-4.040	3.064	61.571*
				(4.70)	(7.20)	(31.88)
age				1.122	0.735	-1.281
				(0.70)	(0.75)	(1.57)
logarithm of ISEEU				-2.958***	-3.836***	-6.987***
				(0.83)	(1.19)	(2.15)
Father's level of education						
high school diploma					-0.964	-0.584
					(2.72)	(4.26)
academic degree					2.609	8.082
					(3.33)	(7.05)
postgraduate degree					1.404	10.107
					(5.65)	(9.95)
Mother's level of education						
high school diploma					-3.875	-8.936*
					(2.72)	(4.61)
academic degree					-0.402	-6.088
					(3.15)	(5.21)
postgraduate degree					-6.858	-20.564**
					(5.80)	(10.03)
Extraversion*female						-3.516
						(2.25)
Agreeableness*female						1.602
						(3.82)
Conscientiousness*female						-0.783
						(2.87)
Emotional stability*female						-6.274
						(5.41)
Openness*female						1.967
						(2.97)
constant	30.301	-67.627***	-69.734***	-38.193	24.894	236.369*
	(23.62)	(23.48)	(23.93)	(40.12)	(52.58)	(134.56)

NOTES: Standard errors in parentheses. Levels of significance *** p<0.01, ** p<0.05, * p<0.1.
Number of observations: 396.

Table 13: OLS linear regressions of GPA for the Life sciences category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.012	-0.019	-0.018	0.000	-0.008	0.020
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.10)
Agreeableness	-0.102	-0.021	-0.033	-0.050	-0.065	-0.156
	(0.08)	(0.08)	(0.08)	(0.07)	(0.08)	(0.15)
Conscientiousness	0.398***	0.147**	0.185***	0.181***	0.193**	0.140
	(0.08)	(0.07)	(0.07)	(0.07)	(0.08)	(0.16)
Emotional stability	-0.004	-0.127*	-0.058	-0.046	0.010	-0.106
	(0.09)	(0.07)	(0.07)	(0.07)	(0.09)	(0.13)
Openness	-0.083	0.003	-0.030	-0.021	-0.051	0.183
	(0.09)	(0.07)	(0.07)	(0.08)	(0.09)	(0.19)
high school diploma grade		0.071***	0.059***	0.056***	0.056***	0.064***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Category of high school diploma						
scientific lyceum			0.507*	0.374	0.654	0.044
			(0.28)	(0.34)	(0.46)	(0.95)
other lyceum			-0.303	-0.316	-0.491	-0.343
			(0.28)	(0.29)	(0.30)	(0.40)
technical/professional institute			-0.276	-0.396	-0.294	-0.662
			(0.26)	(0.29)	(0.37)	(0.60)
female				0.375	0.128	0.822
				(0.26)	(0.30)	(1.45)
age				0.114*	0.159*	0.052
				(0.07)	(0.09)	(0.16)
logarithm of ISEEU				-0.091*	-0.037	-0.107
				(0.05)	(0.06)	(0.12)
Father's level of education						
high school diploma					-0.169	-0.001
					(0.18)	(0.32)
academic degree					-0.434	-0.137
					(0.31)	(0.50)
postgraduate degree					-0.675**	-0.692*
					(0.32)	(0.42)
Mother's level of education						
high school diploma					0.046	-0.057
					(0.17)	(0.23)
academic degree					-0.018	-0.132
					(0.25)	(0.32)
postgraduate degree					0.526	0.278
					(0.41)	(0.50)
Extraversion*female						-0.025
						(0.12)
Agreeableness*female						0.183
						(0.27)
Conscientiousness*female						0.018
						(0.19)
Emotional stability*female						0.004
						(0.20)
Openness*female						-0.283
						(0.19)
constant	18.775***	18.623***	18.355***	16.880***	14.973***	19.521***
	(1.18)	(0.85)	(1.05)	(2.43)	(3.11)	(6.90)

NOTES: Standard errors in parentheses. Levels of significance *** p<0.01, ** p<0.05, * p<0.1.
Number of observations: 1,516.

Table 14: OLS linear regressions of the total number of academic credits for the Life sciences category.

	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	0.157	0.162	0.025	0.283	0.209	-0.554
	(0.38)	(0.36)	(0.40)	(0.38)	(0.41)	(0.76)
Agreeableness	-0.413	-0.418	-0.413	-0.353	-0.325	-0.260
	(0.49)	(0.51)	(0.51)	(0.52)	(0.52)	(1.11)
Conscientiousness	0.533	0.584	0.127	0.474	0.477	0.642
	(0.47)	(0.63)	(0.66)	(0.57)	(0.58)	(1.09)
Emotional stability	-0.229	-0.219	-0.461	0.234	0.441	0.740
	(0.49)	(0.48)	(0.68)	(0.62)	(0.71)	(1.03)
Openness	0.126	0.108	0.384	-0.155	-0.306	-0.063
	(0.53)	(0.53)	(0.72)	(0.59)	(0.70)	(1.35)
high school diploma grade		-0.013	0.096	0.105	0.139*	0.137
		(0.07)	(0.08)	(0.07)	(0.08)	(0.10)
Type of high school diploma						
scientific lyceum			3.602	5.963***	8.011**	7.943
			(2.42)	(2.24)	(3.34)	(6.53)
other lyceum			6.703***	3.322	2.773	3.052
			(2.17)	(2.28)	(2.43)	(3.52)
technical/professional institute			8.251***	6.389***	7.874***	7.688**
			(1.95)	(1.82)	(2.27)	(3.46)
female				-3.886*	-5.354**	-4.101
				(2.09)	(2.50)	(10.76)
age				0.658	0.794	0.766
				(0.49)	(0.50)	(0.69)
logarithm of ISEEU				-3.430***	-3.401***	-3.402***
				(0.46)	(0.50)	(0.57)
Father's level of education						
high school diploma					0.022	-0.013
					(1.35)	(1.94)
academic degree					0.155	0.139
					(1.99)	(2.62)
postgraduate degree					-0.563	-0.509
					(2.66)	(3.26)
Mother's level of education						
high school diploma					1.498	1.448
					(1.30)	(1.97)
academic degree					1.019	0.971
					(1.83)	(2.15)
postgraduate degree					4.734	4.716
					(2.95)	(4.35)
Extraversion*female						1.428
						(0.89)
Agreeableness*female						-0.001
						(1.80)
Conscientiousness*female						-0.314
						(1.21)
Emotional stability*female						-0.584
						(1.37)
Openness*female						-0.540
						(1.30)
constant	28.069**	28.020***	28.108**	27.164	19.116	16.391
	(11.17)	(10.32)	(14.07)	(17.88)	(20.57)	(40.45)

NOTES. Standard errors in parentheses. Significance levels *** p<0.01, ** p<0.05, * p<0.1.
Number of observations 1,825.