The Relationship Between Economic Preferences and Psychological Personality Measures

Anke Becker,[1,2] Thomas Deckers,[1,2] Thomas Dohmen,[3] Armin Falk,[1] and Fabian Kosse[1,2]

[1]Department of Economics, and [2]Bonn Graduate School of Economics, University of Bonn, 53113 Bonn, Germany; email: armin.falk@uni-bonn.de

[3]ROA (Research Centre for Education and the Labour Market) and Department of Economics, Maastricht University, 6200 MD Maastricht, The Netherlands

Annu. Rev. Econ. 2012. 4:453–78

First published online as a Review in Advance on April 5, 2012

The *Annual Review of Economics* is online at economics.annualreviews.org

This article's doi: 10.1146/annurev-economics-080511-110922

JEL codes: C91, D01, D80, D90, I00, J30, J62

1941-1383/12/0904-0453$20.00

Keywords

risk preference, time preference, social preferences, locus of control, Big Five

Abstract

Although both economists and psychologists seek to identify determinants of heterogeneity in behavior, they use different concepts to capture them. In this review, we first analyze the extent to which economic preferences and psychological concepts of personality, such as the Big Five and locus of control, are related. We analyze data from incentivized laboratory experiments and representative samples and find only low degrees of association between economic preferences and personality. We then regress life outcomes (such as labor market success, health status, and life satisfaction) simultaneously on preference and personality measures. The analysis reveals that the two concepts are rather complementary when it comes to explaining heterogeneity in important life outcomes and behavior.

1. INTRODUCTION

Both economists and personality psychologists seek to identify determinants of heterogeneity in behavior. Economists typically depict decision problems in a framework of utility maximization. An individual's utility is shaped by preferences such as risk, time, and social preferences.[1] These preferences, in combination with expectations of future events, perceptions, beliefs, strategic consideration, prices, and constraints, shape behavior. Personality psychology, the branch of psychology studying personality and individual differences, offers several frameworks describing universal traits and individual differences. Personality traits—defined by Roberts (2009, p. 140) as "the relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances"—are important determinants of personality (Roberts 2006) and affect outcomes. There has been a long tradition in personality psychology of measuring personality traits. The Big Five, or five-factor, model is the most widely used taxonomy of personality traits. It originates from the lexical hypothesis of Allport & Odbert (1936), which postulates that individual differences are encoded in language (see Borghans et al. 2008). After years of research in this tradition, psychologists have arrived at a hierarchical organization of personality traits with five traits at the highest level. These Big Five traits (which are commonly labeled as openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) capture personality traits at the broadest level of abstraction. Each Big Five trait condenses several distinct and more narrowly defined traits. It has been argued that the bulk of items that personality psychologists have used to measure personality can be mapped into the Big Five taxonomy (see, e.g., Costa & McCrae 1992; for a more detailed description of the research on the development of the Big Five, criticism of the approach, and alternative measurement systems, see Borghans et al. 2008). Another important concept in psychology focusing on individual beliefs and perceptions is the locus-of-control framework by Rotter (1966). It represents the framework of the social learning theory of personality and refers to the extent people believe they have control over events.

An integration of the different measures and concepts used by economists and personality psychologists promises much potential for amalgamating evidence about the drivers of human behavior, which accumulated disjointedly in the fields of economics and psychology (Borghans et al. 2008). Recently, scholars have begun to integrate personality into economic decision making (e.g., Borghans et al. 2008). Almlund et al. (2011) enrich theory by incorporating personality traits in a standard economic framework of production, choice, and information. Their model interprets measured personality as a "construct derived from an economic model of preferences, constraints, and information" (Almlund et al. 2011, p. 3). However, empirical knowledge is too limited to judge how personality traits relate to the concepts and parameters economists typically model to predict behavior.

[1] In the standard expected utility framework, risk preference is captured by the curvature of the utility function, whereas the degree of risk aversion is represented in the concavity of the utility function (e.g., Gollier 2001). Time preference describes how an individual trades off utility at different points in time (Samuelson 1937, Frederick et al. 2002). Social preferences capture the idea that an individual's utility does not depend only on his own material payoff, but that it is also shaped by others' behavior and material payoff. Social preferences include altruism (e.g., Eckel & Grossmann 1996) and negative and positive reciprocity (e.g., Falk & Fischbacher 2006). Finally, trust describes an individual's belief about others' trustworthiness combined with a preference to take social risks (e.g., Fehr 2009). Another important economic preference is the preference for work versus leisure. This preference is difficult to measure in experiments and is therefore not part of our analysis.

To shed more light on the relationship between economic preferences and psychological measures of personality, we therefore study how key economic preferences (such as risk, time, and social preferences) are linked to conventional measures of personality, such as the Big Five and locus of control. We analyze this relationship in a coherent framework using two main approaches. The first approach focuses on assessing the magnitude of the correlations between psychological and economic measurement systems in three unique data sets. The second approach departs from the fact that both preference measures and measures of personality traits predict a wide range of important life outcomes. If these two measurement systems are closely linked, they are expected to be substitutes in explaining heterogeneity in behavior. If, however, preferences and personality traits capture different aspects of behavior, the two measurement systems may have complementary predictive power for important life outcomes. We therefore evaluate the individual as well as the joint explanatory power of economic preferences and psychological measures of personality in explaining health, educational, and labor market outcomes.

We use three complementary data sets. First, we look at data from laboratory experiments. Using a student subject pool, we conducted choice experiments on key economic preferences, namely risk taking, time discounting, altruism, trust, and positive and negative reciprocity. We incentivized decision making and obtained multiple behavioral measures for each preference. We assessed the Big Five domains using the 60-item NEO-FFI (NEO Five-Factor Inventory) (Costa & McCrae 1989) and a 15-item subset, the so-called BFI-S (Big Five Inventory Shortversion) (Gerlitz & Schupp 2005). We also measured the locus of control using 10 items adapted from Rotter (1966). Our second data set comprises very similar incentivized experimental measures with respect to risk taking and time discounting using a representative sample of almost 1,000 participants from the German population. We are therefore able to obtain incentivized preference measures for a representative population. Personality was assessed using the BFI-S. The third data set stems from the German Socio-Economic Panel Study (SOEP), comprising preference and personality measures for a representative sample of more than 14,000 individuals. Preference measures were obtained using subjective self-assessment survey items rather than incentivized experiments, and personality was measured by using the BFI-S and the locus-of-control questionnaire. Using this data set, we analyze associations between important life outcomes, such as labor market success, subjective health status and life satisfaction, and individuals' preferences and personalities.

These three data sets allow for a comprehensive analysis. The first data set contains detailed personality measures in combination with multiple experimental indicators for preferences. This student sample therefore provides a particularly accurate assessment of potential relations between economic preferences and personality. The second data set uses experimental measures for a limited set of preferences and a shorter version of the Big Five. However, the sample is now representative of the German population. A comparison of results of the two data sets therefore informs us about the generalizability of our findings from the student sample. The third data set additionally allows us to study an even larger sample and to explore the explanatory power of personality and preferences for important life outcomes.

We start by analyzing data on 489 university students. We relate all five factors that capture personality according to the Big Five taxonomy and the measure of the locus of control to our experimental preference measures. We generally find only small correlations between personality traits and preferences. In particular, only 11 of the 36 correlations in

our student sample exceed 0.1 in absolute value, and only one correlation exceeds 0.2 in absolute value. These 11 correlation coefficients are significant at conventional levels, and eight involve correlations between social preferences and personality traits.

Next we gauge whether the correlation patterns generalize to representative samples. We first turn to the data set that contains very similar experimental measures of risk and time preferences and survey measures of the Big Five for approximately 1,000 individuals, who were sampled to be representative of the adult population living in Germany (see Dohmen et al. 2010). The correlation structure between personality traits and risk and time preferences turns out to be similar to the one we find for students, with few exceptions.

Finally, we assess whether the empirical associations between preference parameters and personality traits are sensitive to the way in which preferences are measured. We compare correlations between personality traits and measures of preferences derived from the incentivized choice experiments in the student and the representative sample to correlations that are constructed based on the nonincentivized subjective self-assessments in a representative sample of 14,000 individuals from the SOEP. Our result on the pattern of correlations between preference measures and personality measures is again largely confirmed.

We then turn to a different type of analysis in which we assess the power of preferences and personality in explaining life outcomes, including health, life satisfaction, earnings, unemployment, and education. Our analysis reveals that both measurement systems have similar explanatory power when used separately as explanatory variables. The explained fraction of variance increases by approximately 60% when life outcomes are regressed on both measurement systems. We therefore conclude that each measurement system captures distinct sources of the heterogeneity in life outcomes. A coherent picture emerges from our analysis. Both approaches strongly suggest that standard measures of preferences and personality are complementary constructs.

So far no clear picture concerning the relations between measures of personality and economic preferences has emerged in the literature (see Almlund et al. 2011). For example, the study by Daly et al. (2009) suggests a negative relationship between conscientiousness and the discount rate, but such a negative correlation is not corroborated by Dohmen et al. (2010), who relate experimental measures of willingness to take risk and impatience to survey measures of the Big Five in a representative sample of adults living in Germany, or by Anderson et al. (2011), who relate a measure of delay acceptance to four of the Big Five domains in a sample of 1,065 US trainee truckers.[2] In fact, Dohmen et al. (2010) find no significant relationship between personality traits and preference measures in a regression framework that includes controls for IQ, gender, age, height, education, and household income. Raw correlations between preference and personality measures, which are also reported in Almlund et al. (2011), are weak; time preference is significantly correlated only to agreeableness (at the 10% level).[3] This finding is confirmed by the significant correlation between delay acceptance and agreeableness in the truck-driver sample of Anderson et al. (2011).

Evidence on the link between risk preferences and the Big Five domains is equally mixed. Raw correlations between a lottery-choice measure of risk preference and personality traits in Dohmen et al.'s (2010) data indicate significant relationships between

[2]The effect sizes of the correlations between preference and personality measures are all smaller than 0.1 in absolute value.

[3]We report this data in **Table 5**.

risk preferences and openness to experience (at the 1% level) and agreeableness (at the 5% level). Anderson et al. (2011) do not measure openness to experience. They do not find a significant correlation for risk preference and agreeableness but report a weak correlation between risk preference and neuroticism (0.05 in absolute value), which is significant at the 10% level. This finding is in line with the significant positive association between risk aversion and neuroticism reported by Borghans et al. (2009). Other researchers (e.g., Zuckerman 1994) have related risk preferences to sensation seeking, a facet of extraversion in the Big Five taxonomy, and found mixed evidence. Whereas Bibby & Ferguson (2010) report a significant correlation between a measure of loss aversion and sensation seeking ($r = 0.27$), Eckel & Grossmann (2002) find no evidence of an association between risk preferences and sensation seeking.

Evidence on the link between social preferences and personality is somewhat stronger. Dohmen et al. (2008) relate survey measures of social preferences to measures of the Big Five using data from the SOEP and find significant associations between trust, as well as positive and negative reciprocity, and personality traits. Trust is related positively to agreeableness and openness to experience, and negatively to conscientiousness and neuroticism. Whereas positive reciprocity is positively associated with all five personality factors, negative reciprocity is related negatively to conscientiousness and extraversion, and positively to neuroticism. A link between extraversion and behavior in the dictator game, which can be interpreted as a measure of altruism, has been established by Ben-Ner & Kramer (2010).

This review is structured as follows. Section 2 describes our three data sets. In Section 3, we introduce our research strategy for investigating the link between personality and preferences. Section 4 presents evidence on the correlation between measures of personality and measures of preferences. In addition it contains an assessment of the explanatory power of preferences and personality in explaining important life outcomes. Section 5 concludes.

2. DATA AND MEASURES

In this section, we provide a description of the three complementary data sets that we employ for our analysis. Before we present our experimental and survey measures in detail, a few comments on identification are warranted. Economists typically try to infer preferences from choices, the so-called revealed preference approach. For example, one might surmise that a person who does not wear a safety belt and who invests in risky stocks has a preference for taking risks. It is, however, easy to show that the same behavioral pattern is compatible with very different risk preferences if other factors affect the person's decisions. For example, differences in beliefs about how risky driving without a safety belt or investing in stocks actually is may have as much effect on decisions as underlying risk preferences do. The problem is that the decision context is uncontrolled and person specific, rendering precise statements about preference parameters very difficult.[4] This is why economists run experiments to infer preferences. In a typical choice experiment, subjects make decisions in a well-controlled decision environment. In risk experiments, for example, stakes and probabilities are fixed, and the action space is identical for every subject.

[4]Conceptually identical problems apply to the identification of traits such as ability, physical strength, and personality characteristics from observed performance on tasks, when performance also depends on other unobserved factors such as time, energy, and attention devoted to the task. An illuminating discussion of the identification problem is provided in Almlund et al. (2011, section 3).

Observing subjects' decisions in a controlled experimental environment therefore rules out many potentially confounding factors, allowing a more precise identification of preferences. Even in an experiment, however, the identification of preferences is limited (see Manski 2002 for a thorough discussion on the identification of experimental outcomes). The same observed action can reflect different risk attitudes, for example, if the experimental subjects dispose of different wealth levels and the curvature of the utility function is not invariant to wealth levels. Despite these limitations, experiments deliver much more precise behavioral outcomes than nonexperimental observations. In strategic situations, which are relevant for measuring trust and reciprocity, we are able to elicit not just an action, but a complete strategy. With field observations, this is impossible. The relevance of eliciting a strategy is obvious: Suppose one observes a second mover who defects in a cooperation context in response to a noncooperative act of a first mover. This could reveal selfish preferences as well as reciprocal preferences. Disentangling the two requires knowledge about what the decision maker would have done had the first mover cooperated. Eliciting a strategy instead of observing only actions does exactly this. Experimental observations have the additional advantage over survey responses that decisions have immediate monetary consequences. This is of obvious importance, for example, for identifying altruism. There is a big difference between simply stating altruistic preferences and revealing them in a costly manner.

2.1. Experimental Data

The first data set consists of decisions from laboratory experiments among university students. We ran a series of simple incentivized choice experiments to elicit preferences concerning risk taking, discounting, positive and negative reciprocity, and trust as well as altruism (for a detailed description of the experimental procedures, see Falk et al. 2011). **Table 1** presents an overview of the experiments and provides a short description of the elicitation methods and the obtained behavioral measures. Four important features about our experimental design are worth noting. First, subjects took part in two very similar experiments each for risk taking, discounting, trust, and positive reciprocity. This allows us to average over both outcomes for each subject to minimize measurement error. Second, to reduce spillovers between different choices, we ran the experiments not in one single session but in two sessions, which were scheduled one week apart.[5] Third, to reduce possible income effects with respect to outcomes within a session, we gave feedback about experimental outcomes only at the end of an experimental session. Fourth, the vast majority of subjects in the experiments had never taken part in an experiment before. This eliminates possible confounds in behavior due to previous experiences in similar experiments. In total, 489 students from different majors from the University of Bonn participated.[6] The experiments were run at the Laboratory for Experimental Economics at the University of Bonn (BonnEconLab). We used zTree (Fischbacher 2007) as experimental software and recruited subjects using ORSEE (Greiner 2004). Each session lasted about two hours, and average earnings were 64 euros.

[5] We reversed the order of the sessions for half the subjects. Statistical tests reveal no significant order effects.

[6] Out of these 489 students, 80 took part in a pretest of the study. Most of these 80 subjects had taken part in an experiment before. The pretest did not include the experiments on altruism and negative reciprocity.

Table 1 Overview of the experimental measures in data set from laboratory experiments among university students

Preference	Experiment	Measure
Time	Two lists of choices between an amount of money "today" and an amount of money "in 12 months"	Average switching point over both lists of choices from the early to the delayed amount
Risk	Two lists of choices between a lottery and varying safe options	Average switching point over both lists of choices from the lottery to the safe option
Positive reciprocity	Second-mover behavior in two versions of the trust game (strategy method)	Average amount sent back in both trust games
Negative reciprocity	Investment into punishment after unilateral defection of the opponent in a prisoner's dilemma (strategy method)	Amount invested into punishment
Trust	First-mover behavior in two versions of the trust game	Average amount sent as a first mover in both trust games
Altruism	First-mover behavior in a dictator game with a charitable organization as recipient	Size of donation

2.1.1. Preference measures. In the following paragraphs we provide descriptions of all experiments that we conducted to obtain incentivized behavioral measures of risk taking, discounting, and social preferences.

Risk preferences. To elicit risk attitudes, we adapted the design from Dohmen et al. (2010). Subjects were shown a list of binary alternatives, a lottery and a (varying) safe option. The lottery was the same for each decision: If they chose the lottery, participants could receive either 1,000 points or zero points, with 50% probability each. The safe option increased from row to row, starting from a value of (close to) zero and increasing up to a value of (close to) the maximum payoff of the lottery. To reduce measurement error, subjects participated in two risk experiments. The choice list of the second experiment was simply a perturbed version of the first one. Perturbations were constructed such that a randomly drawn integer value between -5 and $+5$ was added to the safe option in every choice, corresponding to perturbations of maximally 5% of the step size of the increase in the safe option. The complete list of choices was shown to subjects on the first screen. Each choice situation was then presented on a separate screen, where subjects entered their respective choice. Subjects were informed that one choice in each list would be selected randomly and paid. Subjects with monotonic preferences should choose the lottery for lower safe options and switch to the safe option when the latter reaches or exceeds the level of their certainty equivalent. Thus switching points inform us about individual risk attitudes. The earlier a subject switches to the save option, the less she is willing to take risks. For our analysis, we constructed a risk preference measure using the average of the two switching points from the two experiments.[7]

[7]If subjects switched between the lottery and the safe option more than once, we took the average switching row as an estimate of their certainty equivalent. This happened in 16% of the cases in the first experiment on risk taking and in 11% of the cases in the second experiment.

Time preferences. To measure individuals' time preferences, we implemented a procedure very similar to the one for risk attitudes. In the discounting experiments, subjects were given two lists of choices between an earlier amount of money ("today"), which was the same in all choices, and an increasing delayed amount of money ("in 12 months"). In the first row, the early amount was equal to the delayed amount. Delayed amounts increased from row to row by 2.5%. As for risk preferences, subjects participated in a very similar, second discounting experiment with small perturbations of delayed amounts between $+0.5$ and -0.5 percentage points. One choice in each of the two lists was randomly selected for payment. Payments resulting from the two experiments were sent to subjects via regular mail. If a subject chose the early amount, the payment was sent out on the day of the experimental session. If a subject chose the delayed amount, the payment was sent out with a delay of 12 months.[8] The switching point from early to delayed payment informs us about a subject's time preference. Subjects who switch later discount the future amount by more (i.e., are less patient) than subjects who switch earlier.[9] Our measure of individual discounting is the average switching row in both lists. To ease interpretation of the correlations reported below, we recode the measure, such that higher values imply earlier switching rows, i.e., a higher level of patience.

Trust. We elicited trust from first-mover behavior in the so-called trust game (Berg et al. 1995). We conducted two versions of the trust game. In one version, the amount sent by the first mover was doubled by the experimenter, whereas in the second version, the amount was tripled. Every subject was in the role of the first and of the second mover twice.[10] Both trust games were incentivized; i.e., every (relevant) decision was paid. In the role of a first mover, subjects could choose to send any amount in $\{0, 50, 100, \ldots, 500\}$ points to the second mover. All interactions in the trust game, as well as in all other social preference experiments, were one shot and anonymous (perfect stranger matching protocol). The average amount sent as a first mover in both trust games constitutes our experimental measure for trust: Subjects who send higher amounts of money are those who display higher levels of trust.

Positive reciprocity. To elicit positive reciprocal inclinations, we measured subjects' second-mover behavior in the trust game (see above). We implemented the strategy method (Selten 1967). This means that for every possible amount sent by the first mover, subjects were asked to indicate how much they wanted to send back. The actual decision of the first mover determined which of these decisions became payoff relevant. The average amount sent back as a second mover in both trust games was taken as individuals' willingness to reciprocate, such that higher values imply a higher willingness to reciprocate.

Negative reciprocity. To measure subjects' willingness to engage in costly punishment of unfair behavior, we conducted a prisoner's dilemma with a subsequent punishment stage. (The design of the experiment was adapted from Falk et al. 2005.) In the punishment

[8]Keeping the payoff mode identical over both time horizons rules out credibility concerns.

[9]For subjects who switched more than once, we took the average switching row as an estimate of their discount rate. This happened in 5% of the cases in the first experiment on time discounting and in 7% of the cases in the second experiment.

[10]Overall, we therefore ran four trust games.

stage, subjects could choose to invest points in order to deduct points from their opponent. Punishment was costly. Again, we implemented the strategy method. Before taking their decisions in the first stage of the experiment (i.e., in the prisoner's dilemma), subjects were asked to indicate how many points they wanted to deduct from the other player in case he cooperated or defected, for both own cooperation and own defection. Then they played a simultaneous prisoner's dilemma. The outcome of the first stage determined which choice of the second stage became payoff relevant. The chosen investment into punishment after unilateral defection of the other player served as a measure of an individual's willingness to reciprocate negatively.

Altruism. To measure altruistic behavior, we had subjects take part in a modified dictator game in which the recipient was a charitable organization (adapted from Eckel & Grossmann 1996). Subjects were endowed with 300 points and had to decide how much of this endowment to donate to a charitable organization.[11] This decision serves as our experimental measure of subjects' altruistic inclination.

2.1.2. Personality measures. The following paragraph provides an overview of the personality measures we use in our analysis.

Big Five. As part of the study, subjects were given a paper-and-pencil survey, which they were asked to fill out at home and return to us via mail.[12] Of the 489 subjects, 319 completed the survey and sent it back to us. The survey included the NEO-FFI version of the Big Five (Costa & McCrae 1989). During the experimental sessions, all 489 subjects also answered a shorter version of the NEO-FFI: the BFI-S, a subset consisting of 15 items. The BFI-S has been developed by Gerlitz & Schupp (2005) and was also part of the 2005 and 2009 waves of the SOEP. Correlations between the long version and the short version of the Big Five differ between the five personality dimensions. The lowest correlation is $r = 0.48$ for openness, and the highest is $r = 0.71$ for conscientiousness (all p values < 0.001). We constructed our Big Five measure in that we use data from the long version whenever available, while for the remaining subjects, we refer to the short version. That way, we have measures of the Big Five domains for all 489 subjects.

Locus of control. The paper-and-pencil survey included 10 items that allow us to construct a measure of the locus of control for the 319 individuals who filled in the survey. These 10 items have been adapted from Rotter (1966), and they have also been implemented in the 2005 wave of the SOEP. The personality construct of the locus of control assesses how much people believe they have control over their life outcomes, or how much their lives are determined by forces that are outside of their control, such as luck or faith. We constructed the measure such that higher values represent a more internal locus of control, i.e., the belief that an individual can influence his life outcomes. Lower values represent a more external locus of control.

[11] Subjects could choose a charitable organization from a list or name one themselves.

[12] We also handed out stamped envelopes with the address of our research institute to minimize additional costs for returning the survey.

2.2. Representative Experimental Data

The second data set we employ consists of experimental data for a representative sample of the German population. (The same data set is used in Dohmen et al. 2010.) This data set is used to assess whether the findings from the sample of university students can be corroborated in a representative sample. Subjects' risk and time preferences were elicited, and we again have information on participants' personality. The data used here stem from a study conducted in 2005 and contain information on 1,012 individuals (for a detailed description of the study and its procedures, see Dohmen et al. 2010).

2.2.1. Preference measures. The experiments on risk and time preferences were similar to the ones we used in the laboratory experiments. In both experiments, subjects had to make multiple decisions in a list of choices. To elicit their risk preferences, we had subjects choose between a lottery, which remained the same in all choices, and safe options, which increased in their value. As in the experiments discussed above, the switching point informs us about the individual's willingness to take risks. Similarly, to elicit individuals' time preferences, we had all participants make a number of intertemporal choices. They had to decide between an amount "today" and a larger amount "12 months later." The early amount remained the same in all choices. The first delayed amount presented to subjects was devised to imply a 2.5% return on the early amount assuming semiannual compounding. In the subsequent choices, the delayed payment was gradually increased and was calculated such that the implied rate of return rose in steps of 2.5 percentage points. Again, the switching points from the early to the delayed option inform us about the subjects' time preferences.

2.2.2. Personality measures. The five personality domains were assessed using the BFI-S (see Section 2.1.2 for a more detailed description).

2.3. Representative Panel Data

The third data set we use stems from the SOEP, a large panel data set that is representative of the adult population living in Germany (see Schupp & Wagner 2002 and Wagner et al. 2007 for a detailed description of the SOEP). We use information from eight waves collected in the years between 2003 and 2009. In each of these waves, more than 20,000 individuals were interviewed. The SOEP combines extensive sociodemographic information with various measures of attitudes, preferences, and psychological traits. In particular, the SOEP includes survey items relating to all personality and preference measures that we discuss in the previous sections.

Personality and economic preference measures were elicited several times between 2003 and 2009. To construct a measure for each individual, we use the maximum available number of observations of a given measure. If several measures of personality and preferences are available, we take the average of the standardized measures of all years in which this measure was elicited. The resulting average is then standardized as well. In case a particular measure was elicited only in one wave (e.g., as is the case for patience), we just take the standardized measure from that respective year. We restrict the sample to individuals for whom we have information about each personality and preference measure. This results in a sample size of 14,243 individuals.

2.3.1. Preference measures. As a measure for time preference, we use answers to the following survey question: "How would you describe yourself: Are you generally an impatient person, or someone who always shows great patience?"[13] Participants gave an answer on an 11-point scale, where zero means "very impatient" and 10 means "very patient." This survey question was implemented in the SOEP only in 2008. The risk preference question is worded in the same manner: "How do you see yourself: Are you generally a person who is fully prepared to take risks, or do you try to avoid taking risks?" Answers were given on an 11-point scale, where zero means "unwilling to take risks" and 10 means "fully prepared to take risks." This question was included in the 2004, 2006, 2008, and 2009 waves. The general risk question has been studied in various papers and has been validated using incentivized experiments in representative samples as well as through behavioral evidence in Dohmen et al. (2011). In 2005, the SOEP contained six items to measure reciprocal inclinations, three items each on positive and negative reciprocity. Examples for positive and negative reciprocity are as follows: "If someone does me a favor, I am prepared to return it" and "If I suffer a serious wrong, I will take revenge as soon as possible, no matter what the costs." Participants expressed how well these six statements apply to them on a seven-point Likert scale (for a detailed description, see Dohmen et al. 2009). Standard trust questions were included in the 2003 and 2008 waves, using three substatements about whether "one can trust people," whether "in these times one can't rely on anybody else," and whether "when dealing with strangers it is better to be cautious." Answers were given on a five-point scale ranging from "totally agree" to "totally disagree." Finally, our survey measure for altruism is the answer to the question of how important it is for the participant "to be there for others." Answers were given on a four-point scale. The altruism question was included in the 2004 and 2008 waves.

2.3.2. Personality measures. The 2005 and 2009 waves of the SOEP contained the BFI-S questionnaire, developed by Gerlitz & Schupp (2005). The locus of control was elicited in 2005 using Rotter's (1966) locus-of-control scale. Both inventories were also used in our laboratory experimental data (see Section 2.1.1 for more details on the BFI-S and the locus-of-control scale).

3. RESEARCH STRATEGY

To answer the question of whether measures of personality and economic preferences are closely linked, we first study the raw correlations between these measures. High correlations would indicate some degree of substitutability. Low correlations, conversely, would suggest that the two measurement systems are complementary concepts in explaining heterogeneity in behavior. Whether a correlation should be interpreted as high or low is of course always debatable. We therefore first look at statistical significance levels. Statistical significance, however, can also be found for correlations that are low in terms of effect size (Cohen 1992). Following conventions in the social sciences, we interpret effect sizes (i.e., correlations r) as rather low if r is between 0.1 and 0.3, as medium if r is between 0.3 and 0.5, and as large if r is larger than 0.5. Because the analysis of correlations is restricted to linear relations, we also check for potential nonlinear associations by

[13]The behavioral validity of this question with respect to incentivized experiments is documented in Vischer et al. (2011).

conducting nonparametric regressions. In particular, we look at kernel-weighted local linear polynomial regressions.

We then check to see whether measures of personality and preferences are substitutes or complements in terms of their explanatory power for life outcomes. In particular, we conduct linear regressions and assess the explanatory power of the two concepts by reporting levels of adjusted R^2. In these regressions, measures of personality and preferences are included individually as well as jointly. If the two measurement systems are substitutes, adjusted R^2 in the combined regressions should not be distinctly higher than in regressions that include only one of the two concepts. The opposite should hold for complements. Additionally, we investigate model selection criteria in these regressions. We check for robustness using binary and ordered choice models as well as more comprehensive specifications, including square terms and cross-products of all regressors.

4. RESULTS

In this section we discuss our main findings. To ease comparison between data sets and measures, we standardized all experimental as well as all personality measures for the data analysis.

4.1. Correlation Structure

This section provides results on the correlation structure between preference and personality measures obtained from the three data sets.

4.1.1. Experimental data. **Table 2** displays the 36 raw correlations of the personality and economic preference measures obtained from the laboratory experiments. A first inspection of **Table 2** reveals that only 11 of these 36 correlations are statistically significant at the 5% or 1% level.[14] All correlation coefficients are smaller than 0.3 in absolute value. Hence there is no correlation with a medium effect size or larger. Moreover, of the 36 correlations, only 11 exceed 0.1 in absolute value, and only 1 slightly exceeds 0.2. [Results qualitatively stay the same when investigating Spearman correlations instead of Pearson correlations (see **Table 3**). Moreover, when looking at a potential linear mapping (i.e., linear regressions of either the Big Five on preferences or vice versa), R^2 is always below 10%.]

Table 2 also shows that among all personality factors, agreeableness exhibits the highest and statistically most significant correlations with measures of economic preferences. It is significantly correlated with measures for positive and negative reciprocity, trust, and altruism (all p values < 0.01) as well as with time preference (p value < 0.05). Correlations with social preferences range between 0.1 and 0.3 in absolute value, indicating a small effect size according to the classification of Cohen (1988). The high frequency of significant correlations of agreeableness with social preferences is not surprising as the former is defined as "the tendency to act in a cooperative, unselfish manner" (see **Table 4**).

The finding of only moderate correlations between preference and personality measures does not necessarily indicate that these constructs are weakly connected; it indicates only that there are weak linear relations. For example, a perfect U-shaped relation between a

[14]Five additional correlations are weakly significant (i.e., significant at the 10% level).

Table 2 Pearson correlation structure experimental data set

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0370	0.0057	−0.0084	0.1026**	−0.0518	0.0847
Risk	−0.0379	−0.0611	0.0762*	0.0202	−0.1201***	0.0434
Positive reciprocity	0.1724***	0.0140	0.0211	0.2042***	0.0361	0.0152
Negative reciprocity	−0.0885*	−0.0393	0.0943*	−0.1451***	−0.0136	−0.1418**
Trust	0.1232***	−0.1300***	0.0004	0.1665***	−0.0134	−0.0140
Altruism	0.1242**	−0.0979*	0.0249	0.1911***	0.0847*	0.0480

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. Correlations between economic preferences and the Big Five were calculated using 394–477 observations. Correlations between economic preferences and the locus of control (LoC) were calculated using 254–315 observations. All measures are standardized.

Table 3 Spearman correlation structure experimental data set

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0388	0.0162	−0.0114	0.1077**	−0.0684	0.1063*
Risk	0.0027	−0.0486	0.0726*	0.0206	−0.0995**	0.0485
Positive reciprocity	0.1606***	0.0078	0.0177	0.2029***	0.0152	0.0414
Negative reciprocity	−0.0967*	−0.0221	0.0462	−0.083*	−0.0165	−0.1376**
Trust	0.1354***	−0.1198***	0.002	−0.1696***	−0.002	−0.0648
Altruism	0.0969*	−0.0804	−0.0034	0.2000***	0.0879*	0.0418

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. Correlations between economic preferences and the Big Five were calculated using 394–477 observations. Correlations between economic preferences and the locus of control (LoC) were calculated using 254–315 observations. All measures are standardized.

personality factor and a preference would result in an insignificant linear correlation. To explore the possibility of nonlinear relationships, we therefore estimate kernel-weighted local linear polynomial regressions.[15] In each regression, we restrict the sample to a range of four standard deviations around the mean of each variable to circumvent an analysis biased by outliers. Therefore, the results are calculated using 70%–97% of all observations. The predicted regressions are displayed in **Figure 1** (see color insert). Although sometimes there are small deviations from linearity at the boundaries, the overall picture strongly suggests a linear relation in the vast majority of combinations.

Summarizing our analysis of the laboratory experimental data, we find that associations between preference and personality measures are linear and that the degree of association is rather low, suggesting a complementary relationship. We next turn to the question of whether the correlation patterns observed in student samples can be replicated in a sample that is representative of the adult population.

[15] We use the Epanechikov kernel, and bandwidth is selected via the plug-in estimator of the asymptotically optimal constant bandwidth.

Table 4 Definitions of the Big Five domains

Big Five domain	APA Dictionary definition
Openness	Individual differences in the tendency to be open to new aesthetic, cultural, and intellectual experiences
Conscientiousness	The tendency to be organized, responsible, and hardworking; located at one end of a dimension of individual differences (conscientiousness versus lack of direction)
Extraversion	An orientation of one's interests and energies toward the outerworld of people and things rather than the inner world of subjective experience; includes the qualities of being outgoing, gregarious, sociable, and openly expressive
Agreeableness	The tendency to act in a cooperative, unselfish manner; located at one end of a dimension of individual differences (agreeableness versus disagreeableness)
Neuroticism	A chronic level of emotional instability and proneness to psychological distress

This table is in part reproduced from Borghans et al. (2008).

Table 5 Pearson correlation structure representative experimental data

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Time	−0.0080	−0.0682	−0.0655	−0.0830*	−0.0602
Risk	0.1356***	−0.0720	0.0757	−0.0941**	−0.0290

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. All measures are standardized.

Table 6 Spearman correlation structure representative experimental data

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Time	−0.0199	−0.0737	−0.0764*	−0.0.829*	−0.0598
Risk	0.1315*	−0.0744	0.0661	−0.0.854*	−0.0261

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. All measures are standardized.

4.1.2. Representative experimental data. **Table 5** shows the correlations between the outcomes from the risk and time experiments and the personality traits. As above, the measure for time is reversed so that higher values indicate higher patience. In terms of significance, the pattern is similar to the one in the laboratory study. Only one correlation is significant at the 1% level, one is significant at the 5% level, and one is significant at the 10% level. In terms of effect size, only the coefficient of the association between openness and risk preferences exceeds the 0.1 benchmark to be classified as a small correlation (Cohen 1988). [Results qualitatively stay the same when investigating Spearman correlations instead of Pearson correlations (see **Table 6**).] Interestingly, the sign is positive, in contrast to our laboratory data. The other two significant coefficients are even smaller. The analysis of representative data therefore confirms that the level of association between preference personality measures is rather small. However, we can draw this conclusion only with respect to time and risk preferences, as we do not have experimental data on trust and social preferences. We next analyze whether these findings also hold when looking at all preference measures in a large representative sample.

4.1.3. Representative panel data. In this section, we study whether our findings from the experiments generalize to a large representative sample using survey rather than experimental instruments for measuring economic preferences. **Table 7** shows the raw correlations between personality measures and economic preferences using 14,243 observations from the SOEP. Given the large number of observations, it is not surprising to find a large number of significant correlation coefficients (p values < 0.05 for all correlation coefficients). In terms of effect size, however, only two correlations are of medium size (i.e., larger than 0.3). Of the reported 36 correlations, 18 can be classified as small, whereas 16 correlations are even below 0.1. This confirms the overall picture that emerged from the analysis of the two experimental data sets. [Results qualitatively stay the same when investigating Spearman correlations instead of Pearson correlations (see **Table 8**). Moreover, when looking at a potential linear mapping (i.e., linear regressions of either the Big Five on preferences or vice versa), R^2 is always around 15% with the exception of agreeableness, for which R^2 reaches 28%.] A closer comparison of the SOEP survey measures with our experimental measures further reveals large similarities. As reported above, 11 correlations are significant at the 5% level in the experimental data. Ten of these correlations have the same sign and are significant at the 1% level using survey data. Moreover, as is the case in the laboratory data set, the personality trait agreeableness exhibits the

Table 7 Pearson correlation structure between personality measures and economic preferences from SOEP observations

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0183**	0.1122***	−0.0415***	0.3122***	−0.0584***	0.0681***
Risk	0.2793***	−0.0400***	0.2601***	−0.1454***	−0.0996***	0.1521***
Positive reciprocity	0.1814***	0.2520***	0.1473***	0.1842***	0.0872***	0.0954***
Negative reciprocity	−0.0522***	−0.1558***	−0.0264***	−0.3756***	0.0612***	−0.2154***
Trust	0.1272***	−0.0680***	0.0575***	0.0945***	−0.1919***	0.2094***
Altruism	0.1756***	0.1495***	0.1670***	0.2557***	0.0908***	0.0874***

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. Correlations are calculated using 14,243 observations. All measures are standardized. Abbreviation: LoC, locus of control.

Table 8 Spearman correlation structure between personality measures and economic preferences from SOEP observations

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0233	0.1192	−0.0342	0.3099	−0.0643	0.0709
Risk	0.2632	−0.0500	0.2452	−0.1496	−0.1049	0.1426
Positive reciprocity	0.1835	0.2622	0.1547	0.1947	0.0808	0.1041
Negative reciprocity	−0.0616	−0.1767	−0.0426	−0.3853	0.0572	−0.2257
Trust	0.1224	−0.0693	0.0523	0.0788	−0.1889	0.2012
Altruism	0.1693	0.1501	0.1602	0.2416	0.0860	0.0843

All correlations are significant at the 1% level and are calculated using 14,243 observations. All measures are standardized. Abbreviation: LoC, locus of control.

highest correlations with economic preferences, in particular social preferences. Although there are small differences in the results compared with the experimental data set (i.e., seven of the 36 correlation coefficients show a different sign), the general pattern emerging from the SOEP measures is consistent with our previous findings. Of the seven correlation coefficients, only two are (weakly) significant in the experimental data set. Nevertheless, the inconsistency of signs brings into question the conjecture that correlations are universally identical (i.e., identical irrespective of age or other person characteristics). We return to this aspect in the final section.

We conclude this section with an analysis of potential nonlinearities between our SOEP preference and personality measures. As for the laboratory experimental data, we perform kernel-weighted local linear polynomial regressions restricting the sample in each regression to four standard deviations above and below the mean. The resulting subsamples represent 92%–97% of the observations of the main sample. The predicted functions presented in **Figure 2** (see color insert) show no particular nonlinearities, except for some splines at the left ends of the considered range. Thus, analogous to the experimental data set, it is not the case that systematic nonlinearities bias correlation coefficients.

4.1.4. Explanatory power for life outcomes. All reported correlation structures indicate that personality and preference measures are far from perfectly substitutable. To determine whether they actually complement each other, we now analyze their explanatory power with respect to important life outcomes. To that end, we again use data from the SOEP. In particular, we consider the following outcomes: subjective health, life satisfaction, gross wage, being unemployed, and years of education. For each outcome, we estimate linear regression models in which outcomes are regressed on the set of economic preferences, the Big Five, and the locus of control, separately as well as jointly. (The corresponding regressions are shown in **Table 9**.) The idea is to assess the explanatory power of each concept in isolation and in combination. This enables us to check the extent to which explanatory power increases when combining the concepts and thus allows us to reach conclusions regarding the degree of their complementarity. The criterion used to compare differences in explanatory power is adjusted R^2.

All life outcomes we use come from the 2009 wave of the SOEP. Subjective health was measured on a five-point scale, from "very good" to "bad." We reverse the answer scale such that higher values indicate a better subjective health status. Life satisfaction was elicited using the question "How satisfied are you with your life, all things considered?", which was answered on an 11-point scale (with higher values indicating higher life satisfaction). Our measure for gross hourly wage is the gross monthly wage divided by monthly working hours.[16] Unemployment status is a binary variable equal to one if the person was unemployed at the time of the survey and zero otherwise. The variable years of education is created by adding up years of schooling and additional occupational training (including university).[17]

Figure 3 shows adjusted R^2's for the different life outcomes. R^2 values for the three concepts (the Big Five, the locus of control, and economic preferences) in isolation range from 1% to 10% and vary both among concepts and among outcomes. Thus

[16]Monthly working hours are calculated as the average weekly working hours multiplied by four.

[17]For each school degree and occupational training (including university), official standard graduation times in years are used for the calculation.

Table 9 Outcome regressions: representative experimental data

Life outcomes	Subj. Health	Life satisf.	Gross wage	Unemployed	Years of educ.
Openness	0.043***	0.123***	0.989***	−0.018***	0.667***
	(0.009)	(0.017)	(0.162)	(0.004)	(0.027)
Conscientiousness	0.038***	0.106***	0.565***	−0.014***	−0.182***
	(0.009)	(0.017)	(0.161)	(0.004)	(0.026)
Extraversion	0.026***	0.134***	−1.201***	0.006*	−0.309***
	(0.009)	(0.017)	(0.154)	(0.004)	(0.026)
Agreeableness	0.033***	0.139***	−1.288***	0.023***	−0.146***
	(0.010)	(0.018)	(0.165)	(0.004)	(0.028)
Neuroticism	−0.140***	−0.186***	−1.009***	0.018***	−0.272***
	(0.009)	(0.016)	(0.158)	(0.004)	(0.026)
Locus of control	0.105***	0.307***	1.899***	−0.043***	0.421***
	(0.008)	(0.015)	(0.145)	(0.003)	(0.024)
Patience	0.024***	0.129***	−0.343**	0.001	−0.151***
	(0.008)	(0.015)	(0.136)	(0.003)	(0.023)
Risk	0.131***	0.076***	0.415**	0.003	0.210***
	(0.009)	(0.017)	(0.166)	(0.004)	(0.027)
Positive reciprocity	−0.035***	0.006	0.388***	−0.002	0.005
	(0.008)	(0.015)	(0.140)	(0.003)	(0.023)
Negative reciprocity	0.064***	0.039**	−0.329**	0.006*	−0.137***
	(0.008)	(0.015)	(0.147)	(0.003)	(0.024)
Trust	0.122***	0.308***	1.763***	−0.035***	0.587***
	(0.009)	(0.015)	(0.145)	(0.003)	(0.024)
Altruism	0.070***	0.072***	−0.780***	0.005	0.084***
	(0.009)	(0.016)	(0.152)	(0.003)	(0.025)
Constant	3.300***	6.852***	16.100***	0.099***	12.346***
	(0.007)	(0.014)	(0.131)	(0.003)	(0.021)
Observations	14,218	14,214	7,199	9,095	13,768
Adjusted R^2	0.108	0.159	0.0919	0.0547	0.174

The asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels. All measures are standardized. Standard errors are in parentheses.

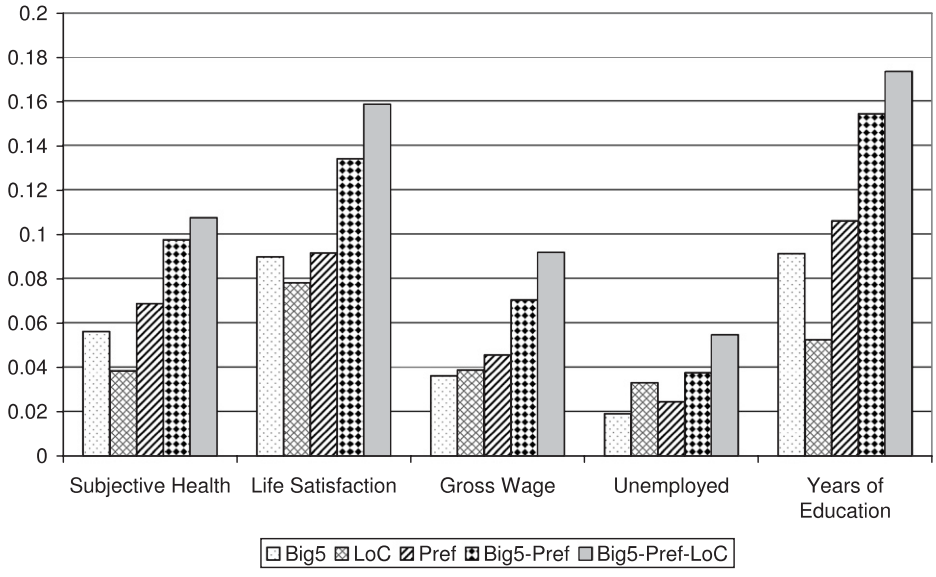

Figure 3

Adjusted R^2's for linear regressions for life outcomes. The number of observations available varies for the different life outcomes: subjective health (14,218), life satisfaction (14,214), gross wage (7,199), unemployed (9,095), and years of education (13,768). Gross wage measures the gross hourly wage. Abbreviation: LoC, locus of control.

they contribute to explaining heterogeneity in important life outcomes.[18] More important in light of our research question, however, is that the explanatory power is considerably larger when combining the Big Five, the locus of control, and economic preferences compared to using each concept individually. Moreover, explanatory power is always maximized when all three concepts are included in the regression, hereafter referred to as the full model. In this case, resulting adjusted R^2 values reach levels of about 6%–18%. This clearly indicates the existence of important complementarities among the different concepts. **Figures 4** and **5** present overviews of the raw correlations between each preference and personality trait and life outcomes.

Because the question here is one of model selection, we also employ model selection criteria (in particular, the Akaike and Bayesian information criteria) to check whether the full model is also chosen by model selection criteria. As seen in **Table 10**, this is the case for all life outcomes considered, corroborating our previous results. We perform the same analysis using binary and ordered choice models when appropriate. Again, the full model is chosen by the model selection criteria in all cases. As another robustness check, we consider more flexible models: Along with including each predictor linearly in our regressions, we also include square terms and all possible cross-products (see **Table 11**). Again the full model obtains the highest adjusted R^2 measures when using ordinary-least-squares

[18]In the explanation of life outcomes such as gross wages, unemployment, and years of education, the preference for work versus leisure would probably play a key role. However, no question related to this preference was included in the survey.

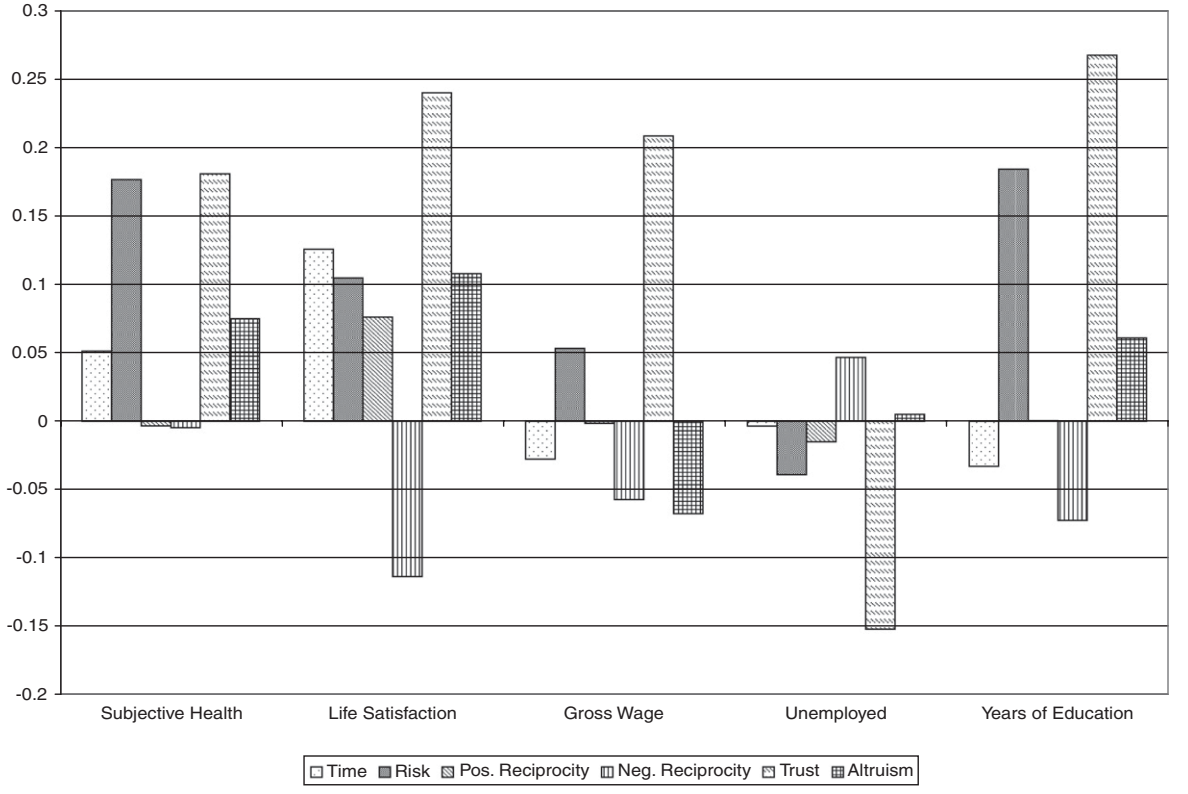

Figure 4

Pearson correlation coefficients between preference measures and life outcomes using SOEP data. Trust always shows the strongest association with life outcomes. More trust and a higher willingness to take risk are always related to better life outcomes (e.g., better health and greater life satisfaction), whereas negative reciprocity is associated with less life satisfaction and lower wages. The number of observations available varies for the different life outcomes: subjective health (14,218), life satisfaction (14,214), gross wage (7,199), unemployed (9,095), and years of education (13,768). Gross wage measures the gross hourly wage.

estimation and is also chosen by the information criteria in nearly all cases.[19] Results are again robust for employing binary and ordered choice models when appropriate. Moreover, in all models considered, the joint hypothesis that all coefficients are equal to zero is always rejected at the 1% level (**Tables 10** and **11**). In summary, sizeable complementarities among the different concepts are corroborated in all robustness checks.

5. DISCUSSION

In this review we examine the relation between economic preferences and personality using three different data sets. We find no indication for a strong linear or a nonlinear association

[19]Only the Bayesian information criterion chooses a model just including the locus of control when it comes to explaining gross wage and unemployment. However, this is not surprising given the number of regressors included and the tendency of the Bayesian information criterion to choose parsimonious models.

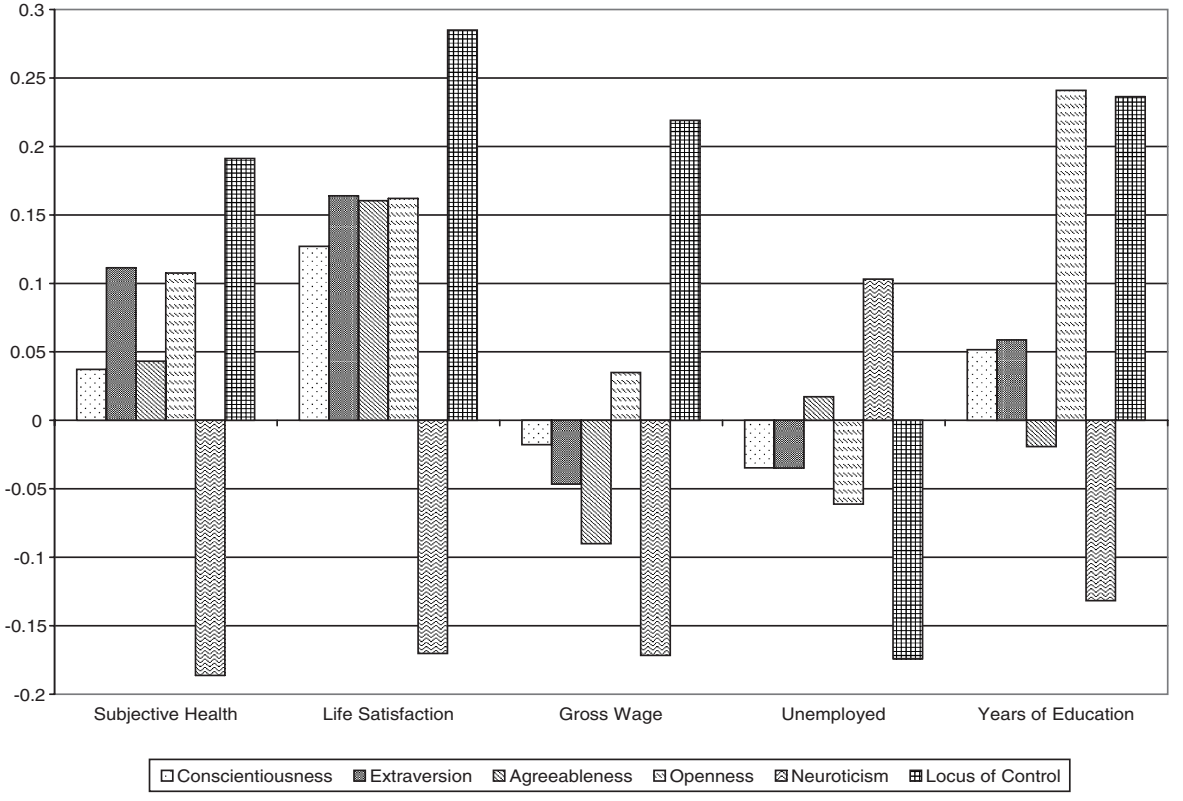

Figure 5

Pearson correlation coefficients between personality measures and life outcomes using SOEP data. The locus of control and neuroticism show the strongest associations with life outcomes. A more internal locus of control is always related to better outcomes (e.g., better health or more life satisfaction), whereas a higher degree of neuroticism is associated with lower wages or a higher probability of being unemployed. The number of observations available varies for the different life outcomes: subjective health (14,218), life satisfaction (14,214), gross wage (7,199), unemployed (9,095), and years of education (13,768). Gross wage measures the gross hourly wage.

between the two. Thus we conclude that the two concepts cannot substitute for each other. In fact, with regard to explaining heterogeneity in life outcomes, we find that the two concepts play complementary roles. Our findings imply that researchers in economics and psychology can benefit greatly from the respective disciplines when looking for potential sources of heterogeneity in life outcomes.

The finding of a rather low association between economic preferences and psychological measures of personality is perhaps not surprising. First, both concepts are constructed in very different ways. Whereas preferences are rooted in utility theory, derived in terms of specific functional forms of utility functions, the Big Five personality indicators originated in language analysis. Second, the Big Five measure rather broad aspects of personality. In particular, each dimension of the Big Five is by itself already an aggregation of different attitudes or subfacets. Thus, although our results show low associations between personality and economic preferences, we cannot exclude the possibility that there is a stronger degree

Table 10 Linear specification of outcome regressions

	Subjective health (OLS)					Subjective health (ordered probit)				
	Big 5	LoC	Pref	Big 5–Pref	Big 5–Pref–LoC	Big 5	LoC	Pref	Big 5–Pref	Big 5–Pref–LoC
Adj. R^2/pseudo-R^2	0.0561	0.0383	0.0688	0.0975	0.1075	0.0220	0.0145	0.0268	0.0388	0.0429
F test/LR test	170.04	567.35	176.01	140.59	143.72	834.99	550.62	1,016.47	1,471.22	1,627.11
AIC	37,833	38,094	37,641	37,201	37,043	37,139	37,415	36,960	36,515	36,361
BIC	37,878	38,109	37,694	37,292	37,142	37,207	37,453	37,035	36,628	36,482
	Life satisfaction (OLS)					Life satisfaction (ordered probit)				
Adj. R^2/pseudo-R^2	0.0899	0.0782	0.0917	0.1342	0.1588	0.0261	0.0219	0.0256	0.0390	0.0467
F test/LR test	281.88	1206.91	240.08	201.27	224.67	1,406.38	1,178.16	1,376.73	2,098.73	2,513.61
AIC	55,038	55,216	55,012	54,335	53,926	52,448	52,668	52,480	51,768	51,355
BIC	55,083	55,231	55,065	54,426	54,024	52,561	52,751	52,601	51,926	51,521
	Gross wage (OLS)									
Adj. R^2/pseudo-R^2	0.0361	0.0388	0.0456	0.0704	0.0919	—	—	—	—	—
F test/LR test	54.97	291.20	58.31	50.57	61.71	—	—	—	—	—
AIC	55,088	55,088	55,042	54,857	54,690	—	—	—	—	—
BIC	55,102	55,102	55,090	54,940	54,779	—	—	—	—	—
	Unemployed (OLS)					Unemployed (probit)				
Adj. R^2/pseudo-R^2	0.0191	0.0331	0.0245	0.0375	0.0547	0.0322	0.0527	0.0412	0.0648	0.0926
F test/LR test	36.34	312.13	39.05	33.22	44.82	180.12	294.52	230.37	361.89	517.42
AIC	3,067	2,932	3,017	2,900	2,738	5,420	5,298	5,372	5,250	5,097
BIC	3,110	2,946	3,067	2,986	2,830	5,463	5,312	5,422	5,336	5,189
	Years of education (OLS)					Years of education (ordered probit)				
Adj. R^2/pseudo-R^2	0.0914	0.0525	0.1061	0.1545	0.1736	0.0209	0.0126	0.0241	0.0359	0.0415
F test/LR test	277.93	763.89	273.29	229.74	242.03	1,355.80	817.10	1,563.14	2,329.14	2,688.38
AIC	65,506	66,078	65,282	64,520	64,206	63,490	64,021	63,285	62,529	62,171
BIC	65,551	66,093	65,335	64,610	64,304	63,641	64,141	63,443	62,724	62,375

For the ordinary-least-squares (OLS) models, we calculate R^2, whereas for the ordinal models, we calculate pseudo-R^2. The joint significance of all coefficients is tested using the F test (OLS models) and the LR test (ordinal models). All F and LR tests are significant at the 1% level. With regard to the Akaike information criterion (AIC) and Bayesian information criterion (BIC), the smallest value for each outcome regression is underlined. Note that the full model [including the Big 5, locus of control (LoC), and preferences (Pref)] is always chosen by both information criteria. The number of observations available varies for the different life outcomes: subjective health (14,218), life satisfaction (14,214), gross wage (7,199), unemployed (9,095), and years of education (13,768). Gross wage measures the gross hourly wage.

Table 11 Flexible specification of outcome regressions

	Subjective health (OLS)					Subjective health (ordered probit)				
	Big 5	LoC	Pref	Big 5–Pref	Big 5–Pref–LoC	Big 5	LoC	Pref	Big 5–Pref	Big 5–Pref–LoC
Adj. R^2/pseudo-R^2	0.0632	0.0388	0.0714	0.1054	0.1165	0.0251	0.0146	0.0282	0.0435	0.0483
F test/LR test	48.99	288.17	41.48	22.75	21.83	952.98	555.19	1,068.56	1,651.38	1834.03
AIC	37,740	38,088	37,623	37,142	36,977	37,051	37,413	36,949	36,467	36,310
BIC	37,899	38,110	37,834	37,732	37,665	37,232	37,458	37,184	37,079	37,021
	Life satisfaction (OLS)					Life satisfaction (ordered probit)				
Adj. R^2/pseudo-R^2	0.0948	0.0783	0.0948	0.1397	0.1659	0.0278	0.0219	0.0273	0.0422	0.0505
F test/LR test	75.47	605.45	56.12	30.967	32.41	1,493.78	1,178.45	1,470.26	2,273.51	2,715.76
AIC	54,976	55,214	54,984	54,311	53,884	52,391	52,670	52,428	51,725	51,309
BIC	55,135	55,237	55,196	54,901	54,572	52,617	52,761	52,708	52,383	52,065
	Gross wage (OLS)									
Adj. R^2/pseudo-R^2	0.0382	0.0387	0.0527	0.0797	0.1039	—	—	—	—	—
F test/LR test	15.30	145.74	15.84	9.092	10.27	—	—	—	—	—
AIC	55,111	55,090	55,009	54,851	54,672	—	—	—	—	—
BIC	55,256	55,111	55,202	55,388	55,298	—	—	—	—	—
	Unemployed (OLS)					Unemployed (probit)				
Adj. R^2/pseudo-R^2	0.0212	0.0385	0.0291	0.0463	0.0705	0.0357	0.0539	0.0498	0.0852	0.1166
F test/LR test	10.87	183.13	11.11	6.73	8.66	199.54	301.02	278.38	475.96	651.83
AIC	3,062	2,882	2,995	2,882	2,662	5,431	5,294	5,366	5,268	5,118
BIC	3,211	2,903	3,194	3,437	3,309	5,580	5,314	5,565	5,823	5,766
	Years of education (OLS)					Years of education (ordered probit)				
Adj. R^2/pseudo-R^2	0.1043	0.0525	0.1200	0.1771	0.1982	0.0243	0.0126	0.0281	0.0433	0.0497
F test/LR test	81.13	382.50	70.55	39.48	38.81	1,575.60	817.25	1,819.82	2,808.59	3,223.85
AIC	65,324	66,079	65,087	64,213	63,869	63,300	64,023	63,070	62,181	61,792
BIC	65,482	66,102	65,297	64,800	64,554	63,564	64,151	63,386	62,874	62,583

The outcome variables are regressed on the indicated personality and preference measures. The difference with regard to the linear specification is that the model includes squares of all variables as well as all cross-products. Cross-products are also calculated between concepts in case more than one concept is included; e.g., in the Big 5–preferences (Pref) case, we also include the cross-term neuroticism*risk, among others. For the ordinary-least-squares (OLS) models, we calculate R^2, whereas for the ordinal models we calculate pseudo-R^2. The joint significance of all coefficients is tested using the F test (OLS models) and the LR test (ordinal models). All F and LR tests are significant at the 1% level. With regard to the Akaike information criterion (AIC) and Bayesian information criterion (BIC), the smallest value for each outcome regression is underlined. Note that the full model [including the Big 5, locus of control (LoC), and Pref] is chosen by both information criteria in nearly all cases; only for gross wage and unemployment does the BIC indicate that the model with only LoC and LoC^2 included should be used. The number of observations available varies for the different life outcomes: subjective health (14,218), life satisfaction (14,214), gross wage (7,199), unemployed (9,095), years of education (13,768). Gross wage measures the gross hourly wage.

of association between economic preferences and subfacets of the five personality traits. The trait extraversion, for example, comprises different attitudes, such as being relatively outgoing, gregarious, sociable, and openly expressive (see **Table 4**), measured by 12 different questions in the NEO-FFI or three different questions in the BFI-S. In other words, each personality measure not only comprises multiple items, but more importantly captures distinct aspects of a character trait. Economic preferences, conversely, are defined more narrowly. For example, the concept of time preferences refers to the individual's willingness to abstain from something in the present in order to benefit from that decision in the future. Although this concept is applicable to different domains (e.g., to health outcomes or financial decision making), the underlying concept remains the same and is measured by standard incentivized experiments or survey items, as employed in this study. In this sense, our preference measures might resemble the subordinate aspects of the five personality factors.

Third, the finding of strong complementarities between economic preferences and personality measures may simply reflect conceptual differences in the way economic and psychological models are constructed. The economic model explains heterogeneity in behavior in terms of three distinct components: preferences, beliefs, and constraints, such as abilities. In contrast, psychological measures such as the Big Five include notions of preferences as well as beliefs and constraints. In other words, in our analysis we correlate economic preferences at least partly with beliefs and constraints, which by construction should not necessarily be correlated. A good example is conscientiousness. Being able and willing to work hard and being organized comprise aspects of both preferences and personal abilities. Likewise, emotional instability, which is part of the neuroticism facet, is related to personal inability rather than a preference. Even more extreme is the case of the locus of control, which is clearly a belief rather than a preference. This does not rule out the possibility that the two concepts are related, for example, because an external locus of control is conducive to the development of impatient behavior: If it does not pay off to invest because life circumstances are predominately determined by circumstances beyond one's control, the willingness to forgo current consumption and wait in order to earn a return in the future makes little sense. Yet beliefs and preferences are two distinct concepts.

The main focus of this review is the rather weak association and complementary nature of economic and psychological measures of personality. We do not discuss the specific signs of the correlations or ways to integrate personality into the economic model. Important work in this direction has been done by Almlund et al. (2001). Many signs of the correlations reported above are consistent across the three data sets, in particular those that are significant. For example, in all three data sets, risk attitudes and extraversion are positively correlated, and risk and neuroticism are negatively correlated. There are important exceptions, however. In the student sample, for example, risk attitudes and openness are negatively correlated, whereas they are positively and significantly negatively correlated in the two representative data sets. These and other inconsistencies raise important questions. One possible reason for finding different signs is the use of different elicitation methods for economic preferences (experiments and survey responses). Another possibility is that the reported correlations vary over the life cycle. If traits develop with different speed and at different points in life, correlations should vary with age. This could explain differences between a relatively young student sample and the representative samples. Not much is known about how economic preferences develop over the life cycle, but at least for risk

attitudes, there seems to be a robust and large negative age effect on willingness to take risks (Dohmen et al. 2011). Another possibility is that preferences and personality are generically differentially correlated between specific groups of the population (e.g., varying by gender, age, height, or education). From an evolutionary perspective, the coevolution of traits may serve different purposes depending on specific life circumstances. It may be optimal for one subgroup of the population to develop a positive correlation among particular traits, whereas for another subgroup it is adaptive to form a negative correlation. More work needs to be done to uncover potential group-specific correlations between personality and preferences.

The approach taken above is agnostic in the sense that we simply correlate existing and important measurement systems as they are. We think this is an important exercise, but it can only be a first step. What is needed is the development of a comprehensive framework that combines insights from the approaches taken by economists and psychologists to capture sources of heterogeneity in behavior. It is surprising that the Big Five apparently miss important preferences such as attitudes toward risk and time. Similarly, the economic model is incomplete not only with respect to important preferences, but also with respect to heterogeneity in abilities and beliefs. In the standard economic framework, beliefs are assumed to be endogenous to the strategic situation and formed in a rational way. Perhaps with the exception of interpersonal trust, beliefs are typically assumed to follow common prior assumptions and rational updating. The role of the locus of control in explaining fundamental life outcomes on top of preferences, however, reveals the importance of enduring and individual specific belief systems. Other examples include optimism, pessimism, religious beliefs, and ideological beliefs. The stability of belief heterogeneity is not well understood. It probably originates in different priors inherited from parents, self-selection into peer groups and institutions with reinforcing belief characteristics, and boundedly rational belief formation, such as selected perception, non-Bayesian updating, and ego utility (Köszegi 2006). Regardless of the precise channels that support enduring heterogeneous beliefs, economics would largely benefit from measuring and including them in explanations of economic outcomes. In addition, economists have started to model the fact that preferences and beliefs are intimately related and not separable as traditionally assumed. In fact, people often want to believe certain things, for example, in terms of being liked by others or being better than others (overconfidence). Finally, another important extension of the economic model would be the measurement of person-specific abilities. Whereas IQ has become a standard individual-specific characteristic included in outcome regressions, little work has acknowledged the importance of other competencies captured by Big Five traits, for example, the role of conscientiousness for educational or labor market outcomes.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

We gratefully acknowledge support from the European Research Council (starting grant) and the Deutsche Forschungsgemeinschaft through the Bonn Graduate School of Economics (BGSE).

LITERATURE CITED

Allport GW, Odbert HS. 1936. Trait-names: a psycho-lexical study. *Psychol. Monogr.* 47:1–171

Almlund M, Duckworth A, Heckman J, Kautz T. 2011. Personality psychology and economics. *IZA Discuss. Pap. 5500*, IZA, Bonn, Ger.

Anderson J, Burks S, DeYoung C, Rustichini A. 2011. *Toward the integration of personality theory and decision theory in the explanation of economic behavior.* Unpublished manuscript, Univ. Minnesota

Ben-Ner A, Kramer A. 2010. Personality and altruism in the dictator game: relationship to giving to kin, collaborators, competitors, and neutrals. *Personal. Individ. Differ.* 51:216–21

Berg J, Dickhaut J, McCabe K. 1995. Trust, reciprocity, and social history. *Games Econ. Behav.* 10:122–42

Bibby P, Ferguson E. 2010. The ability to process emotional information predicts loss aversion. *Personal. Individ. Differ.* 51:263–66

Borghans L, Duckworth AL, Heckman JJ, ter Weel B. 2008. The economics and psychology of personality traits. *J. Hum. Resour.* 43:972–1059

Borghans L, Golsteyn B, Heckman J, Meijers H. 2009. Gender differences in risk aversion and ambiguity aversion. *J. Eur. Econ. Assoc.* 7:649–58

Cohen J. 1988. *Statistical Power Analysis for the Social Sciences*. Hillsdale, NJ: Erlbaum. 2nd ed.

Cohen J. 1992. A power primer. *Psychol. Bull.* 112:155–59

Costa P, McCrae R. 1989. *NEO-PI/FFI Manual Supplement*. Odessa, FL: Psychol. Assess. Resour.

Costa P, McCrae R. 1992. *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI)*. Odessa, FL: Psychol. Assess. Resour.

Daly M, Delaney L, Harmon C. 2009. Psychological and biological foundations of time preferences. *J. Eur. Econ. Assoc.* 7:659–69

Dohmen T, Falk A, Huffman D, Sunde U. 2008. Representative trust and reciprocity: prevalence and determinants. *Econ. Inq.* 46:84–90

Dohmen T, Falk A, Huffman D, Sunde U. 2009. Homo reciprocans: survey evidence on behavioural outcomes. *Econ. J.* 119:592–612

Dohmen T, Falk A, Huffman D, Sunde U. 2010. Are risk aversion and impatience related to cognitive ability? *Am. Econ. Rev.* 100:1238–60

Dohmen T, Falk A, Huffman D, Sunde U. 2011. Individual risk attitudes: measurement, determinants, and behavioral consequences. *J. Eur. Econ. Assoc.* 9:522–50

Eckel C, Grossmann P. 1996. Altruism in anonymous dictator games. *Games Econ. Behav.* 16:181–91

Eckel C, Grossmann P. 2002. Sex differences and statistical stereotyping in attitudes toward financial risk. *Evol. Hum. Behav.* 23:281–95

Falk A, Dohmen T, Huffman D, Sunde U, Becker A. 2011. *A validated preference module*. Unpublished manuscript, Univ. Bonn

Falk A, Fehr E, Fischbacher U. 2005. Driving forces behind informal sanctions. *Econometrica* 73:2017–30

Falk A, Fischbacher U. 2006. A theory of reciprocity. *Games Econ. Behav.* 54:293–315

Fehr E. 2009. On the economics and biology of trust. *J. Eur. Econ. Assoc.* 7:235–66

Fischbacher U. 2007. zTree: Zurich Toolbox for Ready-made Economic Experiments. *Exp. Econ.* 10:171–78

Frederick S, Loewenstein G, O'Donoghue T. 2002. Time discounting and time preference: a critical review. *J. Econ. Lit.* 40:351–401

Gerlitz JY, Schupp J. 2005. *Zur Erhebung der Big-Five-basierten Persönlichkeitsmerkmale im SOEP.* Res. Notes, DIW Berlin

Gollier C. 2001. *The Economics of Risk and Time*. Cambridge, MA: MIT Press

Greiner B. 2004. An online recruitment system for economic experiments. *Forsch. Wiss. Rechn.* 63:79–93

Köszegi B. 2006. Ego utility, overconfidence, and task choice. *J. Eur. Econ. Assoc.* 4:673–707

Manski C. 2002. Identification of decision rules in experiments on simple games of proposal and response. *Eur. Econ. Rev.* 46:880–91

Roberts BW. 2006. Personality development and organizational behavior. In *Research on Organizational Behavior*, ed. BM Staw, pp. 1–41. Amsterdam: Elsevier Sci.

Roberts BW. 2009. Back to the future: personality and assessment and personality development. *J. Res. Personal.* 43:137–45

Rotter J. 1966. Generalized expectancies for internal versus external control of reinforcement. *Psychol. Monogr.* 80:1–28

Samuelson P. 1937. A note on measurement of utility. *Rev. Econ. Stud.* 4:155–61

Schupp J, Wagner GG. 2002. Maintenance of and innovation in long-term panel studies: the case of the German Socio-Economic Panel (GSOEP). *Allg. Stat. Arch.* 86:163–75

Selten R. 1967. Die Strategiemethode zur Erforschung des eingeschränkt rationalen Verhaltens im Rahmen eines Oligopolexperiments. In *Beiträge zur experimentellen Wirtschaftsforschung*, ed. H Sauermann, pp. 136–68. Tübingen: J.C.B. Mohr (Paul Siebeck)

Vischer T, Dohmen T, Falk A, Huffman D, Schupp J, et al. 2011. *Measuring time preferences in representative samples by combining experimental elicitation and survey measures*. Unpublished manuscript, Univ. St. Gallen

Wagner GG, Frick JR, Schupp J. 2007. The German Socio-Economic Panel Study (SOEP): evolution, scope and enhancements. *SOEPpapers 1*, DIW Berlin

Zuckerman M. 1994. *Behavioral Expressions and Biosocial Bases of Sensation Seeking*. New York: Cambridge Univ. Press

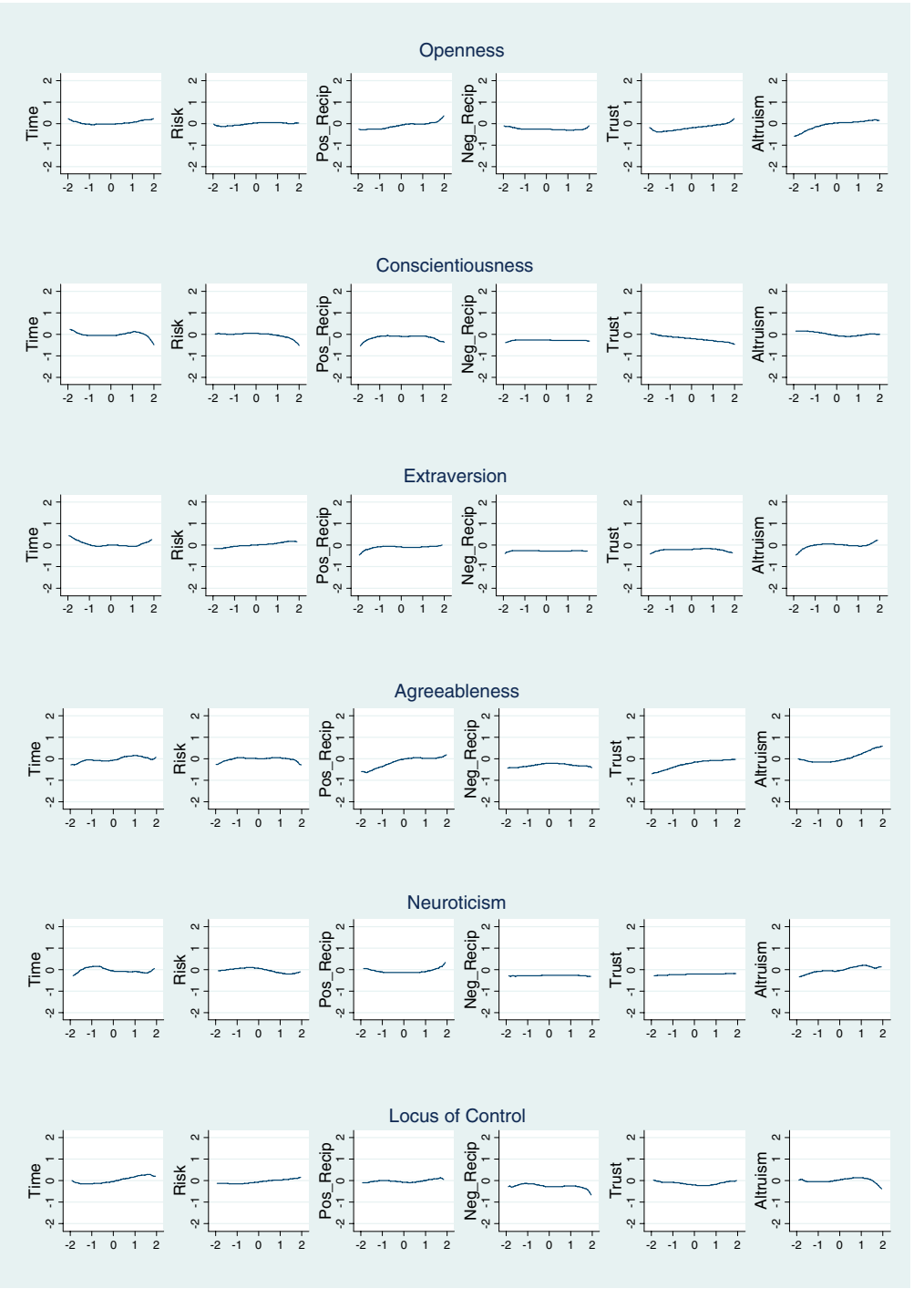

Figure 1

Kernel-weighted local linear polynomial regressions using experimental data.

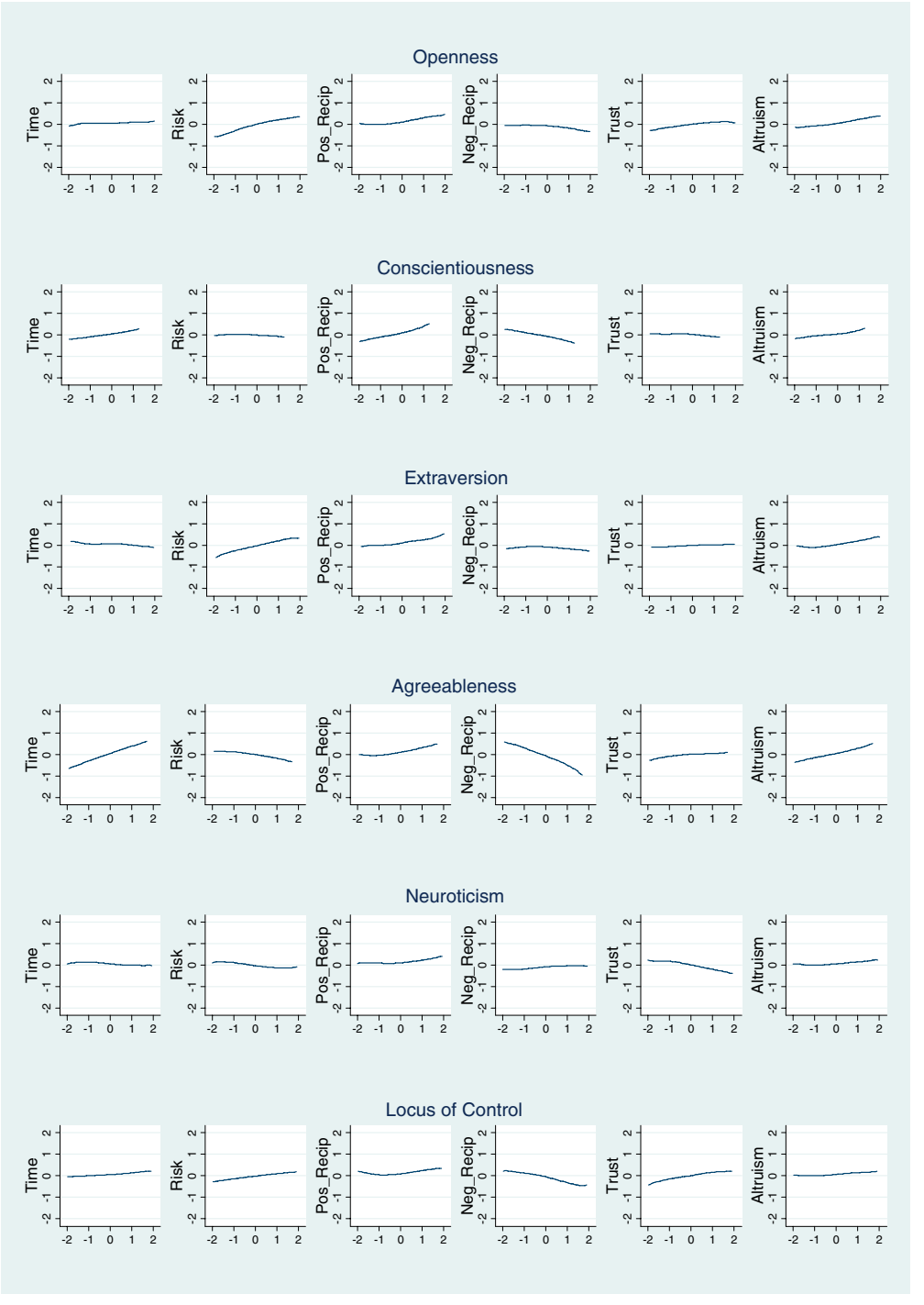

Figure 2

Kernel-weighted local linear polynomial regressions using SOEP data.

Annual Review of Economics

Volume 4, 2012

Contents

Indexes

Errata

An online log of corrections to *Annual Review of Economics* articles may be found at http://econ.annualreviews.org