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Article

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Games

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Article

HEXACO Personality Dimensions Do Not Predict Individual Differences in Adolescent Trust Behavior

Hester Sijtsma ^{1,*} , Nikki C. Lee ^{1,2}, Jacek Buczny ¹ , Miriam Hollarek ¹, Reubs J. Walsh ¹, Mariët Van Buuren ¹ and Lydia Krabbendam ¹

¹ Department of Clinical, Neuro- and Developmental Psychology, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, 1081 BT Amsterdam, The Netherlands

² Department of Developmental Psychology, Faculty of Social and Behavioural Sciences, Utrecht University, 3584 CS Utrecht, The Netherlands

* Correspondence: h.sijtsma@vu.nl

Abstract: Adolescence is an important developmental period for both trust behavior and personality maturation, and individual differences in trust decisions may be related to different personality traits. In the current study, a group of adolescents ($n = 483$, $M_{age} = 13.5$, $SD_{age} = 0.4$) played two counterbalanced conditions of a multi-round trust game. In one condition, the partner displayed trustworthy behavior (the trustworthy condition), while the partner in the other condition played untrustworthy behavior (the untrustworthy condition). Three types of trust behavior were examined: initial trust behavior, the adaptation of trust behavior (trustworthy condition), and the adaptation of trust behavior (untrustworthy condition). Personality was measured using the Brief HEXACO Inventory. We expected the HEXACO personality dimensions of honesty–humility and agreeableness to be positively associated with initial trust behavior, but conscientiousness to be negatively related to initial trust behavior. The examination of the relationship between these dimensions and the adaptation of trust behavior were conducted on an exploratory basis. The investigation of the relationship between the remaining dimensions (emotionality, extraversion, and openness to experience) and the three types of trust behavior were also carried out on an exploratory basis. For each type of trust behavior, a hierarchical multiple regression analysis was undertaken to examine whether the HEXACO personality dimensions were related to trust behavior. Using frequentist analyses, no evidence was found that supported the HEXACO dimensions as significant predictors of the three types of trust behavior. Moreover, additional Bayesian analyses showed evidence that the hypothesized HEXACO dimensions (honesty–humility, agreeableness, and conscientiousness) did not outperform the non-hypothesized HEXACO dimensions (emotionality, extraversion, and openness to experience). The association between personality traits and trust might be less pronounced during adolescence as personality matures across an individual's lifespan. Additionally, due to a heightened sensitivity to the environment, contextual cues may affect adolescent decision-making processes, leaving less room for personality-driven behaviors.

Keywords: trust behavior; personality; HEXACO dimensions; adolescence



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1. Introduction

Trust is often referred to as the glue that holds society together. Trust makes social interactions run smoothly, which is required to build strong social relationships [1]. Both self-report and experimental studies indicate that people differ in the degree to which they trust others [2]. These differences start to emerge during development and likely reflect the complex interplay between nature and nurture. Recently, there has been a growing interest in using personality traits to explain individual differences in trust behavior during social interactions [3–5]. Adolescence is an important developmental period for both trust behavior and personality maturation [6–10]. However, the association between personality

and trust behavior has not been investigated for adolescents, despite suggestions that personality traits can help us to understand individual differences in adolescent social behavior [11]. Therefore, in the current study, we examined the relationship between personality traits and trust behavior in an adolescent sample.

Adolescence is an important developmental phase for learning to trust others and to adjust behavior based on the trustworthiness of others [10,12,13]. Well-adjusted trust behavior is crucial during adolescence, as it plays an important role in creating and maintaining peer relationships [1]. Peer relationships are associated with positive life outcomes, such as improved mental health, self-esteem, and school adjustment [14]. Trust behavior can be measured using a well-known experimental paradigm called the trust game [15]. This game can consist of one (i.e., one-round trust game) or multiple rounds (i.e., multi-round trust game). During each round, the trustor allocates an amount of money between themselves and the partner. The amount of money shared with the partner is called the investment, which is indicative of trust behavior and is tripled before the partner receives it. Subsequently, the partner returns an amount to the trustor, which is indicative of reciprocity behavior (i.e., trustworthiness) and keeps the remainder for themselves. The investment in a one-round trust game measures baseline trust behavior, reflecting the levels of trust that people show toward (unknown) others. The first investment in a multi-round trust game is often referred to as the initial trust behavior, as this first investment forms the start of repeated social interactions. During multi-round trust games, other factors start to play a role, such as strategic considerations and safeguarding one's social reputation. Furthermore, a multi-round trust game allows for the examination of how an individual's trust behavior develops throughout a social interaction. The trustor's adaptation of their trust behavior in response to the partner's trustworthiness can be quantified by modeling the change in the trustor's investments throughout the game. The trustor may respond differently to a partner showing trustworthy behavior than to a partner showing untrustworthy behavior. To control the (un)trustworthiness of the partner's behavior, a preprogrammed algorithm can be used that models the partner's returns. A recent study showed that the trust behavior exhibited in the trust game is positively associated with measures outside of lab conditions, such as self-reported trust [16].

By using the trust game, some studies have shown that baseline trust behavior (i.e., in studies that used a one-round trust game) and initial trust behavior (i.e., in studies that used a multi-round trust game) generally increase during adolescence [12,13] and that adolescents become more flexible in the adaptation of trust behavior toward the interaction partner [10,13]. Interestingly, previous work focusing on adolescents has shown individual differences in the trustor's investments related to demographic variables and cognitive skills [17]. Another factor that may explain heterogeneity in trust behavior is personality, as the decision to trust the partner, as well as responses to the partner's behavior, may be related to various levels of personality traits.

Personality is often assessed within the framework of the HEXACO model, which covers six personality dimensions [18]. These dimensions are as follows: honesty–humility (defined by fairness, sincerity, low entitlement), emotionality (defined by empathy/attachment, harm-avoidance, help-seeking), extraversion (defined by sociability, leadership, exhibition), agreeableness (defined by tolerance, forgivingness, low quarrelsomeness), conscientiousness (defined by diligence, organization, planfulness), and openness to experience (defined by curiosity, imaginativeness, depth) [19].

Concerning the development of personality, some studies have found support for the maturity hypothesis by describing increases in the mean levels of several personality traits across adolescence [8,20–22] and also support the disruption hypothesis, which describes an initial dip in certain personality traits in early adolescence, followed by a later increase with age [8,20–22]. In line with the maturity hypothesis, Ashton and Lee [23] found an upward trend with age for the HEXACO dimensions of extraversion, conscientiousness, and openness to experience. Consistent with the disruption hypothesis, it was found that honesty–humility maturation shows a temporary dip during adolescence, followed by

an increase during adulthood. The remaining HEXACO dimensions, i.e., agreeableness, showed only weak trends in relation to age, while emotionality showed a downward trend across development.

Late childhood and adolescence are important developmental phases for trust behavior and personality [11,13,24]. However, there is a shortage of studies that examine the association between adolescent trust behavior and personality traits. A recent meta-analysis that investigated the associations between personality traits and prosocial behavior in adults indicated that the dimensions of honesty–humility and agreeableness were positively associated with trust behavior [4]. This has been explained by the fact that honesty–humility and agreeableness are related to cooperative behavior [25–27] and that people with high honesty–humility and agreeableness scores are inclined to show greater trust in others in order to establish cooperation. Furthermore, people’s behavior is often guided by their personal norms about how they are supposed to behave (known as the moral preference hypothesis). For example, people with high levels of honesty–humility care about fairness and sincerity, leading to increased levels of trust behavior [28–30]. In line, people with high Machiavellianism scores, a personality trait related to manipulative behavior and a lack of morals, showed lower levels of trust behavior than people with low levels of Machiavellianism [31]. Further results from the meta-analysis of personality and trust in adults indicated that conscientiousness was negatively related to trust behavior [4]. Conscientiousness is characterized by rational thinking, diligence, and planfulness, as well as by reduced levels of risk-taking behavior [19,32], suggesting a lower inclination to run the risk that an investment may not be returned. As a result, conscientiousness may make one hesitant to trust the other, i.e., to invest during the trust game. Furthermore, the meta-analysis reported no evidence of a relationship between trust behavior and the dimensions of emotionality, extraversion, and openness to experience [4]. In conclusion, a relationship between personality (i.e., the dimensions of honesty–humility, agreeableness, and conscientiousness) and trust was found in adults, but this has yet to be investigated in adolescents.

The role of personality traits in trust behavior during social interactions may differ as a result of an individual’s role within the game. Müller and Schwieren [3] showed, using a one-round trust game, that personality traits were related to the trustor’s baseline investment, while these traits were not related to the partner’s return. An explanation for these findings was that the trustor finds themselves in a so-called weak situation, where few situational cues are present to provide direction concerning the partner’s trustworthiness, leading to uncertainty. In contrast, the partner is in a more certain situation, being informed of the trustor’s investment before making their own decision and, thus, behaves reactively to the trustor. They suggested that, in the absence of information about the interaction partner, the decision to trust is impacted by personality, such as how optimistic or pessimistic one is about the potential return from the interaction partner. In contrast, as the partner is in a stronger situation, with the advantage of situational cues, their personality traits may have less influence on their decision on how much of the trustor’s investment to return. The situation for a multi-round trust game may be different. On the one hand, the trustor gains increasing amounts of information about the partner, which can guide their trust decisions, perhaps leading to a less pronounced function of personality traits in the adaptation of trust compared to the role of personality in the emergence of initial trust. On the other hand, it is also possible that there are individual differences in the way the trustor responds to the partner’s behavior. For example, one’s sensitivity to the betrayal of trust is related to one’s personality [5], which may play a role during continued social interactions (i.e., in the multi-round trust game and the adaptation of trust). Specifically, people scoring high on the HEXACO dimension of agreeableness may be more forgiving toward their partner than those with low scores on this dimension and, therefore, show higher levels of trust behavior [5].

Further research is required to investigate the association between personality and trust during adolescence, distinguishing the effects of initial trust behavior and the adaptation

of trust behavior. The association between personality and trust in adults has been clearly described in a meta-analysis [5], but thus far, this association has not been investigated in adolescent samples. Adolescent samples are interesting to study because previous work has shown that trust behavior develops throughout adolescence [10,12,13]; however, more studies are needed to explain which factors support or constrain trust development. One of those factors could be personality traits, as previous research has suggested that personality is useful in explaining individual differences in adolescent social behavior [11]. Therefore, in the current study, we examined the relationship between personality traits and trust behavior in adolescents. Personality was assessed using the Brief HEXACO Inventory (BHI), and trust behavior was measured using the trust game. All the participants played two conditions of a multi-round trust game in the role of the trustor. In each condition, the participants were informed that the partner was a cartoon character and not a human counterpart. The partner's behavior was modeled by a preprogrammed algorithm. The trustworthiness of the partners differed between the two conditions, as the partner in the trustworthy condition behaved in a trustworthy manner, while the partner in the untrustworthy condition behaved in an untrustworthy manner.

Three types of trust behavior were examined: initial trust behavior and the adaptation of trust behavior under trustworthy and untrustworthy conditions. Initial trust was quantified as the investment in the first round in the first condition played. The adaptation of trust behavior during the trustworthy condition was quantified as the change in investments throughout the game; similarly, the adaptation of trust behavior during the untrustworthy condition was quantified as the change in investments throughout the game. In both conditions, the change in investments was identified by regressing the investments on the trials and extracting the individual slopes per participant.

Our hypotheses were based on the theoretical model presented in the meta-analysis by Thielmann, Spadaro and Balliet [4]. Therefore, we hypothesized that the HEXACO personality dimensions of honesty–humility and agreeableness were positively associated with initial trust behavior, but conscientiousness was negatively associated with initial trust behavior. Although examined less often, personality traits could play a role in the adaptation of trust behavior as well, as suggested by Thielmann and Hilbig [5]. Therefore, the analyses on the dimensions of honesty–humility, agreeableness, and conscientiousness and the adaptation of trust behavior were conducted on an exploratory basis. We did not specify hypotheses for the remaining dimensions—emotionality, extraversion, and openness to experience—because of the absence of evidence in the meta-analysis and a lack of theoretical premises for an association between these dimensions and trust behavior. However, as little research has been conducted on adolescent samples, we included these dimensions in the analysis for exploratory purposes. Furthermore, we controlled for gender in all analyses, as gender differences in trust behavior have been demonstrated in previous work [33]. The main results of this paper do not provide evidence for the hypothesized HEXACO dimensions being significantly related to any of the types of trust behavior examined. The non-hypothesized HEXACO dimensions were also not able to predict any of the three types of trust behavior. For each type of trust behavior, exploratory Bayesian regression analyses were conducted to quantify the degree of evidence for the alternative hypothesis or the null hypothesis [34]. The results provided strong evidence that the hypothesized HEXACO dimensions do not explain trust behavior better than the non-hypothesized HEXACO dimensions.

2. Materials and Methods

2.1. Participants

The participants in the current study took part in the #SOCONNeCT project. This project involved six waves of data collection over three school years (two waves per year) at eight secondary schools throughout The Netherlands. All the participants were enrolled in one of the two higher educational tracks (i.e., senior general secondary education or the pre-university education) within the Dutch educational system. During the data collection

period, these tracks encompassed the 40% highest achieving pupils within Dutch secondary schools. The schools received EUR 7.50 per participating pupil per wave for use in class activities. The participants could earn an additional payout based on their average earnings per trial in the trust game. These amounts were calculated following the data collection and added to the total financial compensation given to the class.

The participants were included in the analyses of the current study if they completed the trust game (see Section 2.2 Materials), which was administered in wave 3 of the #SO-CONNeCT project, and if they completed the questionnaire that measured personality (i.e., BHI, see Section 2.2 Materials), which was administered in wave 2. Wave 2 and wave 3 were conducted at approximately 6-month intervals. A total of 534 participants completed the trust game. Of these participants, 15 were excluded from the analyses because, due to a lack of time or motivation, they did not finish the trust game. Of the remaining 519 participants, 483 completed the BHI, meaning that 483 participants were included in the final analyses ($M_{\text{age}} = 13.54$, $SD_{\text{age}} = 0.38$, 230 boys).

2.2. Materials

2.2.1. Brief HEXACO Inventory

Personality was measured using the BHI [35]. This is a shortened self-report questionnaire consisting of 24 items measuring the six personality dimensions of the HEXACO model. The six dimensions are as follows: honesty–humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience. Each dimension was measured using four items. Each item was rated on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral—neither agree nor disagree, 4 = agree, and 5 = strongly agree). The validity of the BHI has been shown to be adequate and previous work showed adequate levels of test–retest reliability and adequate levels of self–other agreement [35]. Per dimension, a sum score was calculated and used as a predictor in the statistical analyses (see Section 2.4 Statistical Analyses). The items of the BHI (English and Dutch versions) can be found in De Vries [35].

2.2.2. Trust Game

The multi-round trust game was used to measure trust behavior [15]. Every participant completed two conditions of the game (the trustworthy condition and the untrustworthy condition). The conditions were administered in a counterbalanced order and consisted of 15 trials. Before the game started, a joint, extensive explanation of how the game works was given in the classroom (see Section 2.3 Procedure). A trial started with a screen displaying the numbers zero to ten, and the participant was asked to make an investment by using the arrow keys to select the amount they wished to invest (see screen 1 in Figure 1). The investment was multiplied by three and received by the partner. Next, a screen displaying a cartoon character was shown accompanied by the text “the partner is thinking” (see screen 2 in Figure 1). This was followed by a screen revealing the partner’s return (see screen 3 in Figure 1). Next, a screen with the total earnings for both players for that trial was displayed (see screen 4 in Figure 1).

In both conditions, the interaction partner was a cartoon character. Prior to the start of the games, the participants were informed that they were playing the games with cartoon characters and not with human counterparts. The behavior of both partners was modeled using a preprogrammed algorithm. The algorithm for both partners was programmed so that the partner’s behavior was equally trustworthy for the first five trials. This was conducted to establish an identical baseline of trustworthiness for both partners. The partner’s behavior changed after the first five trials in both conditions. From the sixth trial onwards, the algorithm modeled trustworthy partner behavior in the trustworthy condition and untrustworthy partner behavior in the untrustworthy condition.

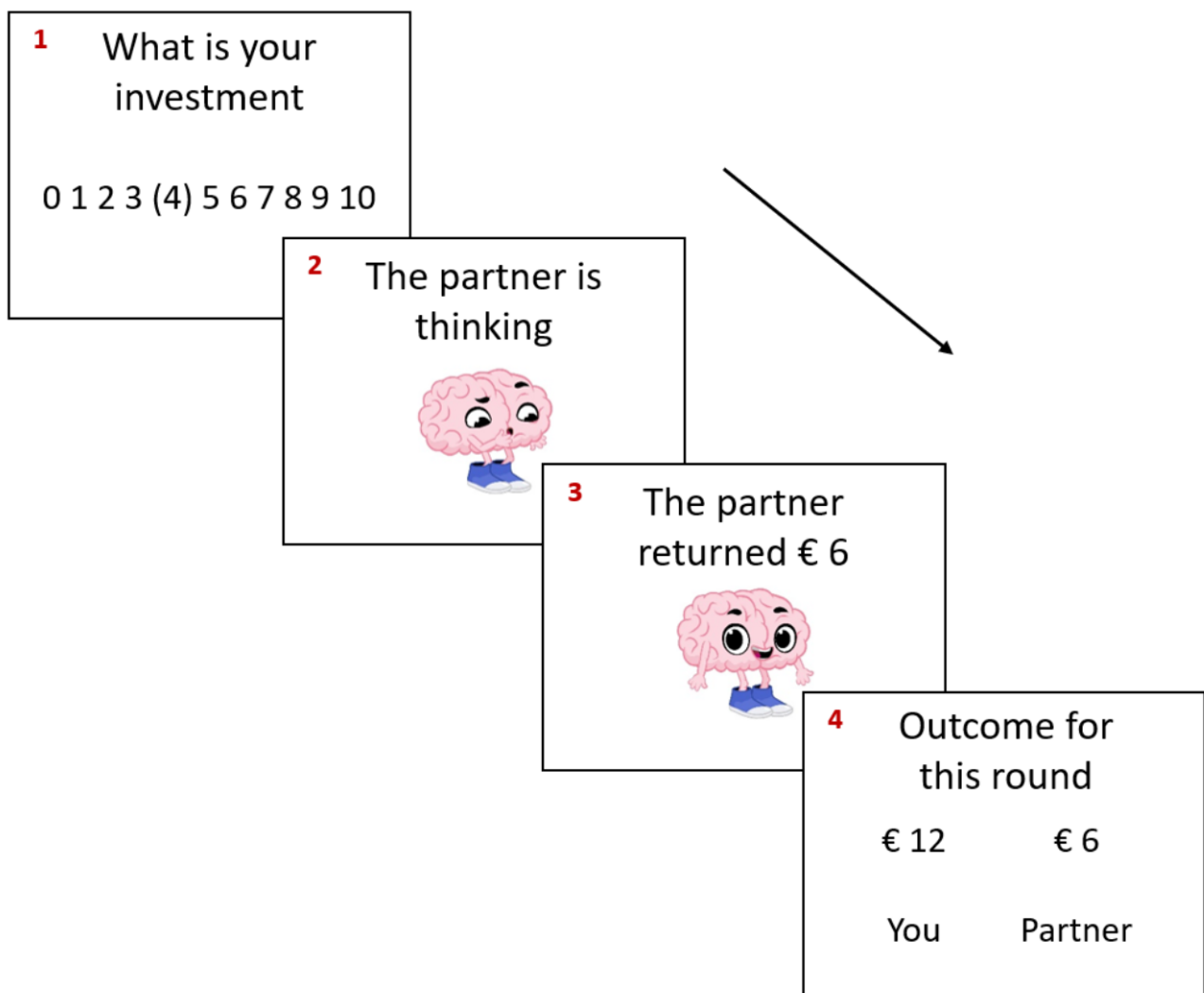


Figure 1. An example of a trial in the trust game in the trustworthy condition. Note: The investment is EUR 4, which is multiplied by 3. This means the partner received EUR 12, and the participant kept EUR 6. The partner's return is EUR 6. Thus, the outcome of this round is EUR 12 for the participant and EUR 6 for the partner. In this example, the factor that determined the partner's return was 1.5.

The partner's return for each trial was determined by the participant's investment multiplied by a factor. In both conditions, the factor for the first trial was randomly selected from the values 1.2, 1.3, and 1.4. The value of the factor for the second through to the fifth trial increased by 0.1 when the participant's investment increased compared to their investment during the previous trial (in steps of 0.1, with a minimum factor of 1.2 and a maximum factor of 1.4). The value of the factor stayed the same when the investment decreased or when the investment did not change compared to the previous trial. From the sixth trial onwards, the algorithm determining the partner's return differed between the conditions.

In the trustworthy condition, the trustworthiness of the partner then increased compared to the first five trials. The factor for the sixth trial was randomly chosen between 1.5 and 2.0 (in steps of 0.1). For the seventh through to the fifteenth trial, the factor increased by 0.1 when the participant's investment increased compared to the investment during the previous trial (with a minimum factor of 1.5 and a maximum factor of 2.0). The factor did not change when the participant's investment decreased or stayed the same compared to the previous investment. In the trustworthy condition, the partner's return was always more than the participant's investment (as the minimum factor is 1.5). The

partner increased their return (i.e., showed trustworthy reciprocal behavior) when the participant increased their investment (i.e., showed trust behavior). In contrast, in the untrustworthy condition, the partner's trustworthiness decreased compared to the first five trials. Under this condition, the factor for the sixth trial was randomly chosen between 0.7 and 1.2 (in steps of 0.1). Thereafter, the factor for the seventh through to the fifteenth trial decreased by 0.1 when the participant's investment increased compared to the previous investment (with a minimum factor of 0.7 and a maximum factor of 1.2). The factor stayed the same when the participant's investment decreased or did not change compared to the previous trial. In sum, both algorithms were adaptive to the increases in participants' investments. However, under the trustworthy condition, the relative returns increased in response to increased investments, whereas under the untrustworthy condition, the relative returns decreased.

2.3. Procedure

The participants in the current study took part in the #SOCONNeCT project. The #SOCONNeCT project and all the procedures were approved by the Scientific and Ethical Review Board of the Faculty of Behavioral and Movement Sciences of the Vrije Universiteit Amsterdam. Before the start of the project, the adolescents received an information package (containing information about the project and an informed consent form) to take home and discuss their participation in the research project with their caregiver(s)/parent(s). The researchers provided additional details at information evenings at the participating schools. Informed consent was obtained from the caregiver(s)/parent(s) prior to participation. Furthermore, researchers also came to the schools to provide explanations to the pupils about the research project (e.g., about what research entails, the rights that participants have, the aim of the research project, and how and for what purpose their data would be used), and they were given the opportunity to ask questions (these questions were mostly about whether the research was part of the education curriculum of their school). If the pupils agreed to participate, they signed active informed consent prior to participation. They were reminded that they were not obliged to participate; they could refrain from participation without any consequences; and if they decided to participate, they could stop participating at any time without having to report a reason. Furthermore, participants were ensured their data were processed anonymously. The participants were reminded about this before each wave of testing.

All the measures were validated prior to data collection during several focus groups with adolescent participants, and the instructions were adjusted according to feedback received during these sessions. The data were collected during in-class sessions under the supervision of the researchers and trained research assistants. The completion of all tasks and questionnaires took approximately 90 min (including those not analyzed in the current study). Each testing session started with an explanation of the procedures, and the participants were reminded that they could stop participating at any time. The participants then individually completed the tasks (including the trust game) on a laptop and the questionnaires (including the BHI) on an iPad provided by the researchers. The administration of the trust game started with a joint, extensive explanation of how the game works, followed by the completion by each participant of a comprehension check, which required them to answer three questions about the game correctly before they could start the task.

2.4. Statistical Analyses

The research aim of the current study was to examine the relationship between personality traits and trust behavior in adolescents. This examination was performed for three different types of trust behavior: initial trust behavior, the adaptation of trust behavior under the trustworthy condition, and the adaptation of trust behavior under the untrustworthy condition. For every type of trust behavior, a hierarchical multiple regression analysis was carried out to examine the relationship between the six HEXACO dimensions

(i.e., the predictor variables) and the specific type of trust behavior (the outcome variable). Gender was also included as a predictor variable in these models to control for the gender differences in trust behavior. Predictor variables were added sequentially in each of the three hierarchical multiple regression analyses. In each of these analyses, we added gender in the first step. In the second step, we added the non-hypothesized HEXACO dimensions to the model, namely the effects of emotionality, extraversion, and openness to experience. To examine whether these predictors contributed significantly to the measured variance, the fit of the model in the second step was compared to the fit of the model in the first step using an ANOVA. In the third step, the hypothesized HEXACO dimensions, namely honesty–humility, agreeableness, and conscientiousness, were added, and the fit of this model was compared to the fit of the model in the second step using an ANOVA. All the analyses were performed in R version 4.1.1 [36].

The three types of trust behavior that served as the outcome variables in the hierarchical regression analyses were operationalized in the following way. First, the initial trust behavior was quantified as the investment in the first trial of the first trust game that was played. Second, the individuals' adaptation of their trust behavior in the trustworthy condition was quantified as the slope of a regression line, modeling the change in investments during the 6th through to the 15th trial. We excluded the first five trials, as, during these, the algorithms for both conditions were programmed to model the same behavior. The slope was calculated by fitting a multi-level model, because this analysis allows for repeated measures of the same participant over trials. The multi-level modeling procedure comprised two steps (maximum likelihood estimation was used). In the first step, a random intercept for the subject, a random slope for the trials, and a linear fixed main effect of the trials were added to the model. In the second step, the quadratic fixed main effect of the trials was added to the model. The fit of the second model was compared to the fit of the first model using a log-likelihood ratio test. Model 2 was regarded as significantly better if the p -value of the log-likelihood ratio test was lower than 0.05 ($p < 0.05$). Per participant, individual slopes were extracted from the model with the best model fit, i.e., either the first model—including the linear effect of the trials, or the second model—including the quadratic effect of the trials. These individual slopes represented the change in investments throughout the trustworthy condition. Subsequently, the individual slopes were used as an operationalization of the adaptation of trust behavior in the trustworthy condition, i.e., as scores of the outcome variable in the hierarchical regression analysis. Multi-level modeling to extract individual slopes was performed using the R packages *lme4* and *lmerTest* [37,38]. Third, similarly to the trustworthy condition, individuals' adaptation of trust behavior in the untrustworthy condition was quantified as the slope of a regression line modeling the change in investments during the 6th through to the 15th trial, i.e., excluding the first five trials during which the algorithm of both conditions was programmed to model equally trustworthy behavior. A similar two-step multi-level modeling procedure was used to calculate the slope of the regression line that models the change in investments (maximum likelihood estimation was used). In the first step, the linear fixed main effect of the trials was added to the model (including a random intercept for the subject and a random slope for the trials), and in the second step, the quadratic fixed main effect of the trials was added to the model. Again, the fit of the second model was compared to the fit of the first model. For each participant, individual slopes were extracted from the model with the best model fit, i.e., either the first model—including a linear effect of the trials, or the second model—including a quadratic effect of the trials. These individual slopes designated the change in investments throughout the untrustworthy condition. Subsequently, the individual slopes were used as an operationalization of the adaptation of trust behavior in the untrustworthy condition and served as the scores of the outcome variable in the hierarchical regression analysis. Descriptive statistics per type of trust behavior are presented in Table 1.

Table 1. Descriptive statistics per type of trust behavior.

Type of Trust Behavior	Mean (SD)
Initial trust behavior	
Boys	4.17 (2.49)
Girls	3.08 (1.68)
Total	3.60 (2.17)
Mean trust behavior (Trustworthy condition)	
Boys	6.63 (2.16)
Girls	5.74 (2.12)
Total	6.17 (2.18)
Mean trust behavior (Untrustworthy condition)	
Boys	4.61 (1.77)
Girls	3.88 (1.32)
Total	4.23 (1.60)

Note—Boys: $n = 230$; $M_{\text{age}} = 13.54$; $SD_{\text{age}} = 0.39$. Girls: $n = 253$; $M_{\text{age}} = 13.54$; $SD_{\text{age}} = 0.38$. SD = standard deviation.

3. Results

3.1. Initial Trust Behavior

A hierarchical multiple regression analysis consisting of three steps was run to examine the relationship between personality and initial trust behavior. The results of the different steps of the hierarchical multiple regression analysis are presented in Table 2. The overall model in the first step, including the control variable of gender, was significant: $F(1, 481) = 32.06$, $p < 0.001$, $R^2 = 0.06$, 95% CI [0.03, 0.11]. Gender was a significant predictor of the initial trust behavior—and boys ($M = 4.17$, $SD = 2.49$) showed higher levels of initial trust behavior compared to girls ($M = 3.08$, $SD = 1.68$) (see Table 2). The overall model in the second step, including gender and the non-hypothesized HEXACO dimensions, was also significant: $F(4, 478) = 8.32$, $p < 0.001$, $R^2 = 0.07$, 95% CI [0.03, 0.12]. However, the non-hypothesized dimensions were not significant predictors of initial trust behavior (see Table 2). The results of the final model in the third step, including gender, the non-hypothesized HEXACO dimensions, and the hypothesized HEXACO dimensions, showed that the overall model was significant: $F(7, 475) = 4.87$, $p < 0.001$, $R^2 = 0.07$, 95% CI [0.04, 0.13]. However, the results of the final model showed that no evidence was found for any of the hypothesized or non-hypothesized HEXACO dimensions as significant predictors of initial trust behavior. In sum, the results did not confirm the hypothesis that the HEXACO personality dimensions of honesty–humility and agreeableness were positively associated with initial trust behavior; nor did the results confirm the hypothesis that conscientiousness was negatively associated with initial trust behavior.

Table 2. Results of the hierarchical regression analysis with initial trust behavior as the outcome variable.

Step	Predictor	B [95% CI]	Standard Error	t-Value (p-Value)
Step 1	Gender	−1.09 [−1.46, −0.71]	0.19	−5.66 (<0.001)
Step 2	Gender	−1.07 [−1.47, −0.67]	0.20	−5.26 (<0.001)
	Emotionality	−0.02 [−0.09, 0.06]	0.04	−0.45 (0.65)
	Extraversion	0.03 [−0.07, 0.12]	0.05	0.58 (0.56)
	Openness to experience	0.02 [−0.05, 0.09]	0.04	0.65 (0.52)
	Gender	−1.04 [−1.45, −0.64]	0.21	−5.07 (<0.001)
	Emotionality	−0.02 [−0.09, 0.06]	0.04	−0.45 (0.65)
	Extraversion	0.03 [−0.06, 0.13]	0.05	0.67 (0.51)
Step 3	Openness to experience	0.02 [−0.05, 0.10]	0.04	0.64 (0.52)
	Honesty–humility	−0.03 [−0.11, 0.05]	0.04	−0.81 (0.42)
	Agreeableness	−0.01 [−0.1, 0.08]	0.05	−0.30 (0.76)
	Conscientiousness	−0.003 [−0.08, 0.07]	0.04	−0.09 (0.93)

Note— $n = 483$. R^2 in step 1 was 0.06. ΔR^2 in step 2 was 0.003 ($p = 0.72$); ΔR^2 in step 3 was 0.002 ($p = 0.81$).

3.2. The Adaptation of Trust Behavior

For the analyses of the adaptation of trust behavior in the trustworthy condition, individual slopes were extracted from a multi-level model. The best fitting model was model 1, which included the significant linear fixed main effect of the trials: $B = 21.53$, 95% CI [15.74, 27.09], $t(519) = 7.41$, $p < 0.001$. The results showed that the linear effect of the trials showed an average upward trend in investments. Model 2, which included the quadratic fixed main effect of the trials, did not fit significantly better than model 1 (the results of the log-likelihood test when the fit of model 2 was compared to the fit of model 1 were: $\chi^2(1) = 0.44$, $p = 0.51$). Individual slopes were extracted from model 1 and used as an outcome variable in the hierarchical multiple regression analysis.

The results of the consecutive steps of the hierarchical multiple regression analysis for the adaptation of trust behavior in the trustworthy condition are presented in Table 3. The overall model in the first step, including the control variable of gender, was not significant: $F(1, 481) = 0.19$, $p = 0.67$, $R^2 = 0.0004$, 95% CI [2.19×10^{-6} , 0.01]. The overall model in the second step, including gender and the non-hypothesized HEXACO dimensions, was also not significant: $F(4, 478) = 2.29$, $p = 0.06$, $R^2 = 0.02$, 95% CI [0.006, 0.06]. The results indicated that the non-hypothesized dimensions were not significant predictors of the adaptation of trust behavior in the trustworthy condition (see Table 3). The results of the final model in the third step, including gender, the non-hypothesized HEXACO dimensions, and the hypothesized HEXACO dimensions, showed that the overall model was also not significant: $F(7, 475) = 1.63$, $p = 0.13$, $R^2 = 0.02$, 95% CI [0.01, 0.07]. The results showed that emotionality was a significant predictor of trust behavior, but as the overall model was not significant, the results of the individual predictor of emotionality should be interpreted with caution. Furthermore, the results of the final model showed no evidence that the hypothesized and the other two non-hypothesized HEXACO dimensions were significant predictors of the adaptation of trust behavior in the trustworthy condition.

Table 3. Results of the hierarchical regression analysis with the adaptation of trust behavior in the trustworthy condition as the outcome variable.

Step	Predictor	B [95% CI]	Standard Error	t-Value (p-Value)
Step 1	Gender	0.01 [−0.02, 0.04]	0.02	0.43 (0.67)
Step 2	Gender	0.01 [−0.02, 0.05]	0.02	0.87 (0.39)
	Emotionality	−0.006 [−0.01, 0.0003]	0.003	−1.85 (0.06)
	Extraversion	0.004 [−0.004, 0.01]	0.004	0.92 (0.36)
	Openness to experience	0.005 [−0.0009, 0.01]	0.003	1.65 (0.1)
	Gender	0.01 [−0.02, 0.04]	0.02	0.70 (0.49)
	Emotionality	−0.006 [−0.01, 6.59×10^{-6}]	0.003	−1.97 (0.05)
	Extraversion	0.003 [−0.004, 0.01]	0.004	0.89 (0.37)
Step 3	Openness to experience	0.005 [−0.0005, 0.01]	0.003	1.80 (0.07)
	Honesty-humility	0.005 [−0.002, 0.01]	0.003	1.43 (0.15)
	Agreeableness	−0.001 [−0.009, 0.006]	0.004	−0.34 (0.73)
	Conscientiousness	−0.002 [−0.008, 0.004]	0.003	−0.71 (0.48)

Note— $n = 483$. R^2 in step 1 was 0.0004. ΔR^2 in step 2 was 0.02 ($p = 0.03$); ΔR^2 in step 3 was 0.005 ($p = 0.53$).

For the analyses of the adaptation of trust behavior in the untrustworthy condition, individual slopes were extracted from a multi-level model. The best fitting model was model 2, which included the significant quadratic fixed main effect of the trials: $B = 16.39$, 95% CI [11.59, 21.08], $t(4152) = 7.06$, $p < 0.001$. The results revealed that the quadratic effect of the trials showed an average downward trend in investments. Model 2 had a significantly better fit than model 1, which included the linear fixed main effect of the trials (the results of the log-likelihood test when the fit of model 2 was compared to the fit of model 1 were: $\chi^2(1) = 49.59$, $p < 0.001$). Individual slopes were extracted from model 2 and used as an outcome variable in the hierarchical multiple regression analysis.

The results of the consecutive steps of the hierarchical multiple regression analysis for the adaptation of trust behavior in the untrustworthy condition are presented in Table 4. The overall model in the first step, including the control variable of gender, was not significant: $F(1, 481) = 1.35$, $p = 0.25$, $R^2 = 0.003$, 95% CI [6.65×10^{-6} , 0.02]. The overall model in the second step, including gender and the non-hypothesized HEXACO dimensions, was significant: $F(4, 478) = 2.63$, $p = 0.03$, $R^2 = 0.02$, 95% CI [0.008, 0.06]. The results indicated that the non-hypothesized dimensions of extraversion and openness to experience were significant predictors of the adaptation of trust behavior in the untrustworthy condition (see Table 4). The results of the final model in the third step, including gender, the non-hypothesized HEXACO dimensions, and the hypothesized HEXACO dimensions, showed that the overall model for the adaption of trust behavior in the untrustworthy condition was not significant: $F(7, 475) = 1.82$, $p = 0.08$, $R^2 = 0.03$, 95% CI [0.02, 0.07]. The results showed that extraversion and openness to experience were significant predictors of trust behavior, but as the overall model was not significant, the results of the individual predictors of extraversion and openness to experience should be interpreted with caution. Furthermore, the results of the final model showed no evidence that the hypothesized and the other non-hypothesized HEXACO dimensions were significant predictors of the adaptation of trust behavior in the untrustworthy condition.

Table 4. Results of the hierarchical regression analysis with the adaptation of trust behavior in the untrustworthy condition as the outcome variable.

Step	Predictor	B [95% CI]	Standard Error	t-Value (p-Value)
Step 1	Gender	0.02 [−0.01, 0.04]	0.01	1.16 (0.25)
Step 2	Gender	0.02 [−0.01, 0.05]	0.01	1.22 (0.22)
	Emotionality	−0.0004 [−0.006, 0.005]	0.003	−0.14 (0.89)
	Extraversion	0.007 [0.0007, 0.01]	0.003	2.20 (0.03)
	Openness to experience	−0.006 [−0.01, −0.0007]	0.003	−2.24 (0.03)
	Gender	0.02 [−0.009, 0.05]	0.01	1.37 (0.17)
	Emotionality	-7.6×10^{-6} [−0.005, 0.005]	0.003	−0.003 (0.99)
Step 3	Extraversion	0.007 [0.0007, 0.01]	0.003	2.19 (0.03)
	Openness to experience	−0.006 [−0.01, −0.001]	0.003	−2.40 (0.02)
	Honesty–humility	−0.004 [−0.01, 0.002]	0.003	−1.42 (0.16)
	Agreeableness	0.002 [−0.005, 0.008]	0.003	0.53 (0.6)
	Conscientiousness	0.002 [−0.003, 0.007]	0.003	0.65 (0.52)

Note— $n = 483$. R^2 in step 1 was 0.003. ΔR^2 in step 2 was 0.02 ($p = 0.03$); ΔR^2 in step 3 was 0.005 ($p = 0.52$).

3.3. Exploratory Analyses

The above-reported final models for hierarchical multiple regression analyses for the adaptation of trust behavior in the trustworthy condition and for the adaptation of trust behavior in the untrustworthy condition were not significant. Furthermore, the above-reported final model for hierarchical multiple regression analysis for initial trust behavior was significant; however, no evidence was found to support HEXACO dimensions as significant predictors of initial trust behavior. As we used frequentist multiple regression analyses, we can only reject the null hypothesis and find support for the alternative hypothesis [39]. However, Bayesian regression analysis can help quantify the degree of evidence for the alternative hypothesis (H_1) or for the null hypothesis (H_0) or show that the results indicate that there is no more evidence for the alternative hypothesis than for the null hypothesis [34]. In the current analysis, we used the Bayes factor (BF) to reflect the extent to which the evidence supported either the H_1 or the H_0 . BF is a ratio of the likelihood of two competing models predicting the data. The BF_{10} measure can be used as a quantification of the support for the alternative model over the null model (i.e., how much more likely is the alternative model over the null model given this dataset). Rules of thumb exist to interpret the BF_{10} . Specifically, values of BF_{10} provide evidence for H_1 according to the following scale: BF_{10} higher than 100—decisive evidence for H_1 ; 30–100—very strong evidence; 10–30—strong evidence; 3–10—substantial evidence; and 1–3—trivial evidence.

Meanwhile, values of BF_{10} provide evidence for H_0 according to the following scale: BF_{10} in the range 0.33–1—trivial evidence; 0.10–0.33—substantial evidence; 0.03–0.10—strong evidence; 0.01–0.03—very strong evidence; and values lower than 0.01—decisive evidence for H_0 [40].

A Bayesian regression analysis was carried out for the three types of trust behavior. In each of the Bayesian regression analyses, an alternative (i.e., hypothesized) model including gender, the non-hypothesized HEXACO dimensions—specifically emotionality, extraversion, and openness to experience—and the hypothesized dimensions—of honesty–humility, agreeableness, and conscientiousness—were compared to a model including gender and the non-hypothesized dimensions, i.e., the null model. Analyses were performed in R version 4.1.1. [36] using the *BayesFactor* package [41].

The results of the initial trust behavior showed that the BF_{10} (i.e., the BF indicating evidence for the alternative model over the null model) was 0.02 when the alternative model, which included gender, the non-hypothesized dimensions, and the hypothesized dimensions, was compared to the null model, which included gender and the non-hypothesized dimensions. This indicates that there was very strong evidence that the alternative model did not explain the initial trust behavior better than the null model.

Furthermore, the results of the adaption of trust behavior in the trustworthy condition showed that the BF_{10} was 0.05 when the alternative model, which included gender, the non-hypothesized dimensions, and the hypothesized dimensions, was compared to the null model, which included gender and the non-hypothesized dimensions. This indicates that there was strong evidence that the alternative model did not explain the adaptation of trust behavior in the trustworthy condition better than the null model.

Finally, the results of the adaptation of trust behavior in the untrustworthy condition showed that the BF_{10} was 0.05 when the alternative model, which included gender, the non-hypothesized dimensions, and the hypothesized dimensions, was compared to the null model, which included gender and the non-hypothesized dimensions. This indicates that there was strong evidence that the alternative model did not explain the adaptation of trust behavior in the untrustworthy condition better than the null model.

4. Discussion

In the current study, we examined the relationship between personality traits and trust behavior in adolescents. This examination was conducted for three types of trust behavior, namely, the initial trust behavior, the adaptation of trust behavior in a trustworthy condition, and the adaptation of trust behavior in an untrustworthy condition. None of the three final models provided evidence for the hypothesized HEXACO dimensions being significantly related to trust behavior. Furthermore, for every type of trust behavior, based on the Bayesian regression analyses, there was evidence that the hypothesized HEXACO dimensions (honesty–humility, agreeableness, and conscientiousness) did not outperform the non-hypothesized HEXACO dimensions (emotionality, extraversion, and openness to experience). Based on frequentist and Bayesian analyses, we conclude that there are strong indications that the HEXACO personality dimensions are not related to trust behavior in young adolescents.

There has been an increased interest in using personality traits to explain individual differences in trust behavior during social interactions [3–5]. However, there is still a paucity of studies examining the association between personality traits and trust behavior during adolescence despite this being an important phase for the maturation of both personality and trust [10,13,23]. The results of the current study indicate that there is a lack of evidence that the hypothesized HEXACO dimensions are associated with trust behavior during adolescence, while significant relationships between personality and trust have been found in adults [4]. An explanation for the absence of the relationship between personality and trust during adolescence might be that personality continues to mature over a lifespan and that personality traits are, therefore, more pronounced in adulthood than during adolescence. For example, studies have shown that personality traits associated with trust

behavior, such as conscientiousness and honesty–humility, still show maturational growth during adolescence and into adulthood [23].

In addition to the continued effects of personality development, the influence of social and contextual processes that play a role during trust behavior may differ between adolescents and adults. The influence of these processes may, therefore, leave less room for personality traits to explain the individual differences in the trust decisions of adolescents. It has been argued that decisions in the trust game are not merely rational acts focused on potential outcomes, but that these decisions may also be influenced by emotional and social-contextual factors [42]. Indeed, the decision to trust is also an emotional act, as feelings and immediate emotions (such as being nervous to trust someone) affect one's trust decisions [42]. Trust is also a social act, as decisions to trust are influenced by social norms and by the relationship with the interaction partner [42]. These emotional and social influences during trust decisions are perhaps even more prominent in adolescents compared to adults because adolescence is a period of social and affective change [43], and, as such, adolescents are more susceptible to situational cues than adults. Notably, adolescents show a heightened sensitivity to their environment, and during this period, they become more sensitive to rewards and emotions and to social influences, such as the opinions of others and acceptance by peers [43–45]. These social-contextual factors, which play a role in interpersonal situations such as the trust game, appear to influence adolescent behavior and decision-making more than they do in adults [45]. This idea has been supported by previous studies using various economic game paradigms. Studies using the trust game showed that adolescents became less sensitive to contextual information about the interaction partner with age [10]. Studies that used other economic paradigms also demonstrated the influence of other social-contextual factors in adolescents, such as being observed by a peer [46,47] or the relationship with the interaction partner [48]. Since adolescents are particularly sensitive to environmental cues when engaging in social interactions, this may suggest that adolescent trust decisions in the current study may have been more guided by affective and social cues than by factors related to their personality traits.

Gender was added as a control variable in the regression models, and the results showed support for gender differences in initial trust behavior, with boys showing higher levels of initial trust than girls. This result is in line with a meta-analysis in adults, which examined the gender differences in baseline trust behavior [33], and with some studies of adolescents [17,49]. Trusting others has been suggested to involve risk-taking as one does not know whether their trust will be reciprocated; hence, there is a chance of betrayal of trust [50]. The increased risk-taking tendencies seen in men compared to women may explain the gender differences in initial trust behavior [33,51]. Another explanation for the gender differences in initial trust behavior is the increased expectations among men when compared to women, assuming that others will behave cooperatively [52,53]. Expecting others to behave cooperatively may increase one's own initial trust decisions, possibly explaining the higher level of initial trust among boys compared to girls.

When interpreting the results of the current study, several considerations should be kept in mind. The BHI and the trust game were administered six months apart because the current study was part of a larger project (the BHI was administered prior to the trust game). Although personality develops throughout adolescence, it is not expected that personality traits will undergo major changes in only a few months [54]. Therefore, the delay between the measures will not have impacted the results. Furthermore, it should be noted that the participants in the sample were mainly Western and highly educated adolescents, which limits the generalizability of the results to other cultures and levels of education. Moreover, the interaction partner in the trust game was not a human counterpart, and this may have affected the results. However, previous work has shown similar responses when interacting with computer counterparts compared to human counterparts, although these responses are somewhat weaker [55–58]. Additionally, considering our research questions, it was unfeasible to use a human counterpart, as we aimed to control the partner's trustworthiness through an algorithm that modeled the partner's behavior. Furthermore, we did not want

to falsely inform the participants that they were playing with human counterparts and thus used cartoon characters. Another point of consideration is that the trust game was designed with a waiting period to wait for the partner's response following one's own investment. A text was shown during this waiting period and indicated that the partner was thinking about their return. This text may have encouraged participants to have a more deliberative mindset and may have stimulated them to carefully consider how the money should be allocated between themselves and their partner. Lastly, it would have been interesting to test for the developmental effects related to the association between personality traits and trust (e.g., testing the possible moderating role of age in the relationship between personality and trust behavior); however, this was unfeasible in the current dataset due to the low age variance.

5. Conclusions

To conclude, the relationship between personality traits and three types of trust behavior in adolescents was examined in the current study. No support was found for a relationship between any of the HEXACO personality dimensions and trust behavior. Based on the frequentist and Bayesian analysis, we conclude that there are strong indications that the HEXACO personality dimensions are not related to trust behavior in young adolescents. Perhaps the association between personality traits and trust behavior is less pronounced during adolescence as their personality is maturing, and due to a heightened sensitivity to the environment, resulting in contextual cues possibly affecting adolescent trust behavior and decision-making processes, leaving less room for the influence of personality traits. Future research could further investigate the relationship between personality and trust behavior in children, adolescents, and adults to examine whether this relationship depends on age. Furthermore, experimental manipulations could be used to test how social-contextual factors (e.g., the presence or observation of peers) might influence trust decisions differently in children, adolescents, and adults. Altogether, this study provides insight into the (absence of the) relationship between personality traits and individual differences in trust behavior during adolescence.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The participants and their parents did not provide explicit consent for the public archiving of the research data; therefore, the data are not stored in a public repository. Anonymized data will be made available to individual researchers upon request when compatible with the General Data Protection Regulation. Additionally, researchers that request the data will be required to have obtained ethical approval from their host institution and are not allowed to share the data.

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