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**Cooperation and Personality**

Eugenio Proto and Aldo Rustichini  
CAGE, University of Warwick

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# Cooperation and Personality

**Eugenio Proto<sup>a</sup> Aldo Rustichini<sup>b</sup>**

<sup>a</sup>Department of Economics, University of Warwick and CAGE

<sup>b</sup>Department of Economics, University of Minnesota

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**Abstract:** Cooperating and trusting behavior may be explained by preferences over social outcomes (people care about others, are unselfish and helpful), or attitudes to work and social responsibilities (plans have to be carried out, norms have to be followed). If the first hypothesis is true, Agreeableness, reporting stated empathy for others, should matter most; if the second, higher score in traits expressing attitude to work, intrinsic motivation (Conscientiousness) should be correlated with cooperating behavior and trust. We find experimental support for the second hypothesis when subjects provide real mental effort in two treatments with identical task, differing by whether others' payment is affected.

*JEL classification: C90, D03, D82*

*Keywords: Personality Traits, Cooperation, Effort Provision*

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# 1 Introduction

The personality of individuals working together in economic organizations may significantly affect their performance, beyond what standard characteristics considered by economists, and described by risk attitude, time preferences and effort cost may predict. This insight has 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. However economic analysis has only recently started to address the question on how personality affect individuals performances, especially when individuals work together and benefits of cooperation may arise.

We test in particular whether cooperating and trusting behavior can be successfully explained by a generally empathic attitude, by a helpful and unselfish orientations to others. In our data, such more favorable inclination to others is measured by Agreeableness, which explicitly measure stated cooperation and trust.<sup>2</sup>

Other possible personality variables that might explain cooperative behavior are traits leading to reliability and care in work, consistency in carrying out plans, such as Conscientiousness.<sup>3</sup>

We present an experiment designed to provide an answer to this complex question in a systematic way. Since our interest is in understanding the working of real life social institution, we insist that cooperation and trust should involve a real cost (in our design, a cost of mental effort), rather than symbolic display of care for others. 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 subject. The tasks in the two

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

<sup>2</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.

<sup>3</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).

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. More precisely in the control treatment each subject performs three series of ten additions and he is paid proportionally to the number of correct answers. 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 performs one series of addition for the partner, and one for his own use. Hence the final outcome of each teammate is dependent on the effort of both. The interaction is one-shot and simultaneous.

As they do 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. 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 other-regarding preferences drive their behavior) or if they feel that norms of social behavior should be followed, or they are concerned about the response and opinion of others to their behavior. Our measure of the personality characteristics is based on the Big Five personality scale (Costa and McCrae, 1992), arguably the most common and studied measurement method.<sup>4</sup>

Our results show that some personality traits are associated in a significant and positive way to the effort provision in the cooperative treatment. These effects are significantly different, both in terms of quantity and quality, from the effect on the same task when this is performed individually. Agreeableness plays no role, thus the first hypothesis finds little support. Subjects with higher Conscientiousness and Neuroticism score are relatively more effective in the cooperative tasks, although in different way. While subjects with higher Neuroticism score are more effective in helping the partner to achieve better results, those with higher score in Conscientiousness are better in both trusting and helping. The effect of Neuroticism 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

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<sup>4</sup>The Big Five personality traits are five broad dimensions that are used to describe human personality. They are Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. See Anderson et al. (2011), p. 3-4 for a synthetic description of the big five traits.

the other.<sup>5</sup>

This paper suggests a new line of research based on the integration of personality traits with incentives in conditions of informational asymmetries. Generally this literature, based on the principal agent model, assume the existence of individuals' heterogeneity with respect to preferences for goods, skills or risk attitudes in line with the rest of the economic literature (see e.g. Bolton and Dewatripont 2001).<sup>6</sup>

The two traits that improve the cooperative outcomes are Neuroticism and Conscientiousness, the traits usually associated with different forms of motivation. Neuroticism is usually associated with negative incentives (i.e. fear of failing or not achieving a result); and Conscientiousness representing the ability to set and maintain longer-term goals.<sup>7</sup> To the best of our knowledge, in this paper we perform the first laboratory experiment in economics where the final outcome is based on real effort rather than monetary transfers Hirsh and Peterson (2009) and Pothos et al. (2010) link personality traits to strategic behavior in experiments using the prisoner dilemma framework. Anderson et al (2011) analyze the effect of traits on the trust game using a large sample 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.

In a similar vein as in our paper Fr chet te et al. (2013) design 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, as in our research, personality affects outcome when the tasks are performed jointly by two individuals, an investor and the intermediary.

Beyond experimental research, Barrick et Mount (1991) present a meta-

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<sup>5</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.

<sup>6</sup>In general, economists are starting to recognize the importance of introducing personality traits in economic environment: Rustichini (2009) discusses on how personality can be integrated in the classical economic model. Borghans et al., 2008 argue that data on personality traits can be considered at least as stable as the economic preferences on risky outcomes, inter-temporal payments and leisure.

<sup>7</sup>See deYoung et Gray 2010 for a comprehensive description of the recent literature on personality traits.

analysis showing how conscientiousness is a good predictor in all job performances. Almlund et al., (2011) present 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 kind of jobs.

There is also an experimental psychology literature on team work and personality, which have focused on the qualitative nature of the roles within the team; analyzing how traits influence the allocation of task roles and social roles and emphasising 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 analyzed 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 is, to the best of knowledge, new and possibly relevant with respect to psychology literature as well.

The paper is organized as follows. Section 2 describes the experiment; section 3 describes the main results. In the appendix we provide a formal time-line of the experiment in 4. 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, defined as *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, say  $S_i^1 = A_i^1 + B_i^1 + C_i^1 + D_i^1 + E_i^1$  in 4 minutes.
2. Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers, say  $S_i^2 = A_i^2 + B_i^2 + C_i^2 + D_i^2 + E_i^2$  in 4 minutes.
3. Add the 10 numbers obtained in step 1 above and the 10 numbers obtained in step 2 above, producing for each  $i$  a sum  $S_i = S_i^1 + S_i^2$  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, say  $S_i^1 = A_i^1 + B_i^1 + C_i^1 + D_i^1 + E_i^1$  in 4 minutes.
2. Perform 10 more additions, also indexed by  $i = 1, \dots, 10$ , of 5 two-digits numbers, say  $S_i^2 = A_i^2 + B_i^2 + C_i^2 + D_i^2 + E_i^2$  in 4 minutes.
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 obtained from the partner.
4. Add the 10 numbers obtained in step 1 above and the 10 numbers obtained from the randomly matched partner, producing and output  $S_i = S_i^1 + S_i^{*2}$  in 2 minutes.

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.

In both cases, the payment rule was 15 GBP (approximately 26 USD) minus 1 for any incorrect final sum. 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 3x3 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 7.<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 timeline of the experiment and in the supplementary material, we present the instructions and the quiz on the instructions administered to subjects. The Ethical Approval 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).

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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.

### 3 Result

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>

Personality traits are measured on a scale between 1 and 5; *Raven* is the score in the Raven APM. We are not considering the final answers  $S_i$ , 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.

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 ) 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.

It is important to note that *Correct 2* is not significantly different in the two treatments (with p-value 0.26), while *Correct 1* is slightly smaller by about 0.4 in the cooperative treatment (with p-values 0.058). 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.

#### Model

In what follows we estimate the model:

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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.

$$\begin{aligned}
Correct_j = & \beta_O O + \beta_C C + \beta_E E + \beta_A A + \beta_N N + \beta_R R + \\
& Coop * (\beta'_O O + \beta'_C C + \beta'_E E + \beta'_A A + \beta'_N N + \beta'_R R) + \\
& \beta'_0 Coop + \beta_0 + \beta_F F + \Gamma Day + e;
\end{aligned} \tag{1}$$

with  $j=1,2$ .

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.  $Coop$  is 1 if the treatment is cooperative,  $e$  is the error term. In the model,  $\beta'_x$  represents the differential effect of the trait  $x$  and  $\beta_x$  is the effect of the trait  $x$  in the control treatment. The effect of  $x$  in the cooperative treatment is given by  $\beta'_x + \beta_x$ . To assess the significance of this effect we will perform the test  $\beta'_x + \beta_x = 0$ .

Note that *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. Whereas *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.

To help with the interpretation of the results, variables measuring personality traits and Raven score have been rescaled to assume a value between 0 to 1, using for each variable the transformation:

$$x_i = \frac{\hat{x}_i - \hat{x}_{min}}{\hat{x}_{max} - \hat{x}_{min}} \tag{2}$$

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

## Model estimation

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

Furthermore, in the bottom panel of 4, we present the effect of the trait  $x$  in the cooperative treatment, the sum  $\beta'_x + \beta_x$  in the model 1, with the asterisk representing the level of significance the hypothesis  $\beta'_x + \beta_x = 0$  can be rejected.

## Cooperative treatment

From columns 1 and 3 of table 4 we note 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>11</sup> Hence, comparing columns 1 and 2 and columns 3 and 4 respectively, we can argue that although the difference between cooperation and baseline treatment is rather small or null in average, there are significant differences in the way different personalities affect the final outcomes. Hence, we argue the following

**Observation 3.1.** *There is little differences in average performances when individuals act singularly or in cooperation. But, once the effect of personality are taken into account, these differences become very large.*

## Neuroticism

Neuroticism has a positive differential effect in the cooperative treatment. Considering the second 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.

Furthermore, Neuroticism has a negative impact in the control treatment as we note from the coefficient of Neuroticism in column 2 of table 4, but it seems a positive determinant of the performances in the cooperative treatment as we note from the bottom panel of 4.

Figure 1 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.

Considering the fourth column of 4, we note a substantially similar effect of Neuroticism on the 1st series of additions. In *Correct 1* Neuroticism is negative in the control task; positive, but non significant, in the cooperative task; and the interaction with treatment is positive and significant, although

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<sup>11</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.

its effect on the cooperative task seems smaller than in *Correct 2*. Therefore we make the following:

**Observation 3.2.** *Subjects with higher Neuroticism score have a comparative weaker performance in the control treatment (with individual payment), but are comparatively stronger in the cooperative treatment, especially in the task of helping the partner.*

### Conscientiousness

From the fourth column of table 4 we note that conscientiousness has a positive differential effect in the cooperative treatment for *Correct 1*. A positive differential effect seems to exist also for *Correct 2* although this last is non significant, as we note from column 2. Furthermore, from the bottom panel of table 4, we note that both *Correct 2* and *Correct 1* are increasing in conscientiousness in the cooperative treatment, the overall effect is 2.5 additions, a quarter of the entire task for both *Correct 2* and *Correct 1*; while, from the top panel of 4 we note that conscientiousness does not have a significant effect in the baseline treatment.

In figures 2 and 3, we plot the two regression lines of conscientiousness in both treatments over *Correct 2* and *Correct 1* respectively, we can observe this relation as well. We then make the following:

**Observation 3.3.** *More conscientious subjects have a comparative stronger performance in a cooperative treatment, especially in trusting the partner; and they seem not to have significantly larger performance in the control treatment.*

### Agreeableness

Finally 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. Then, we can argue that:

**Observation 3.4.** *More Agreeable subjects do not have comparatively higher performance in the cooperative treatment, nor agreeableness is a predictor of performances in the control treatment.*

### Openness and IQ

Openness has a negative differential effect in *Correct 1* in cooperation and it is weakly negatively associated with performances in cooperation, at the same time but it does not have an effect in the baseline treatment. The Raven

score is a strong predictor of performances in both *Correct 2* and *Correct 1* only for the control treatment and it is weaker and non significant for the cooperative treatment. The differential effect is non significant.

In Figure 4 and 5 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.

### Gender Effects

Women are usually considered more cooperative than men (see e.g. Kuhn and Villeval 2013, for a recent contribution): it is therefore important to assess how the gender effect interact with personality in determining the performances in the two treatments.

In table 5 we introduce the dummy female interacted with cooperative dummy indicating the treatment. Considering column 1, we note that female have a comparative advantage in the cooperative treatment, but in column 2 we note that this disappear when we introduce the differential effect of Neuroticism. So the comparative advantage of female subjects in the cooperative treatment seems to be due to their Neuroticism rather than their gender effect. From column 3, we note that female seem to trust more their partners and perform better in *Correct 1* of the cooperative treatment. This effect seems not be particularly affected by the Neuroticism.

In table 6 we do a similar exercise than in table 5, in order to assess the effect of gender on the effect of conscientiousness. From the column 4 we note that both female and conscientiousness affect the trust in an independent way.

## 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 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 too regard our design as a modified 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 his 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 he 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. We may conclude that the difference in the quality of the output in the two treatments is exclusively due to the different way in which subjects view the relative merit of their and others' payoff. We consider now how personality traits are associated with differences in such attitude.

Possibly the most surprising and instructive conclusion of our study is that the personality trait with 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 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, when the cost associated with altruistic behavior is real effort rather than a monetary transfer. In earlier experiments studying the association of personality traits with strategic behavior, Agreeableness had similarly failed to provide convincing evidence that cooperative behavior is associated with empathic feelings. For example, Hirsh and Peterson (2009) do not find Agreeableness to be associated with choice of Cooperation in a Prisoner's Dilemma (PD). Instead, Neuroticism and Extraversion were found to be associated with choices of cooperation. 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. 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 finding replicated in Becker et al. (2012). Consider however that and most of the effect of this trait seems to be derived from the expectation that others will cooperate— as we note from Anderson et al. (2009) experiment, where beliefs were elicited. If one also considers that Agreeableness is associated with an increase in the payment by second movers who had received no payment, Agreeableness may be driven more by a general naivete (or, less likely, by a weight on one's payoff lower than on those of a clearly selfish anonymous stranger).

If, instead of the verbal statements, one relies on the relative provision of costly effort in the control and cooperative treatment as reliable evidence, then cooperative and trustful behavior is more effectively predicted by two other traits: Conscientiousness and Neuroticism. A different way of stating the conclusion is that an attitude favorable to others is not a matter of preferences over outcomes, but of attitudes to processes. Note that the same correlation of Neuroticism with cooperative behavior has been found by in Hirsch and Peterson (2009) and in Anderson et al. (2009), see Table 9 and 10. 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. At the same time more conscientious individuals do not seem to have an advantage in the individual treatment, when there is a direct incentive to do it correctly, this lends support to the idea that conscientiousness provides intrinsic motivation complementary to the extrinsic motivation of the monetary incentives.

Also the negative effect of Openness is in line with the 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).

Cognitive skill, in particular fluid intelligence as measured by Standard Raven matrices, have been found to be associated with differences in behavior in strategic environments. We find that Raven is a strong predictor of the performances in the baseline (individual) treatment, while the same correlation is weaker in the cooperative task, although the difference is statistically non significant. Hence, the direction of the relation provides only a weak support to the natural conjecture that higher IQ should provide a sharper awareness on one's self interest. On this point our finding is in line with the existing literature.

In conclusion, willingness and inclination to work with others is affected more by a conscientious attitude to work rather than positive and empathic attitude to others. It is soon to hypothesize a causal channel (and a stable trait inducing more cooperation); but a natural hypothesis we can suggest is that people with higher score in conscientiousness are inclined to perform the task because it is the "thing to do", irrespective of the specific incentives.



Table 1: Control Treatment, Main Variables

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>	<b>N</b>
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
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
Raven	8.443	2.696	0	13	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

Table 2: Cooperative Treatment, Main Variables

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>	<b>N</b>
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
Quantitative Degree	0.523	0.501	0	1	130
Maths Grades	0.887	0.156	0.25	1	123
Non European	0.31	0.464	0	1	129
Raven	7.992	2.686	0	13	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

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: OLS estimator** *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. Constant and the dummies for Day are omitted. Robust Standard Errors in Brackets.

	Correct 2	Correct 2	Correct 1	Correct 1
Cooperative Treatment	-0.2324 (0.2777)	-3.5013* (2.0961)	-0.4857* (0.2699)	-3.3493* (1.9592)
Coop.*Neuroticism		5.1089*** (1.4924)		3.4752** (1.4706)
Coop.*Conscientiousness		1.8298 (1.2885)		3.2380** (1.3490)
Coop.*Agreeableness		0.6361 (1.3234)		0.8724 (1.3696)
Coop.*Extraversion		1.3596 (1.3255)		2.1148* (1.2165)
Coop.*Openness		-1.9167 (1.7263)		-2.9634* (1.5576)
Coop.*Raven		-0.3954 (1.2736)		-1.0483 (1.1922)
Neuroticism	-0.0806 (0.7631)	-3.1139*** (0.9766)	-0.1384 (0.7745)	-2.3125** (1.0774)
Conscientiousness	1.8109*** (0.6879)	0.7942 (0.8846)	1.0593 (0.6658)	-0.7067 (0.9690)
Agreeableness	0.5811 (0.6776)	0.0211 (1.0029)	0.2724 (0.7144)	-0.5247 (0.9524)
Extraversion	-0.5496 (0.6467)	-1.3726 (0.8714)	-0.5850 (0.6302)	-1.8705** (0.8592)
Openness	-1.2965 (0.8550)	-0.0192 (1.0085)	-0.8371 (0.7857)	0.8784 (1.0677)
Raven	1.9006*** (0.5946)	2.0454*** (0.7579)	1.8931*** (0.6018)	2.3564*** (0.7351)
Female	-0.3548 (0.2655)	-0.3398 (0.2639)	-0.5440* (0.2763)	-0.5377** (0.2710)
Determinants in Cooperation				
Neuroticism		1.995*		1.1627
$p - value : \beta'_N + \beta_N = 0$		0.0794		0.2699
Conscientiousness		2.624***		2.5313***
$p - value : \beta'_C + \beta_C = 0$		0.0085		0.0069
Agreeableness		0.6572		0.3477
$p - value : \beta'_A + \beta_A = 0$		0.4574		0.7257
Extraversion		-0.0130		0.2443
$p - value : \beta'_E + \beta_E = 0$		0.9897		0.7818
Openness		-1.9359*		-2.085*
$p - value : \beta'_O + \beta_O = 0$		0.1745		0.0698
Raven		1.65*		1.3081
$p - value : \beta'_R + \beta_R = 0$		0.0977		0.1661
r2	0.138	0.190	0.133	0.188
N	269	269	270	270

Table 5: **Effect of gender in the difference of performances between individual and cooperative treatments: OLS estimator** Standard errors between brackets. The 1<sup>st</sup> series of additions are always used by the subject performing them in both the individual and the cooperative treatment. the 2<sup>nd</sup> of additions are passed to the respective partners in the cooperative treatment. The variables representing the traits and Raven have been rescaled so to assume a value between 0 and 1. Robust Standard Errors in Brackets.

	Correct 2 1 b/se	Correct 2 2 b/se	Correct 1 3 b/se	Correct 1 4 b/se
Cooperative Treatment	-0.8434* (0.4313)	-2.4881*** (0.7614)	-1.2349*** (0.3954)	-1.9091*** (0.7004)
Coop.*Female	1.1828** (0.5494)	0.7373 (0.5431)	1.4439*** (0.5337)	1.2644** (0.5495)
Coop.*Neuroticism		3.9553*** (1.3654)		1.6218 (1.4004)
Neuroticism	-0.1589 (0.7559)	-2.3960** (0.9352)	-0.2452 (0.7720)	-1.1567 (1.0099)
Conscientiousness	1.6665** (0.6907)	1.7149** (0.6921)	0.8905 (0.6584)	0.9060 (0.6617)
Agreeableness	0.5627 (0.6674)	0.5267 (0.6610)	0.2484 (0.7019)	0.2344 (0.7028)
Extraversion	-0.5393 (0.6350)	-0.5683 (0.6411)	-0.5806 (0.6250)	-0.5881 (0.6279)
Openness	-1.2313 (0.8477)	-1.0206 (0.8465)	-0.7614 (0.7954)	-0.6727 (0.7945)
Raven	1.8152*** (0.6001)	1.8063*** (0.5913)	1.7885*** (0.6123)	1.7848*** (0.6115)
Female	-0.9047** (0.3605)	-0.6811* (0.3514)	-1.2110*** (0.3592)	-1.1231*** (0.3521)
Constant	6.0462*** (1.1644)	6.7493*** (1.1505)	6.4720*** (1.0786)	6.7577*** (1.1032)
Day Dummy	Yes	Yes	Yes	Yes
r2	0.154	0.180	0.157	0.161
N	269	269	270	270

Table 6: **Effect of gender in the difference of performances between individual and cooperative treatments: OLS estimator.** Standard errors between brackets. The 1<sup>st</sup> series of additions are always used by the subject performing them in both the individual and the cooperative treatment. the 2<sup>nd</sup> of additions are passed to the respective partners in the cooperative treatment. The variables representing the traits and Raven have been rescaled so to assume a value between 0 and 1. Robust Standard Errors in Brackets.

	Correct 2 1 b/se	Correct 2 2 b/se	Correct 1 3 b/se	Correct 1 4 b/se
Cooperative Treatment	-0.8434*	-1.5883*	-1.2349***	-2.9126***
	(0.4313)	(0.8529)	(0.3954)	(0.8271)
Coop.*Female	1.1828**	1.1475**	1.4439***	1.3578**
	(0.5494)	(0.5516)	(0.5337)	(0.5276)
Coop.*Conscientiousness		1.3335		3.0028**
		(1.2923)		(1.3080)
Neuroticism	-0.1589	-0.1668	-0.2452	-0.2747
	(0.7559)	(0.7541)	(0.7720)	(0.7547)
Conscientiousness	1.6665**	0.9663	0.8905	-0.6773
	(0.6907)	(0.8806)	(0.6584)	(0.9446)
Agreeableness	0.5627	0.5265	0.2484	0.1655
	(0.6674)	(0.6618)	(0.7019)	(0.6878)
Extraversion	-0.5393	-0.5822	-0.5806	-0.6859
	(0.6350)	(0.6332)	(0.6250)	(0.6109)
Openness	-1.2313	-1.2086	-0.7614	-0.7148
	(0.8477)	(0.8509)	(0.7954)	(0.7911)
Raven	1.8152***	1.7943***	1.7885***	1.7414***
	(0.6001)	(0.6005)	(0.6123)	(0.6135)
Female	-0.9047**	-0.9021**	-1.2110***	-1.1972***
	(0.3605)	(0.3599)	(0.3592)	(0.3569)
Constant	6.0462***	6.4981***	6.4720***	7.4947***
	(1.1644)	(1.1871)	(1.0786)	(1.1572)
Day Dummy	Yes	Yes	Yes	Yes
r2	0.154	0.157	0.157	0.173
N	269	269	270	270

Figure 1: **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 .

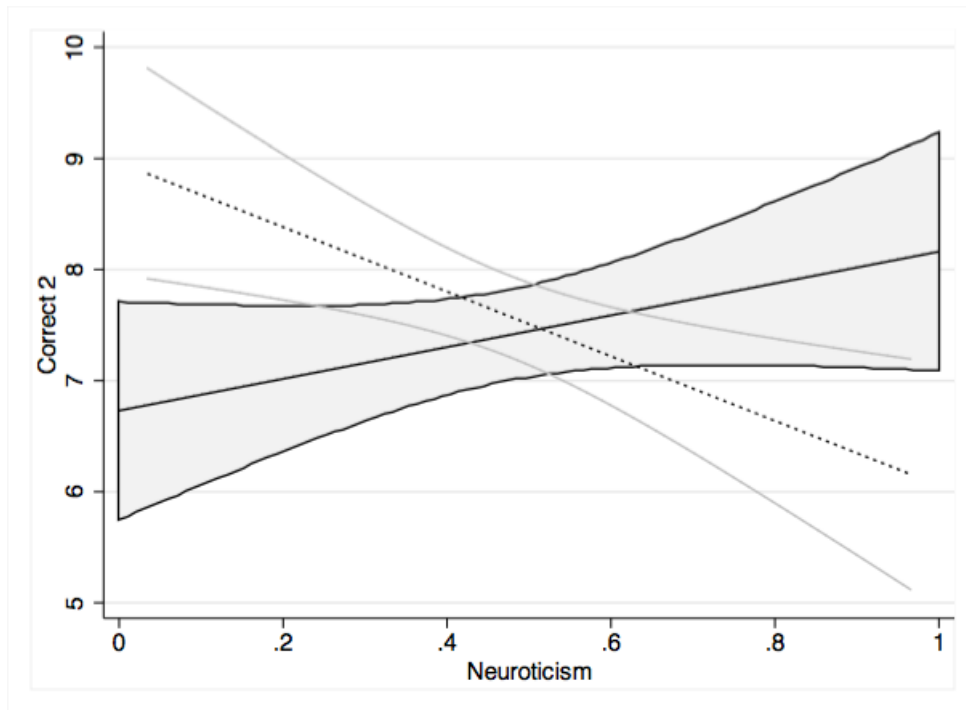


Figure 2: **Correct sums in the 2<sup>nd</sup> series of additions and Conscientiousness.** The dotted line is the control treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .

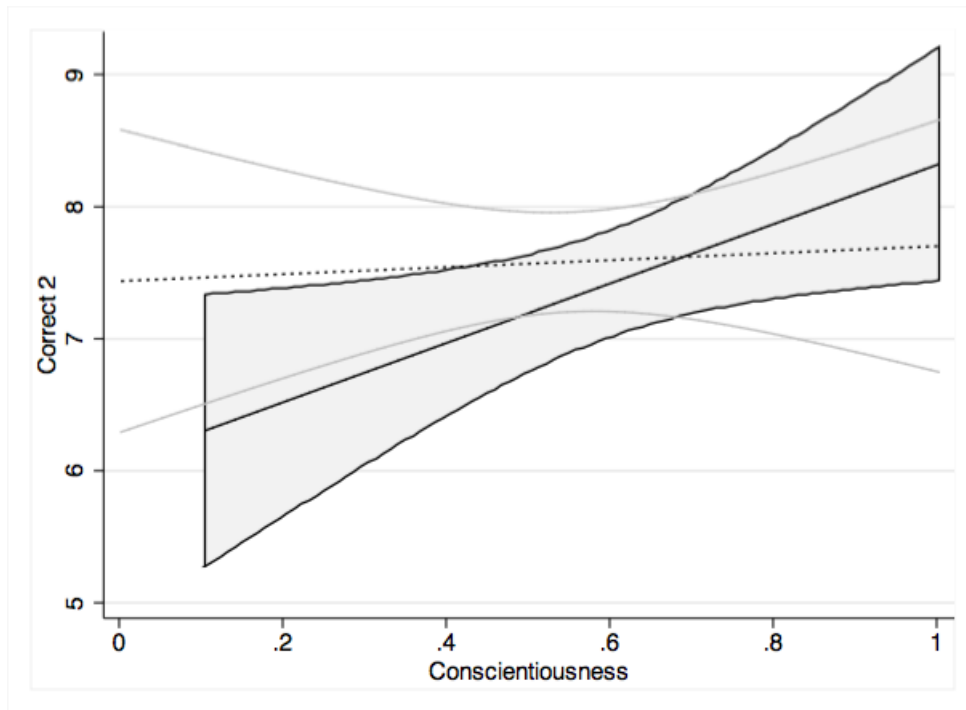
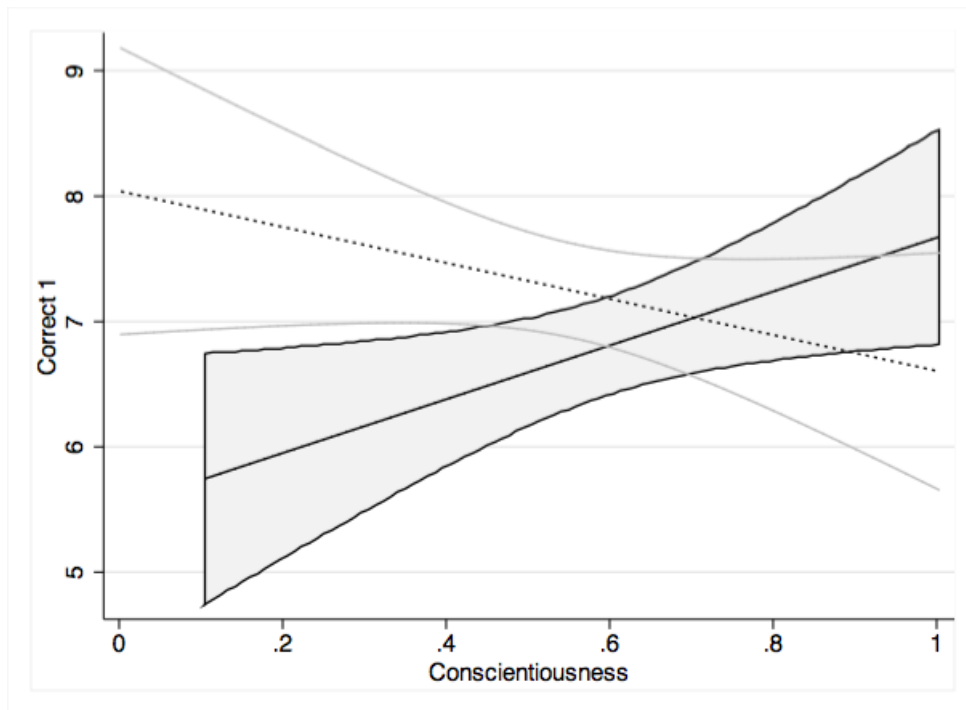


Figure 3: **Correct sums in the 1<sup>st</sup> series of additions and Conscientiousness.** The dotted line is the control treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .





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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  $i = 10$  additions of 5 randomly chosen two-digits numbers, say  $S_i^1 = A_i^1 + B_i^1 + C_i^1 + D_i^1 + E_i^1, i = 1, \dots, 10$  in 4 minutes (with a clock showing the time on the screen).
  - (b) Perform another  $i = 10$  additions of 5 two-digits numbers, say  $S_i^2 = A_i^2 + B_i^2 + C_i^2 + D_i^2 + E_i^2, i = 1, \dots, 10$  in 4 minutes (with a clock showing the time on the screen)
  - (c) Adding the 10 numbers obtained sub a) and the 10 numbers obtained sub b):  $S_i = S_i^1 + S_i^2$  for every  $i = 1, \dots, 10$  in 2 minutes.
7. In the cooperative treatment, individuals perform the task in pair as follows:
  - (a) perform 10 additions of 5 two-digits numbers,  $S_i^1 = A_i^2 + B_i^2 + C_i^2 + D_i^2 + E_i^2, i = 1, \dots, 10$  in 4 minutes (with a clock showing the time on the screen).
  - (b) perform 10 additions of 5 two-digits numbers,  $S_i^2 = A_i^2 + B_i^2 + C_i^2 + D_i^2 + E_i^2, i = 1, \dots, 10$  in 4 minutes (with a clock showing the time on the screen). This series of 10 numbers:  $S_i^2$  was then transferred to another subjects randomly chosen, and the same subject will pass his or her 10 numbers:  $S_i^{*2}$ . The fact that the

10 additions made by a subject will be used by another subject is reminded at this stage as well.

- (c) Adding the 10 numbers obtained sub a) and the 10 numbers obtained sub b) from the randomly matched subject. :  $S_i = S_i^1 + S_i^{*2}, i = 1, \dots, 10$  in 2 minutes.
8. Raven test, 15 tables for 30 seconds each table. Each correct answer was paid 0.20 GBP.
  9. The questionnaire is presented and filled.
  10. The payment rule is 15 GBP minus 1 GBP for any error in the 10 sums  $S_i^1 + S_i^{*2}, i = 1, \dots, 10$  for the cooperative treatment or in the sum  $S_i^1 + S_i^2, i = 1, \dots, 10$  for the control treatment.
  11. 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 7: **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 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 .

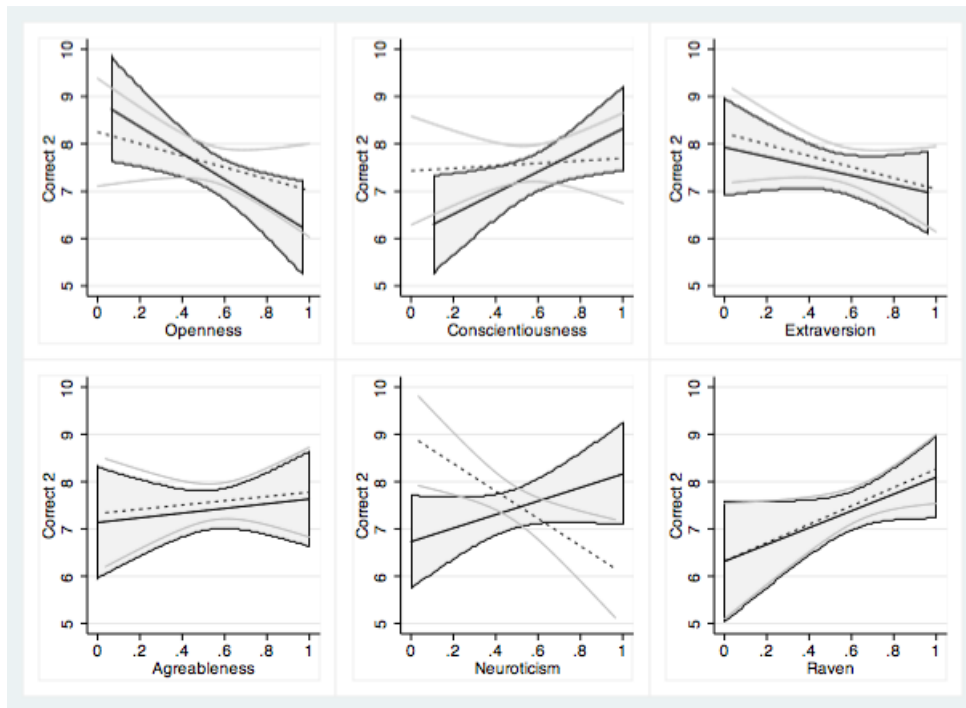


Figure 5: **Correct sums in the 1<sup>st</sup> series of additions, Personality traits and Raven score.** The dotted line is the individual (that is, baseline) treatment, the solid line represents the cooperative treatment, both the 95% confidence intervals are displayed .

