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**Cooperation and Personality**

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# Cooperation and Personality

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**Abstract:** Cooperating behavior may be fostered by personality traits reflecting either favorable inclination to others or willingness to comply with norms and rules. We test the relative importance of these two factors in an experiment where subjects provide real mental effort in two treatments with identical task, differing only by whether others' payment is affected. If the first hypothesis is true, subjects reporting high Agreeableness score should put more effort; if the second is true, reporting higher Conscientiousness should predict more effort. We find experimental support for the second hypothesis but not for the first, as subjects reporting high Altruism do not behave consistently with this statement.

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# 1 Introduction

Personality traits of individuals working together in economic organizations may significantly affect their performance, beyond what one can predict relying on measures of risk attitude, time preferences and effort cost. This insight has already made its way in the business practice. Personality tests are now a frequent practice in the process of applicant selection in many large firms: recently the BBC News Magazine reported<sup>1</sup> that that 89 of the Fortune 100 companies use some test to assess the personality of the job applicants. In general, analysis of personality may provide us with a reliable characterization of systematic elements in the behavior of an individual. Several studies suggest what the genetic and neural basis of the traits are likely to be.<sup>2</sup>

Economic analysis has only recently started to address the question on how measure of personality affect individuals performances, especially in organized groups. Here we test experimentally whether cooperating and trusting behavior can be successfully explained by personality reflecting generally empathic attitude, helpful and unselfish orientations to others, or rather by personality traits revealing willingness to comply with norms and rules. We find strong support for the second hypothesis.

In our data, personality trait revealing a more favorable inclination to others is Agreeableness, defined as: *“The degree to which a person needs pleasant and harmonious relations with others”* (Costa and McCrae, 1992); and it is measured by explicitly asking to report cooperation (question 42), trust (22), helpful and kind attitude to others (7, 12, 27, 32, 37).<sup>3</sup>

The other trait likely to explain cooperative behavior is Conscientiousness, defined as: *“The degree to which a person is willing to comply with conventional*

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<sup>1</sup><http://www.bbc.co.uk/news/magazine-18723950>

<sup>2</sup>See deYoung and Gray 2010 for a comprehensive description of this literature.

<sup>3</sup>We report the statements that enter into the Agreeableness score. Subjects had to indicate whether they agreed with the statement as a description of them. The number indicates the order of presentation, (R) indicating reverse coding: 2. Tends to find fault with others (R). 7. Is helpful and unselfish with others. 12. Starts quarrels with others (R). 17. Has a forgiving nature. 22. Is generally trusting. 27. Can be cold and aloof (R). 32. Is considerate and kind to almost everyone. 37. Is sometimes rude to others (R). 42. Likes to cooperate with others.

*rules, norms, and standards* (Costa and McCrae, 1992). The trait can be measured by survey questions asking subjects to report reliability and care in work (3, 8, 13, 18, 23, 33) and consistency in carrying out plans (38, 43).<sup>4</sup> Here we use the big five personality traits to test the effect of altruistic preferences,<sup>5</sup> and respect of norms on the cooperative behavior.

Since our interest is in understanding the working of real life social institution, we insist that decisions on cooperation and trust should involve an effort cost (mental effort in our design), rather than monetary transfer. There are two reasons for this emphasis on effort provision as opposed to monetary transfer. The first is ecological validity. In all organizations, the cost of productive work is most commonly effort rather than monetary transfers. The second is degree of monitoring and the incentives to “fake” a trait (see e.g. Borghans et al., 2008 for an helpful discussion); monetary transfers are usually perfectly observable, but effort provision is not because its effect on observable outcome is confounded by skill and chance. This different degree of monitoring affects incentives. If a person claims to be unselfish, she is bound, in order to be credible to others as well as to herself, to make monetary transfers consistent with this claim. If instead the test of her claim is effort provision, which is not well monitored, checking the consistency with such claims is hard, thus she is not bound by the claims. As a corollary of this reasoning, it seems natural to conjecture that whereas monetary transfers might be strongly correlated with claims of being unselfish and caring, effort provision will not. This is what we find in our data.

Our method relies on the comparison between the performance in a control treatment where effort of an individual affects his own payment and only his own, and the performance in a treatment (called cooperative) where effort of an individual affects the payment of a different, randomly chosen, anonymous

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<sup>4</sup>Here are the statements entering into the Conscientiousness score: 3. Does a thorough job. 8. Can be somewhat careless (R). 13. Is a reliable worker. 18. Tends to be disorganized (R). 23. Tends to be lazy (R). 33. Does things efficiently. 38. Makes plans and follows through with them. 43. Is easily distracted (R).

<sup>5</sup>In relation to this, Borghans et al., 2008 report: “*To date, there has been no attempt to relate social preferences to the Big Five personality traits that we discuss next, even though at an intuitive level social preferences should be linked with empathy and outgoingness.*”

subject. The tasks in the two treatments are identical, so the two treatments differ in the way in which final payoffs are computed, not the way in which effort is provided or effort translates into performance. In the control treatment each subject performs two series of ten additions and a third series where she adds the two previously obtained series of numbers. The subject is paid proportionally to the number of correct answers to the last series, so the three series of additions are perfectly complementary to obtain the right numbers. In this treatment the final payment depends only on the effort of the subject. In the cooperative treatment each subject is part of a team of two randomly and anonymously matched individuals, and exchanges the second series of addition with the partner. Hence in the cooperative treatment, the final outcome of each teammate is dependent on the effort of both. The interaction is one-shot and simultaneous.

As they complete the first addition, subjects have to anticipate the quality of the input that others will provide them; so their effort will be higher if they trust others to provide adequate effort, or to be of appropriate skill. Instead, when they do the second addition, they might consider that their output will influence the payment to others; so their effort will be higher if they care about the outcome of others (according to the hypothesis that a personality revealing other-regarding preferences drives their behavior) or if they feel that works need to be carried out properly independently from the personal reward, because intrinsically motivated by the fact that a “correct” behavior should be followed.

The measure of Agreeableness is not a good predictor of the performance in the cooperative treatment, as compared with the individual treatment. Thus the first hypothesis that cooperation is driven by self-reported social preferences finds little support. To further investigate the reason for the absence of an effect of Agreeableness we analyzed the impact of two aspects (or *facets*) of this trait that should in theory be relevant for our experiment. The facet *altruism* should positively affect the addition the subjects pass to their partners, whereas the facet *trust* should be positively associated to the addition the subjects perform for themselves (first addition) in expectation that the

partners perform correctly the second. While trust is a correct predictor of the first addition in the cooperative treatment,<sup>6</sup> altruism has no effect. In other words, subjects declaring a stronger willingness to help others do not behave consistently when they need to help other subjects is achieving their goals in our experiment.

On the contrary, subjects who report higher Conscientiousness are better in both trusting and helping the partner to achieve better results in the cooperative treatment; this also holds when we compare the outcome with that in the individual treatment, where Conscientiousness is not a performances' predictor. This finding provides support for our second hypothesis that cooperation is explained by intrinsic motivation and reliability.

Neuroticism is associated with higher sensitivity to negative rewards, thus higher responsiveness to the negative side of incentives.<sup>7</sup> Important considerations may be fear of failing or not achieving a result, and a negative response of others to the failure to produce good output in a cooperative effort. These factors may induce individuals with higher Neuroticism score to higher effort in the cooperative treatment. Accordingly, in our experiment subjects with higher Neuroticism score are more effective in helping the partner to achieve better results. The direction of the effect is particularly interesting. It is negative when individuals have a full incentive to provide optimal effort, but seems to turn positive when this effort is devoted to help the other.

To the best of our knowledge, in this paper we perform the first laboratory experiment on the economic effect of personality in strategic situations where the final outcome is based on real effort rather than monetary cost. Hirsh and Peterson (2009) and Pothos et al. (2010) link personality traits to strategic behavior in experiments but use the classic prisoner dilemma game. Anderson et al (2011) analyze the effect of traits on the trust game using a large sample

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<sup>6</sup>This result lends further support to the literature using the self-reported level of general trust to build an index of the level of social capital (e.g. La Porta et al., 1997; Knack and Keefer, 1997; Algan and Cahuc, 2010)

<sup>7</sup>For convenience we report the statements entering into the Neuroticism score: 4. Is depressed, blue. 9. Is relaxed, handles stress well (R). 14. Can be tense. 19. Worries a lot. 24. Is emotionally stable, not easily upset (R). 29. Can be moody. 34. Remains calm in tense situations (R). 39. Gets nervous easily.

of truck driver trainees. Becker et al. (2012) analyze the effect of the personality traits on the trust game, in the dictator game, and in the punishing behavior in a modified prisoner dilemma game. Filiz-Ozbay et al. (2013) focus on the gift exchange game. We will discuss how their findings are related to ours in the discussion session. As in our paper, the design of Fréchette's et al. (2013) is not based on a classic laboratory game. They frame their laboratory experiment as a relationship between an investor and an intermediary and show how the big five personality traits influence decision under risk when information is not readily available to the investors. In their paper personality affects the way individuals collect and transmit information not readily available, so, personality affects outcome when the tasks are performed jointly by two individuals, an investor and the intermediary.

Testing whether common measures of Agreeableness or Conscientiousness, or both, influence behavior in tasks where actions affect outcomes of others may throw light on the broader debate on cooperation. Several strands in the literature explore the effects of monetary and non monetary incentives on behavior, in decision and strategic environments. The first strand focuses on intrinsic motivation to work, defined as the motivation to exercise effort driven by the enjoyment of the activity, rather than material rewards (e.g. Gneezy and Rustichini 2000; Benabou and Tirole, 2003). A second strand focuses on social norms, where behavior is explained by consistency of beliefs of members of society (e.g. Konow, 2000; Bicchieri, 2006; Lindbeck and Nyberg, 2006).

The third strand makes strategic behavior originate in preferences on social rather than individual outcomes, i.e. social preferences. This is originated by a large literature based on laboratory experiments where subjects plays games involving monetary transfer. (e.g. Camerer and Weigelt, 1988, for an experiment showing reciprocity; Fehr and Schmidt, 1999, and Bolton and Ockenfels, 2000, provide evidences for inequity aversion; Andreoni and Miller, 2002, focus on altruism; Charness and Rabin, 2002, introduce the social welfare in the individuals' utility function). More recently social preferences have been analysed outside the laboratory; List (2006) shows that when real market transaction are involved individual behavior can be better predicted by self-

interest and, more related to the current paper, Stoop et al. (2013) argue that in an experiment with real effort, subjects prefer to maximize private outcomes instead of cooperating for a social optimal outcome.

Empirical studies of the links between personality and economic performances show significant predictive power of some traits, which offer indirect support for our findings. Barrick and Mount (1991) present a meta-analysis showing how Conscientiousness is a good predictor in all job performances. Almlund et al., (2011) study the correlations of the Big Five and IQ with job performance, and show that of the Big Five, Conscientiousness is the most associated with job performance (is about half as predictive as IQ). This finding, generally confirmed by a number of other studies, is consistent with our result that conscientiousness is an important trait for cooperation, if we consider the pervasiveness of cooperation in almost all kinds of jobs.

The literature in experimental psychology dealing with team work and personality has focused on the qualitative nature of the roles within the team; analyzing how traits influence the allocation of task roles and social roles and emphasizing how Conscientiousness is important for the first and Agreeableness for the second, hence in promoting social cohesion (Blumberg 2001, Stewart et al. 2005). Other studies have analysed the impact of personality on team settings (e.g. LePine et al., 1997; Barrick et al., 1998; Mount et al., 1998; Barry and Stewart, 1999; Neuman and Wright, 1999). These studies are not in contrast with ours and, although interesting and relevant for the economist, do not usually focus on the variables usually considered in economic models. In addition, studies in psychology usually do not provide appropriate incentives to participants. Nevertheless, our result that personality has a such different impact on cooperative rather than individual effort for otherwise identical tasks and the inconsistent behaviour of subject declaring high altruism are, to the best of knowledge, new and possibly relevant with respect to psychology literature as well.

The Big Five theory (Costa and McCrae; 1992) enjoys wide acceptance among personality psychologists. The five traits were initially derived from the analysis of the terms used in natural languages by people to describe them-

selves and others. More recently several studies have demonstrated a biological underpinning of the personality traits. For example, using analysis based on the difference between DZ and MZ twins, Rieman et al. (1997) show that, for all five factors, genetic effects were the strongest source of the phenotypic variance on the personality traits measured via self-report, accounting of about 50 percent of the variance. Other studies (see Loehlin's, 1992, meta analysis) based on the difference between twins reared apart and reared together show that shared sibling environment effects contributed little to phenotypic variance. The link of personality with neural structures is analyzed in a large literature on the neuroscience of personality. Empathy is linked to brain systems that are involved in social information processing (see Seitz, Nickel and Azari, 2006 for a meta-analysis based on 80 studies). Serotonin and Glucose production is associated with Conscientiousness and self-discipline in particular (e.g. Gailliot and Baumeister, 2007), prefrontal cortex seems likely to be involved as well (e.g. Brown et al., 2006). Neuroticism is linked to higher sensitivity to negative emotions like anger, hostility or depression (e.g. Clark and Watson, 2008), is associated with structural features of the brain systems associated with sensitivity to threat and punishment (DeYoung and Gray, 2010) and with low levels of serotonin in turns associated with aggression, poor impulse control, depression, and anxiety (Spoont 1992).

The paper is organized as follows. Section 2 describes the experiment; section 3 describes the main results, and show that the result that agreeableness is not a positive predictor of effort in cooperation is robust to alternative specifications of the model. In section 4 we discuss the main results, show the effect of self-reported altruism and trust. In the appendix we provide a formal timeline of the experiment. The questionnaire completed at the end by subjects, the experimental instructions, the comprehension quiz presented to the subject and the recruitment letter circulated are available in the supplementary material.

## 2 Experimental Design

The design has two treatments, called *control* and *cooperative*. Subjects performed exactly the same tasks in both treatments, but the final outcome in the control treatment only depended on the individual effort of each subject, while the final outcome in the cooperative treatment was determined by a combination of the effort of two subjects, randomly and anonymously matched.

### Treatments and Tasks

In the control treatment subjects solved a simple arithmetic problem of adding three series of ten two-digit numbers in the following way (a more formal timeline of the experiment is presented in appendix 4):

1. Perform 10 additions, indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers randomly chosen by the computer, in 4 minutes. Let  $S_i^1$  be the answers provided.
2. Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers randomly chosen by the computer, in 4 minutes. Let  $S_i^2$  be the answers provided.
3. Add the 10 numbers obtained in step 1 above and the 10 numbers obtained in step 2 above, producing for each  $i$  an answer  $S_i^3$  in 2 minutes.

In the cooperative treatment subjects performed the same sequence of additions, but jointly with an anonymous subject, as follows:

1. Perform 10 additions, indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers randomly chosen by the computer, in 4 minutes. Let  $S_i^1$  be the answers provided.
2. Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers randomly chosen by the computer, in 4 minutes. Let  $S_i^2$  be the answers provided.

3. The output of these 10 additions,  $S_i^2, i = 1, \dots, 10$  is transferred to a randomly matched and anonymous partner, and the 10 numbers output produced by this partner is transferred in turn to the subject. We denote by  $S_i^{*2}$  the values of the sum that the partner makes.
4. Add the 10 numbers obtained in step 1 above,  $S_i^1$ , and the 10 numbers obtained from the randomly matched partner,  $S_i^{*2}$ , and producing an output  $S_i^3$  in 2 minutes.

Let  $C_i^k$  denotes the correct final amount from each of the three series of additions specified above, with  $k = 1, 2, 3$ , for each addition  $i$ . In both cases, the payment rule was 15 British Pounds Sterling (GBP), approximately 26 US Dollars (USD), minus 1 in the event of an incorrect final sum: to be precise, the subject lost one pound (and only one pound) for each  $i$  such that  $S_i^3 \neq C_i^3$ .

In all steps a clock on the screen was displaying the time elapsed. In the cooperative treatment we reminded subjects at the beginning of the second step that the 10 additions they were about to make would then be used by another subject. We chose this exercise of summing in a fairly generous amount of time because we believe it is a rather elementary tasks for our pool of subjects, where it is less likely that the skill per se matters and it is mostly how much attention each subjects pay to the task (we will further discuss in section 3 the implication of this feature of the experiment).

A set of instructions in hard copy (available in the supplementary material) was distributed at the beginning and subjects were quizzed with 3 questions of progressive difficulty to check their comprehension. All subjects' answers were checked and the task individually re-explained if subjects made any mistake. Instructions were also reported on a white board.

After the task was completed, subjects performed a Raven Advanced Progressive Matrices (APM) test of 15 tables for 30 seconds each table, paid 0.20 of GBP per correct answer. Before this test we showed subjects a table with an example of a matrix and the correct answer below for 1 minute, to explain the logic of the test.

The Raven test is a nonverbal test commonly used to measure reasoning ability and general intelligence. In each test item, the tables show patterns presented in the form of a  $3 \times 3$  matrix, the subject is asked to identify the missing element that completes a pattern. The Raven APM is appropriate for adults and adolescents of higher average intelligence. The 15 tables presented in order of progressive difficulty were selected from set II. Finally, a standard Big Five personality questionnaire and other questions were presented to the subjects who could answer with no time constraint. In particular we use the Big Five Inventory (BFI) based on 44 question with answer coded on a Likert scale. This version was developed by John, Donahue and Kentle (1991) and recently investigated by John, Naumann and Soto (2008).<sup>8</sup> The BFI is particularly suitable for our purpose because specifically designed for a sample of college and university students.

## Implementation

We conducted 8 sessions for each treatment. In total 270 subjects (140 in the control, 130 in the cooperative treatment) participated, all recruited from the subject pool of the Warwick experimental laboratory. We used the DRAW (“Decision Research at Warwick”) system, based on the ORSEE recruitment software (the recruitment letter circulated is in the supplementary material).

Each session lasted 45 minutes. Subjects earned an average of about 11 GBP (approximately 18 USD), the participation payment was 4 GBP. The breakdown and the dates of the different sessions are presented in table 8.<sup>9</sup> The software used for the entire experiment is z-tree (Fishbacher, 2007).

In the appendix we present a more detailed description of the time-line of the experiment. In the supplementary material we present the instructions and the quiz on the instructions administered to subjects. The Ethical Approval

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<sup>8</sup>The questions can be downloaded from Oliver P John’s website called the Berkeley Personality Lab <http://www.ocf.berkeley.edu/~johnlab/bfi.htm>.

<sup>9</sup>In session 14 there was an odd number of subjects. This session was part of the cooperative treatment, where subjects are paired, so a computer position was filled by a research assistant who performed the addition tasks. This observation has been dropped from the sample.

of this design has been granted from Humanities and Social Sciences Research Ethics Sub-Co at University of Warwick under DRAW Umbrella Approval (Ref: 03/12-13).

### 3 Results

The descriptive statistics of the main variables are presented in tables 1 and 2. *Correct 1* is the number of correct answers in the first sum  $S^1$ , and *Correct 2* is the number of correct answers in the second sum  $S^2$ .<sup>10</sup>

It is important to note that *Correct 2* is not significantly different in the two treatments (with *p-value* = 0.53), while *Correct 1* is slightly smaller by about 0.4 in the cooperative treatment (with *p-value* = 0.06). This result, perhaps of independent interest in experimental tests of mechanisms, shows that one treatment is not particularly more efficient than the other in producing higher *Correct 1* and *Correct 2* and it is arguably a good characteristic of our design because it increases the symmetry of the two treatments. We are not considering the final answers  $S^3$ , since this is heavily dependent on the performances on  $S^1$  and  $S^2$ . The reason we introduced the last task of summing  $S^1$  and  $S^2$  was to stress the idea that the final task was a joint contribution of the two subjects teamed together in the cooperative treatment. Personality traits are measured on a scale between 1 and 5; *Raven* is the score in the Raven APM.

Samples in the two treatments were homogeneous: there is no statistically significant (at the 5 percent level or even above this threshold) difference between variables in the control and in the cooperative treatment if we consider gender, age, personality traits, mathematics grades (the final high school grade, in mathematics normalized between 0 and 1) quantitative (the nature of the university degree subjects are undertaking coded as Yes= 1 and Not= 0 )

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<sup>10</sup>In the control treatment there is one more *Correct 1* observation than *Correct 2*. This occurs because subject made an error in encoding his answer in the second series of additions. There was no reason to drop the observation since this is uncontaminated by the subsequent error.

and non european (coded as 1 if the citizenship of the subjects is non european, 0 otherwise).

Table 3 presents the correlations between the individual characteristics: personality traits, Raven and gender. Both the sign and the size of the correlations are the ones expected, with Neuroticism negatively correlated to the other traits.

## Model

In order to assess the effect of the traits on the individual performances in the two treatments, we estimate the model:

$$Correct_j = \beta_O O + \beta_C C + \beta_E E + \beta_A A + \beta_N N + \beta_R R + \beta_0 + \beta_F F + \Gamma Day + e, j = 1, 2. \quad (1)$$

$$\beta_0 + \beta_F F + \Gamma Day + e, j = 1, 2.$$

where  $O, C, E, A, N, R$  are the measures of Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism, Raven, respectively.  $F$  is equal to 1 if the subject is female,  $Day$  is the days' dummies vector, representing the day the subject  $i$  participated to the experiment. Note that *Correct 1*, in the cooperative treatment is a clear measure of the subject to trust the anonymous partner, because the output of this task is fully complementary for the final result to the output produced by the partner.<sup>11</sup> Given that the task requires little skill but mostly attentional effort, we argue that the trust is respect to attention and effort of the partner, not respect to his or her mathematical skills. Whereas *Correct 2* in the cooperative treatment is a clear measure of the willingness of the subject to assist the anonymous partner, because the output of this task is only used by the partner.

To help with the interpretation of the results, variables measuring personality traits and Raven score have been rescaled to assume a value between 0

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<sup>11</sup>In the discussion session, and in table 7 in particular, we will present some specific evidence consistent with this interpretation.

to 1, using for each variable the transformation:

$$x_i = \frac{\hat{x}_i - \hat{x}_{min}}{\hat{x}_{max} - \hat{x}_{min}} \quad (2)$$

where  $\hat{x}$  represent the original value and  $\hat{x}_{max}$  and  $\hat{x}_{min}$  are the maximum and minimum value of the variables.

From the estimation of model 1, we will be able to assess the effect of the traits, the fluid intelligence (as measured by the Raven test) and the gender on individual performances in the cooperative and individual settings. In order to provide a formal test of the differences of the effect of the above characteristics in the two treatments we estimate another model, where we add to the equation estimated in 1, the interacted term:

$$Coop * (\beta'_O O + \beta'_C C + \beta'_E E + \beta'_A A + \beta'_N N + \beta'_F F + \beta'_R R) + Coop * \beta'_0$$

Where,  $Coop$  is 1 if the treatment is cooperative,  $\beta'_0$  represents the general treatment effect,  $\beta'_x$  represents the differential effect of the characteristics  $x$  between the cooperative and individual treatments. A significant  $\beta'_x$  implies that there is a statistically significant difference between the two treatments in the effect of characteristic  $x$ . Note that a positive (negative) coefficient of the interacted terms,  $\beta'_x$  that we will define as *differential effect between individual and cooperative treatment*, will imply that  $x$  increases (decreases) the performance more in the cooperative treatment than in the individual, or baseline, treatment.

### Model estimation

The estimated equations of model 1, analyzing performances in the first series of additions, measured by *Correct 1*, and in the second series of additions, measured by *Correct 2* is presented in table 4.

## Conscientiousness

From table 4 we note that both *Correct 1* and *Correct 2* are increasing in Conscientiousness in the cooperative treatment, while Conscientiousness has a negative, but not significant effect in the baseline treatment. The overall effect of Conscientiousness is 2.5 additions, a quarter of the entire task for both *Correct 1* and *Correct 2*. From column 2 of table 5 we note that Conscientiousness has statistically significant positive differential effect in the cooperative treatment for *Correct 1*. A positive differential effect seems to exist also for *Correct 2*, as we note from column 4, although this last is non significant.

In figure 1, we plot the regression lines of Conscientiousness in both treatments over *Correct 1*, we can observe this relation as well. We then make the following:<sup>12</sup>

**Observation 3.1.** *More conscientious subjects have a stronger performance in a cooperative treatment, especially in trusting the partner; and they seem not to have significantly larger performance in the control treatment (with individual payment).*

## Agreeableness

From table 4, we note that the effect of agreeableness is non significant in both treatments, nor it is significantly different in the two treatments as table 5 shows. Then, we can argue that:

**Observation 3.2.** *More Agreeable subjects do not have higher performance in the cooperative treatment, nor agreeableness is a predictor of performances in the control treatment.*

## Neuroticism

Neuroticism has a negative impact in the control treatment as we note from the coefficient of Neuroticism in columns 1 and 3 of table 4; its effect on the

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<sup>12</sup>In Figure 3 and 4 in the appendix we report for completeness the comparison between control and cooperative treatment for all the Big Five factors and for the Raven score.

cooperative treatment seems positive, although it is not statistically significant as we observe from columns 2 and 4.

Consistently with results from table 4, Neuroticism has a positive differential effect in the cooperative treatment as we note from columns 2 and 4 of table 5. Furthermore, considering the fourth column, from the magnitude of the coefficients we conclude that an individual with high Neuroticism score performs about 1.7 additions more in the cooperative than in the control treatment (i.e.  $-3.5 + 5.1$ ) in the second series of additions; which seems to suggest that neurotic subjects seem to perform better in the cooperative treatment than in the individual treatment.

Figure 2 illustrates the relation of performance in the second addition in the two treatments and Neuroticism. The two regression lines show that less neurotic individuals perform significantly better in the control treatment, while more neurotic individuals perform better in the cooperative treatment. Furthermore, the relation is clearly negative in the control and it seems positive in the cooperative treatment. Therefore we make the following:

**Observation 3.3.** *Subjects with higher Neuroticism score have a weaker performance in the control treatment (with individual payment), but not in the cooperative treatment, where they seem to have, if anything, a stronger performance, especially in the task of helping the partner.*

### Gender Effects

From table 4 we note that female perform worse than male in the individual treatments, but there is virtually no difference in the cooperative treatment. Consistently with this result, from table 5 we note that there is a positive, although weakly significant, differential effect between the treatments in *Correct 1*. We then make the following

**Observation 3.4.** *Female subjects perform like male subjects in the cooperative treatment but worse than male subjects in the individual treatment.*

This observation is consistent with the findings that women are usually considered more cooperative than men (see e.g. Gneezy et al., 2003; Niederle

and Vesterlund, 2007 and Kuhn and Villeval, 2013, for a more recent contribution).

### **Openness, IQ and Extraversion**

Openness is weakly negatively associated with performances in cooperation at the same time it does not have an effect in the baseline treatment, as we note from table 4. Furthermore, from table 5, we observe that Openness seems to have a negative differential effect in *Correct 1* in cooperation. The Raven score is a positive predictor of performances in both *Correct 1* and *Correct 2* (table 4). It seems stronger for the control treatment, although table 5 rejects the hypothesis of a significant differential effect. We will briefly discuss these results in the next section.

Extraversion seems to be a negative predictor of performances in the individual treatment, but not in the cooperative treatment (table 4). However, table 5 rejects the hypothesis of a statistically significant difference.

Finally note that in Figure 3 and 4 in the appendix we report for completeness the comparison between control and cooperative treatment for all the Big Five factors and for the Raven score.

### **Cooperative treatment**

Finally as we have already argued at the beginning of this section, from columns 1 and 3 of table 5 we observe that when we do not consider the traits interacted by the dummy treatment, the dummy indicating the cooperative treatment are small or non significant. However, when we introduce the interacted terms—measuring the differential effect of the traits in the two treatments—performance in the first and in the second addition is substantially lower in the cooperative treatment than in the control by 3.5 correct answers, as economic analysis of the task suggests.<sup>13</sup> Hence, comparing columns 1 and 2 and columns 3 and 4 respectively, we can argue that

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<sup>13</sup>This is natural: when computing the first addition subjects anticipate that the quality of the input of the others will be lower, so the return to effort is lower. In the second addition, the monetary return to effort is zero.

**Observation 3.5.** *There is little differences in average performances when individuals act singularly or in cooperation. But, once the effect of personality, gender and intelligence are taken into account, these differences become very large.*

The model estimated above implicitly assumes substitutability between skills – like diligence or ability to avoid distraction or notice errors– and effort. A possible objection to this argument is that effort is complementary rather than substitute of those skills; this would explain why subjects reporting more agreeableness do not perform better in the cooperative treatment and especially in *correct 2*: their higher motivation deriving from the willingness of helping the partner may result in higher effort, but this is not enough in itself to guarantee better performances.

To test the validity of this explanation, we introduce in the model an interactions between Agreeableness and Conscientiousness, Agreeableness and Raven, and Agreeableness and Neuroticism. If Agreeableness is complementary to the other traits to improve performances then when interacted with these traits this should improve performances, and the interaction should result significant if subjects reporting high agreeableness were really willing to help the partners. In table 6, we report the estimation of the model with the three new interactions: Agreeableness and Raven in column 1, Agreeableness and Conscientiousness in column 2, Agreeableness and Neuroticism in column 3. None of the interactions are in fact significant, hence more Agreeable subjects even when they are also more skilled in performing for the task in our experiment do not seem to be more helpful for the partners.<sup>14</sup>

## 4 Discussion

In our experimental design two identical tasks were performed under different payment conditions. In one treatment the payment depended only on the effort

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<sup>14</sup>For expositional simplicity we excluded the traits which are not directly involved and the interactions between cooperation and these traits, introducing them in the regressions will not affect our conclusions.

and skill provided by the individual who would then receive the payment. In the other, the final payment was dependent on effort and skill of the individual and of another, randomly matched participant: in this case subjects knew that during the execution of a part of the task, they would not directly benefit of the outcome of their effort, benefit which would instead go to another participant in the session. It may be useful to regard our design as a new, modified version of the classical Trust Game: Both players have to decide how much they trust the other, simultaneously and symmetrically, when they make the first sum, because that effort will provide a return only if the other player cooperates when her time comes to do the second sum. In the second move, when they have to do the sum that the other will use, they do it before they know how much effort the other contributed. In summary, our game can be considered as simultaneous moves trust game, where the reciprocating move is done before the player knows how much the other contributed, and effort cost is real, non monetary. Thus our design gives a condition (the control) that can be used in the comparison of performance when the effort directly benefits (in terms of the payment) the individual who provides it as compared to the environment where someone else enjoys those monetary benefits. In our experiment, willingness and inclination to cooperate is tested by voluntary provision of mentally costly effort that is improving the outcome of others.

#### *The role of Agreeableness, Trust and Altruism*

Possibly the most surprising and instructive conclusion of our study is that the personality trait of a specifically social nature, Agreeableness, is not associated with a significant difference in effort provision in the two treatments. Given the questions in the survey, it is natural and plausible to identify a high score in our measure of Agreeableness with a more generous and benevolent *stated* attitude to others. The evidence of actions shows convincingly that these statements are not necessarily followed by facts, particularly when the cost associated with altruistic behavior is real effort rather than a monetary transfer.

The regressions presented in table 7 further clarify our claim that Agreeableness does not predict better performances in the cooperative tasks. In

this table we introduced the variables Trust corresponding to the answer (on a scale from 1 to 5) to the question: *I am someone who is generally trusting* and Altruism corresponding to the answer (also on a scale from 1 to 5) to the question: *I am someone who is helpful and unselfish with others*. Both questions contribute to the agreeableness score in our measurements. In particular, we introduced the two variables, together with their interaction with the cooperative treatment dummy. We note that (see column 1) the sign of the interaction with trust is positive and significant for the first series of additions, *Correct 1*. This is true also when we add our set of controls in column 3 (the coefficient is almost unchanged, although it becomes borderline significant with a  $p$ -value = 0.055). It is also important to note that interaction with trust is insignificant when regressed against *Correct 2*. These results confirm our interpretation of *Correct 1* as an index of trust on other people and also suggest how this specific aspect of agreeableness is important for cooperation. Instead, interaction with Altruism is negative and non significant, and this is remarkable especially in the regression with *Correct 2* that, we argued, is a measure of how much people are willing to help others. This suggest that that the statement of altruism is not necessarily followed by facts, when the cost associated with altruistic behavior is real effort.

Experiments studying the association of personality traits with strategic behavior, involving exchanges of monetary amounts, provided mixed evidence that cooperative behavior is associated with Agreeableness. For example, Hirsh and Peterson (2009) do not find Agreeableness to be associated with choice of Cooperation in a Prisoner’s Dilemma (PD). Pothos et al. (2010) find that Agreeableness is not associated with choice of cooperation in the PD, although it is associated in the same with off diagonal payoffs permuted where cooperation is the dominant strategy. Filitz-Ozbay et al. (2013) find that Agreeableness is positively associated to mutual exchanges in a typical gift-exchange game. Interestingly, in Anderson et al. (2009), Agreeableness has a clear and positive effect on cooperation (in a sequential PD, which is equivalent to a Trust Game), a similar result is found in Becker et al. (2012). The discrepancy between the effect of the Agreeableness in the two above men-

tioned games and in our real effort experiment can be explained by the nature of the choice. Real effort is subject to a lower level of monitoring than the transfer of the symbolic wealth during the experiment, hence individuals who define themselves altruistic or socially oriented would feel less comfortable in passing a smaller amount of money than putting a lower level of effort for helping the partners. This interpretation finds support in Stoop et al. (2012), who show that subjects contribute less to social outcomes when they perform a real task than when they transfer experiment money.

### *The Effect of Conscientiousness and Neuroticism*

If, instead of the verbal statements on personal inclination to help others, one relies on the provision of costly effort in the control and cooperative treatment as reliable evidence, then cooperative and trustful behavior is better predicted by two other traits: Conscientiousness and Neuroticism. The effect of Conscientiousness is particularly interesting. The effect on *Correct 2* can be explained by intrinsic motivation, conscientious individuals like to do “*a thorough job*” independently from the monetary reward.

In more general terms, cooperating and productive behavior in organizations seems not the result of preferences over outcomes, but of attitudes to processes. Conscientiousness has a direct effect on performance in the addition task only when the outcome is achieved cooperatively. This indicates that Conscientiousness is associated with a positive response exclusively in this condition, which seems the hallmark of what cooperation is. However, more conscientious individuals do not seem to have better performance in the individual treatment, which gives a direct incentive to do the sums correctly. This finding lends support to the idea that conscientiousness provides intrinsic motivation complementary to the extrinsic motivation of the monetary incentives, rather than assigning special consideration to cooperation *per se*. For Neuroticism, the same correlation of this traits with cooperative behavior has been found by in Hirsch and Peterson (2009) and in Anderson et al. (2009; see Table 9 and 10). The negative effect of Openness is in line with previous findings. Although individuals with high levels of Openness may aid cooperation in some particular instances where unconventional thinking is necessary,

such individuals are unfit in subordinating individual creativity in the context of a collaborative work process, especially like the one subjects perform in our experiment (Stewart et al.,2005).

In summary, the willingness and inclination to cooperation is affected more by a conscientious attitude to work rather than positive and empathic attitude to others. Highly conscientious individuals have a good performance in the task irrespective of the incentives, due probably more to intrinsic motivation than to private or social incentives. We believe this paper provides guidance for the explanation of how personality traits score predict cooperative behavior. In particular, it emphasizes the importance of trait revealing intrinsic motivations, and warns about the inconsistency of the statements supposed to measure the degree of altruism. Further research can clarify whether these statements reveal something different than what it is commonly considered altruism, or whether this trait is more prone than others to measurement errors.

Table 1: Control Treatment, Main Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
Correct 1	7.243	2.26	1	10	140
Correct 2	7.583	2.242	1	10	139
Age	21.3	3.003	18	34	140
Female	0.514	0.502	0	1	140
Openness	3.573	0.589	1.9	5	140
Conscientiousness	3.452	0.626	1.667	4.889	140
Extraversion	3.333	0.704	1.625	4.875	140
Agreeableness	3.71	0.559	2.111	5	140
Neuroticism	2.967	0.673	1.375	4.75	140
Raven	8.443	2.696	0	13	140
Trust	4.093	0.758	2	5	140
Altruism	3.957	0.847	1	5	140
Quantitative Degree	0.536	0.501	0	1	140
Maths Grades	0.881	0.146	0.5	1	132
Non European	0.307	0.463	0	1	140

Table 2: Cooperative Treatment, Main Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
Correct 1	6.8	2.297	2	10	130
Correct 2	7.408	2.368	0	10	130
Age	21.969	4.59	18	52	130
Female	0.538	0.5	0	1	130
Openness	3.587	0.589	2.1	4.9	130
Conscientiousness	3.579	0.676	2	4.889	130
Extraversion	3.287	0.788	1.5	4.75	130
Agreeableness	3.639	0.617	2	5	130
Neuroticism	2.966	0.792	1.25	4.875	130
Raven	7.992	2.686	0	13	130
Trust	3.938	0.963	1	5	130
Altruism	3.831	0.982	1	5	130
Quantitative Degree	0.523	0.501	0	1	130
Maths Grades	0.887	0.156	0.25	1	123

*Continued on next page...*

*... table 2 continued*

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>	<b>N</b>
Non European	0.31	0.464	0	1	129

Table 3: Correlations Table ( $p$ -values in brackets)

Variables	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	Raven	Female
Openness	1.000						
Conscientiousness	-0.013 (0.838)	1.000					
Extraversion	0.314 (0.000)	0.048 (0.432)	1.000				
Agreeableness	0.053 (0.385)	0.234 (0.000)	0.087 (0.152)	1.000			
Neuroticism	-0.033 (0.588)	-0.113 (0.064)	-0.255 (0.000)	-0.201 (0.001)	1.000		
Raven	-0.102 (0.093)	-0.043 (0.486)	-0.105 (0.084)	-0.142 (0.020)	-0.090 (0.139)	1.000	
Female	-0.023 (0.709)	0.088 (0.148)	-0.020 (0.746)	0.064 (0.296)	0.281 (0.000)	-0.017 (0.784)	1.000

Table 4: **Analysis of the performances in the cooperative and individual treatments** *Correct 1* are the correct additions used by the subject performing them in both the individual and the cooperative treatment. *Correct 2* are the correct additions passed to the respective partners in the cooperative treatment. The variables representing personality traits and Raven have been rescaled to take a value between 0 and 1. OLS estimator. Robust Standard Errors in Brackets. \*  $p$ -value < 0.1, \*\*  $p$ -value < 0.05, \*\*\*  $p$ -value < 0.01

	Correct 1 Individual	Correct 1 Cooperative	Correct 2 Individual	Correct 2 Cooperative
Conscientiousness	-0.6685 (0.9396)	2.4018** (0.9483)	0.7552 (0.8567)	2.5022** (1.0157)
Agreeableness	-0.3259 (0.9604)	0.2419 (0.9812)	0.1901 (1.0431)	0.6456 (0.8859)
Neuroticism	-2.2111** (1.0466)	0.7598 (1.0949)	-3.0790*** (0.9841)	1.7509 (1.1308)
Extraversion	-1.8612** (0.8360)	0.1382 (0.9002)	-1.2449 (0.8460)	-0.1008 (0.9927)
Openness	0.6460 (1.0451)	-1.9571* (1.1492)	-0.2136 (1.0067)	-1.9179 (1.3872)
Raven	2.0717*** (0.7611)	1.2085 (0.9531)	1.8569** (0.7621)	1.6243 (0.9801)
Female	-1.0257*** (0.3487)	0.0294 (0.4096)	-0.6615* (0.3536)	0.0304 (0.4161)
Constant	8.1001*** (1.4526)	4.5837*** (1.5441)	7.7627*** (1.4007)	3.9067** (1.7848)
Day Dummy	Yes	Yes	Yes	Yes
r <sup>2</sup>	0.250	0.179	0.227	0.191
N	140	130	139	130

Table 5: **Differences in the performances between the two treatments** *Correct 1* are the correct additions used by the subject performing them in both the individual and the cooperative treatment. *Correct 2* are the correct additions passed to the respective partners in the cooperative treatment. The variables representing personality traits and Raven have been rescaled to take a value between 0 and 1. OLS estimator. Robust Standard Errors in Brackets.  
\*  $p - value < 0.1$ , \*\*  $p - value < 0.05$ , \*\*\*  $p - value < 0.01$

	Correct 1	Correct 1	Correct 2	Correct 2
Cooperative Treatment	-0.4857* (0.2699)	-3.1315 (1.9583)	-0.2324 (0.2777)	-3.3711 (2.0947)
Coop.*Conscientiousness		3.0395** (1.3344)		1.7250 (1.2870)
Coop.*Agreeableness		0.5516 (1.3696)		0.4498 (1.3447)
Coop.*Neuroticism		2.6264* (1.5236)		4.6111*** (1.5056)
Coop.*Extraversion		1.9708 (1.2186)		1.2693 (1.3221)
Coop.*Openness		-2.8547* (1.5758)		-1.8558 (1.7291)
Coop.*Raven		-1.1087 (1.2099)		-0.4292 (1.2800)
Coop.*Female		1.0265* (0.5448)		0.5926 (0.5552)
Conscientiousness	1.0593 (0.6658)	-0.7079 (0.9456)	1.8109*** (0.6879)	0.7850 (0.8785)
Agreeableness	0.2724 (0.7144)	-0.3594 (0.9572)	0.5811 (0.6776)	0.1176 (1.0076)
Neuroticism	-0.1384 (0.7745)	-1.9025* (1.0619)	-0.0806 (0.7631)	-2.8677*** (0.9718)
Extraversion	-0.5850 (0.6302)	-1.7780** (0.8481)	-0.5496 (0.6467)	-1.3116 (0.8614)
Openness	-0.8371 (0.7857)	0.8082 (1.0722)	-1.2965 (0.8550)	-0.0573 (1.0189)
Raven	1.8931*** (0.6018)	2.3042*** (0.7513)	1.9006*** (0.5946)	2.0144*** (0.7661)
Female	-0.5440* (0.2763)	-1.0137*** (0.3515)	-0.3548 (0.2655)	-0.6169* (0.3549)
Constant	5.9512*** (1.0771)	7.7868*** (1.3824)	5.6253*** (1.1395)	7.4285*** (1.3164)
Day Dummy	Yes	Yes	Yes	Yes
r2	0.133	0.199	0.138	0.193
N	270	270	269	269

Table 6: **Differences in the performances between the two treatments, assuming that Agreeableness is complementary to other traits** The variables representing personality traits and Raven have been rescaled to take a value between 0 and 1 have been rescaled to take a value between 0 and 1. OLS estimator. Robust Standard Errors in Brackets. \*  $p - value < 0.1$ , \*\*  $p - value < 0.05$ , \*\*\*  $p - value < 0.01$

	Correct 2 M1 b/se	Correct 2 M2 b/se	Correct 2 M3 b/se
Cooperative Treatment	1.7984 (2.2881)	-3.1698 (2.9464)	-3.3437 (2.4019)
Coop.*Agreeableness	-3.7599 (3.8912)	3.7082 (4.7889)	1.4717 (3.3365)
Coop.*Agreeabl.*Raven	5.7805 (6.0991)		
Coop.*Agreeabl.*Consc.		-6.6753 (7.0081)	
Coop.*Agreeabl.*Neurot.			-0.8720 (6.5186)
Agreeabl.*Raven	-2.3179 (3.7608)		
Agreeabl.*Consc.		2.8451 (4.5280)	
Agreeabl.*Neurot.			-0.4126 (5.1948)
Coop.*Conscientiousness		5.0261 (4.2256)	
Coop.*Neuroticism			4.8643 (4.2470)
Coop.*Raven	-4.0428 (3.3825)	-0.6372 (1.2310)	-0.2318 (1.2223)
Coop.*Female	1.2138** (0.5654)	1.1584** (0.5616)	0.7020 (0.5605)
Conscientiousness	1.6949** (0.7078)	-0.5417 (2.7432)	1.7176** (0.7156)
Agreeableness	2.0101 (2.5143)	-1.0789 (2.9770)	0.1295 (2.4828)
Neuroticism	0.0544 (0.7555)	0.0946 (0.7600)	-2.1731 (3.3296)
Raven	3.7218* (2.2505)	2.3401*** (0.7827)	2.1348*** (0.7516)
Female	-0.9487*** (0.3652)	-0.9370** (0.3656)	-0.6799* (0.3589)
Constant	3.7981** (1.6898)	5.9107*** (1.8427)	5.9117*** (1.7961)
Day Dummy	Yes	Yes	Yes
r2	0.142	28 0.146	0.171
N	269	269	269

Table 7: **Differences in the performances between the two treatments and the facets of Agreeableness** *Correct 1* are the correct additions used by the subject performing them in both the individual and the cooperative treatment. *Correct 2* are the correct additions passed to the respective partners in the cooperative treatment. The variables representing Altruism, Trust, and Raven have been rescaled to take a value between 0 and 1. OLS estimator. Robust Standard Errors in Brackets. \*  $p - value < 0.1$ , \*\*  $p - value < 0.05$ , \*\*\*  $p - value < 0.01$

	Correct 1	Correct 2	Correct 1	Correct 2
Cooperative Treatment	-2.0831*	-0.0526	-2.3914*	-0.5246
	(1.1187)	(1.2520)	(1.2296)	(1.4127)
Coop.*Altruism	-0.6924	-1.3151	-0.2053	-0.8499
	(1.2713)	(1.3643)	(1.2195)	(1.2829)
Coop.*Trust	2.8739**	1.1416	2.7081*	0.9016
	(1.4152)	(1.4015)	(1.4035)	(1.4028)
Coop.*Raven			-1.0172	-0.5398
			(1.2006)	(1.2460)
Coop.*Female			1.3915**	1.2969**
			(0.5373)	(0.5671)
Altruism	-0.0703	0.1256	-0.0554	0.1796
	(0.9851)	(1.0997)	(0.9113)	(0.9811)
Trust	-0.4365	0.6829	-0.6410	0.5017
	(1.0541)	(1.1256)	(1.0564)	(1.1274)
Raven			2.4993***	2.1422***
			(0.7307)	(0.7964)
Female			-1.2043***	-0.9357**
			(0.3603)	(0.3675)
Constant	7.6324***	6.9617***	6.4213***	5.6572***
	(0.8605)	(1.0430)	(0.9348)	(1.0963)
Day Dummy	No	No	Yes	Yes
r2	0.036	0.018	0.165	0.123
N	270	269	270	269

Figure 1: **Correct sums in the 1<sup>st</sup> series of additions and Conscientiousness.** The dotted line is the control treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .

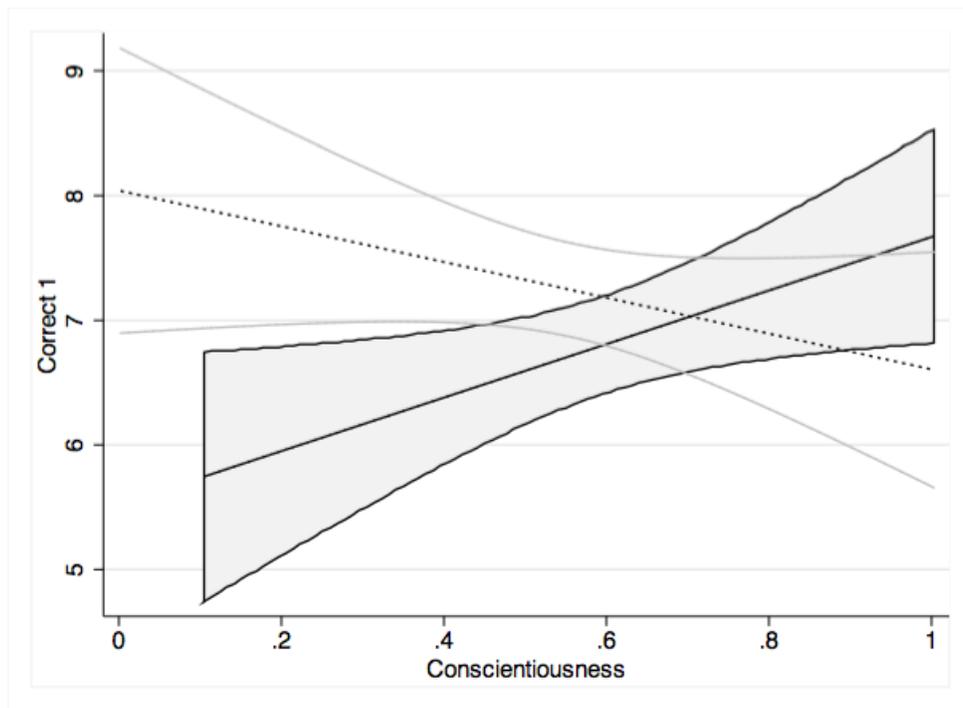
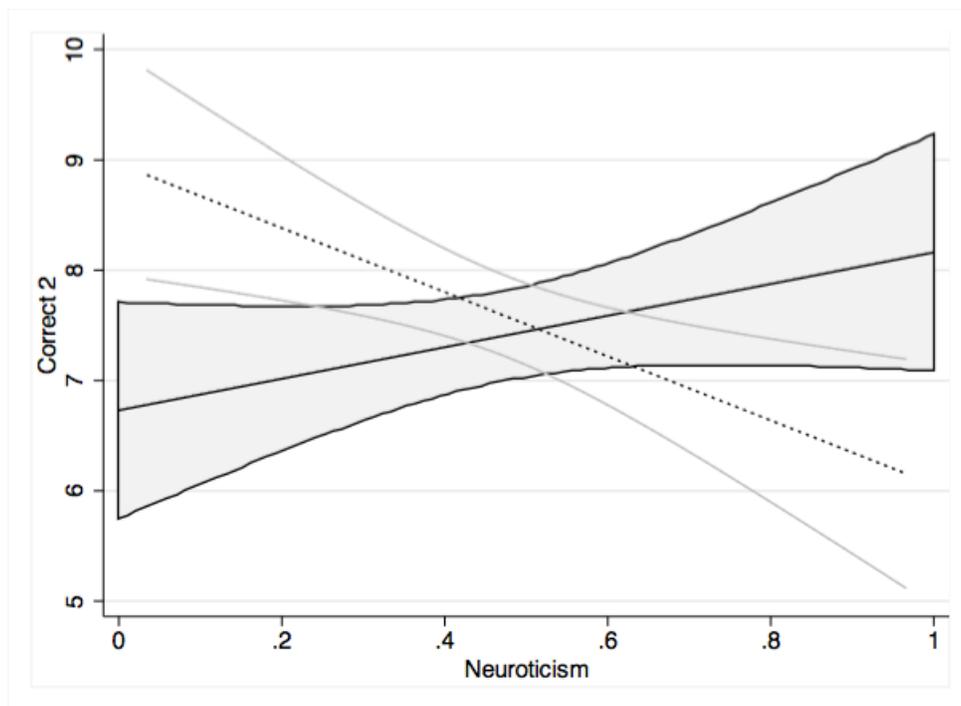


Figure 2: **Correct sums in the 2<sup>nd</sup> series of additions and Neuroticism.** The dotted line is the control treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .



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# Appendix

## Timeline of the Experiment

1. At the beginning participants were assigned a Project ID card, with a number corresponding to a computer station and a paper in hard copy with the illustration of the task they were going to perform. They were asked questions at the end to check for comprehension.
2. An illustration of the task was presented on a white board.
3. Participants are seated in the laboratory at individual, private computer terminals, corresponding to their Project ID cards.
4. Participants read and answer the questions in the instruction paper distributed to them to check their comprehension of the exercise.
5. In sessions 1, 4, 6, 7 participants face the control exercise. In sessions 2 of day 1 and 1 and 3 of day 2 they face the treatment exercise.
6. In the control treatment participants had to add three series of 10 two-digit numbers in the following way:
  - (a) Perform 10 additions, indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers in 4 minutes, let  $S_i^1$  be the answers provided.
  - (b) Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers in 4 minutes, let  $S_i^2$  be the answers provided.
  - (c) Add the 10 numbers obtained in step 1 above and the 10 numbers obtained in step 2 above, producing for each  $i$  an answer  $S_i^3$  in 2 minutes.

In the cooperative treatment subjects performed the same sequence of additions, but jointly with an anonymous subject, as follows:

- (a) Perform 10 additions, indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers in 4 minutes, let  $S_i^1$  be the answers provided.

- (b) Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers in 4 minutes, let  $S_i^2$  be the answers provided.
- (c) The output of these 10 additions,  $S_i^2, i = 1, \dots, 10$  is transferred to a randomly matched and anonymous partner, and the 10 numbers output produced by this partner is transferred in turn to the subject. We denote by  $S_i^{*2}$  the values of the sum that the partner makes.
- (d) Add the 10 numbers obtained in step 1 above,  $S_i^1$ , and the 10 numbers obtained from the randomly matched partner,  $S_i^{*2}$ , and producing an output  $S_i^3$  in 2 minutes.

Let the  $C_i^k$  denotes the correct final amount from the three additions  $k = 1, 2, 3$  for each  $i$ . In both cases, the payment rule was 15 British Pounds Sterling (GBP), approximately 26 US Dollars (USD), minus 1 in the event of an incorrect final sum: to be precise, the subject lost one pound (and only one pound) for each  $i$  such that  $S_i^3 \neq C_i^3$ .

- 7. Raven test, 15 tables for 30 seconds each table. Each correct answer was paid 0.20 GBP.
- 8. The questionnaire is presented and filled.
- 9. Subjects were paid.

We report in the Supplementary Information the entire test for:

- 1. Instructions and Quiz questions for the control/individual treatment
- 2. Instructions Quiz questions for the cooperative treatment
- 3. General questions in the final Questionnaire
- 4. Personality Traits Questions and Scoring Instructions
- 5. The Big Five Aspect Scale

## Dates of Sessions

Table 8: **Dates.**

Day	Session	Subjects	Treatment
1 (13/06/2012)	1	15	Individual
1 (13/06/2012)	2	16	Cooperative
2 (14/06/2012)	3	20	Cooperative
2 (14/06/2012)	4	20	Individual
2 (14/06/2012)	5	16	Cooperative
2 (14/06/2012)	6	16	Individual
3 (19/06/2012)	7	20	Individual
3 (19/06/2012)	8	10	Cooperative
4 (15/05/2013)	9	16	Cooperative
4 (15/05/2013)	10	20	Cooperative
4 (15/05/2013)	11	15	Individual
4 (15/05/2013)	12	19	Individual
5 (15/05/2013)	13	16	Cooperative
5 (15/05/2013)	14	17	Cooperative
5 (15/05/2013)	15	16	Individual
5 (15/05/2013)	16	19	Individual

## Figures

Figure 3: **Correct sums in the 1<sup>st</sup> series of additions, Personality traits and Raven score.** The dotted line is the individual (that is, baseline) treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .

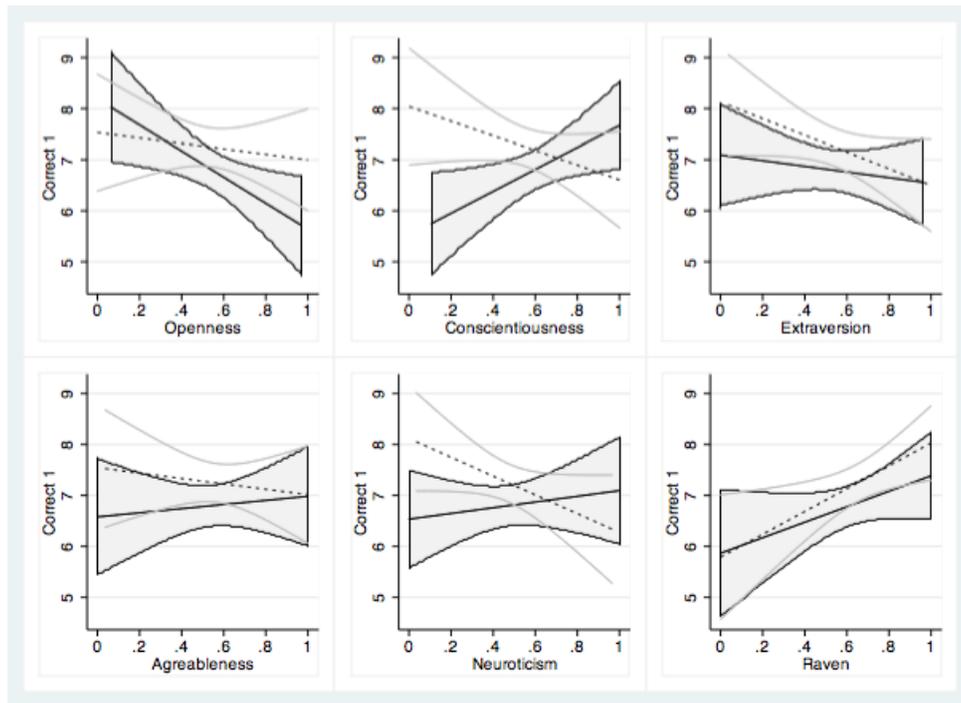


Figure 4: **Correct sums in the 2<sup>nd</sup> series of additions, Personality traits and Raven score.** The dotted line is the individual (that is, baseline) treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .

