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## Damage Trust but Increase Cooperation? Viewing Depression Through a Trust Game Lens

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### Abstract

Depression is theoretically associated with poor social functioning and social impairments, but empirical evidence for poor trust or cooperative behavior among depressed patients is scarce and severely under-researched. Based on a revised version of Trust Game, the present study aimed to clarify the equivocal relationships between depression, trust and altruistic cooperative behaviors, whilst taking into consideration the potentially confounding effects of trait propensity to trust and locus of control. In the new version of Trust Game, each pair of participants played the role of an investor and a trustee respectively. The investor player first receives an endowment of a given amount of money and decides how much he/she would like to invest. The invested endowment is then tripled and given to the trustee, played by the other participant who decides how much repayment he would like to return. This procedure is repeated for 10 rounds, trust behavior and altruistic cooperative behavior are then quantified as the averaged invested endowments and repayments, respectively. Results revealed that depressive symptoms negatively predicted invested endowments (i.e., the trust behavior) after the trait propensity to trust was controlled for, but a positive relationship between depressive symptoms and repayments (i.e., the altruistic cooperative behavior) was found, which was significantly moderated by the external locus of control. Specifically, in those with higher scores in externality, depressive symptoms actually resulted in a decrease (rather than an increase) in altruistic cooperation. This work, for the first time, clarified the relationships between depression and trust and altruistic cooperation by introducing trait factors such as propensity to trust and locus of control, providing new insights into exploring the effects of depressive symptoms on social functions.

## Full Text

### Preamble

#### Damage Trust but Increase Cooperation? Putting Depression in Trust Game Lens

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Depression is theoretically associated with poor social functioning and social impairments, but empirical evidence for poor trust or cooperative behavior among depressed patients is scarce and severely under-researched. Using a revised version of the Trust Game, the present study aimed to clarify the equivocal relationships between depression, trust, and altruistic cooperative behaviors, while taking into consideration the potentially confounding effects of trait propensity to trust and locus of control. In this new version of the Trust Game, each pair of participants played the roles of investor and trustee, respectively. The investor first received an endowment of a given amount of money and decided how much to invest. The invested endowment was then tripled and given to the trustee, who decided how much repayment to return. This procedure was repeated for 10 rounds, with trust behavior and altruistic cooperative behavior quantified as the average invested endowments and repayments, respectively. Results revealed that depressive symptoms negatively predicted invested endowments (i.e., trust behavior) after controlling for trait propensity to trust, but a positive relationship between depressive symptoms and repayments (i.e., altruistic cooperative behavior) was found, which was significantly moderated by external locus of control.

Specifically, among those with higher externality scores, depressive symptoms actually resulted in a decrease (rather than an increase) in altruistic cooperation. This work, for the first time, clarified the relationships between depression and both trust and altruistic cooperation by introducing trait factors such as propensity to trust and locus of control, providing new insights for exploring the effects of depressive symptoms on social functions.

Depression, a common mood disorder, is widely regarded as one of the most prevalent harmful mental illnesses. For example, Major Depressive Disorder (MDD) affects approximately 4.3% of people worldwide according to the World Health Organization. In China, the prevalence rate of depression has also been rising in recent years (World Health Organization, 2017). The main symptoms of major depression include low mood, anhedonia, and are always accompanied by changes in cognitive, physical, and social functions, causing fundamental

damage to daily life and normal social functioning (American Psychiatric Association, 2013).

Depression is often associated with impaired social functioning (Kupferberg, Bicks, & Hasler, 2016) and less fulfilling social interactions (Cruwys, Haslam, Dingle, Haslam, & Jetten, 2014; Santini, Koyanagi, Tyrovolas, Mason, & Haro, 2015). Many studies have pointed out that it is difficult for people with depression to establish close relationships with others (Wehebrink, Koelkebeck, Piest, de Dreu, & Kret, 2018), and that reduced trust can weaken the buffering effect of social support on depression (Hardin, Lee, & Moore, 2018; Wickham, Taylor, Shevlin, & Bental, 2014). Consequently, the mood regulation of depressed patients can be affected, further leading to the development and maintenance of depressive symptoms (Marroquín & Nolen-Hoeksema, 2015).

Although trait propensity to trust is an important social psychological factor related to depression, studies that have adopted economic games to investigate the trust behavior of depressed patients are rare, and conclusions regarding the relationship between depression and trust behavior remain inconsistent. Some studies found that depressed patients displayed less trust behavior in economic games (Wehebrink et al., 2018), while others failed to find differences in trust behavior between depressed patients and healthy individuals (Unoka, Seres, Áspán, Bódi, & Kéri, 2009). One possible explanation for this inconsistency may be that trust behavior is affected not only by depressive symptoms but also by propensity to trust (Evans & Revelle, 2008), a factor ignored by the studies above.

Moreover, scholars have highlighted that depressive symptoms could increase individuals' cooperative altruistic behavior (Batson, 2011; Destoop, Schrijvers, De, Sabbe, & De Bruijn, 2012). They believe that depressive mood is often accompanied by prosocial emotions such as guilt and self-blame, which promote empathy toward others and enhance cooperative altruism. However, this positive linear relationship has only been replicated in some studies with samples of depressed patients in remission (Ong et al., 2017; Pulcu et al., 2015). Some challenging studies have revealed that both depressive symptoms (Clark, Thorne, Hardy, & Cropsey, 2013) and depression (Pulcu et al., 2015) result in reduced cooperative altruism.

Individual differences such as perceived control provide a plausible explanation for this complex depression-altruistic cooperation relationship. Depressed patients often experience low perceived control, including feelings of despair and helplessness (Cheng, Cheung, Chio, & Chan, 2013). Many studies have consistently found that individuals with a lower sense of control display typical external control-oriented behaviors, and those who believe that external factors rather than themselves determine how they live tend to show fewer choices of positive cooperation (Boone et al., 2002; Lefcourt, 2013). Therefore, despite the fact that emotional experiences such as guilt and self-blame can promote empathy and altruism, this promotion may be inhibited in patients with low perceived control and external control. Indeed, more evidence shows that de-

pressed patients have a stronger sense of morality and altruism than healthy people, but they cannot manage to transform these intentions into actual altruistic behavior (Morris & Kanfer, 1983; Pulcu et al., 2015). Since external control can reduce the motivation for an individual's active efforts, it might also be a key factor hindering the transformation between cooperation intentions and actual action. In this respect, we speculated that locus of control can moderate the relationship between depressive symptoms and cooperative altruistic behavior.

This study aims to explore the relationship between depression, trust behavior, and cooperative altruistic behavior, and further examine the impact of trait propensity to trust and locus of control on this relationship through the Trust Game, a validated and widely used socio-economic decision-making task. In this game, each pair of participants played as an investor and a trustee in a virtual investment game. On each round, the investor received an endowment of a given amount of money and decided how much to invest. The invested endowment was then tripled and given to the trustee, who decided how much repayment to return. This procedure was repeated for multiple rounds. Trust behavior and altruistic cooperative behavior were quantified as participants' invested endowments and repayments, respectively (Clark et al., 2013; Ong et al., 2017). Finally, participants completed questionnaires. We hypothesized that: 1) depressive symptoms would negatively predict invested endowments (i.e., trust behavior) after controlling for trait propensity to trust; 2) depressive symptoms would positively predict repayments (i.e., cooperative altruism behavior), and this relationship would be weakened by external-oriented locus of control.

## 1.1 Participants

Twenty-four male and 29 female participants from Mainland China were recruited online. Their average age was 20.75 years ( $SD = 1.8$ ), and none had a history of neurological disorders or psychosis. Seventeen participants scored above 13 on the BDI scale, indicating some level of depression.

## 1.2 Questionnaires

We adopted Chinese versions for all measures following the commonly used translation-back-translation procedure (Brislin, 1970).

**Depression.** Depression was measured using the widely used Beck Depression Inventory-II (BDI-II; Beck et al., 1967), which consists of 21 items rated on a 4-point scale ranging from 0 (not at all) to 3 (extremely). The Cronbach's alpha was 0.91.

**Anxiety.** Anxiety was measured using the Generalized Anxiety Disorder Scale (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006), which consists of 7 items. Participants rated each item on a 4-point scale ranging from 0 (not at all) to 3 (almost every day). The Cronbach's alpha was 0.94.

**Interpersonal Trust.** We measured trait propensity to trust using 25 items from the Interpersonal Trust Scale developed by Rotter (1967), rated on a scale from 1 (completely agree) to 5 (completely disagree). The Cronbach's alpha was 0.65.

**Locus of Control.** We measured internality and externality using the Internality, Powerful Others, and Chance Scale (IPC; Levenson, 1981), which comprises three subscales with 8 items each ( $\alpha = 0.75, 0.84, \text{ and } 0.74$ , respectively). Respondents rated each item on a 6-point Likert-type scale ranging from 1 (extremely disagree) to 6 (extremely agree). Higher scores on the Internality subscale indicated an internal orientation, while higher scores on the Powerful Others and Chance subscales indicated an external orientation.

### 1.3 Trust Game

The task was adapted from the investment/trust game (Berg et al., 1995). Unlike computer-programmed games used in previous studies, we conducted a “face-to-face” game with two unacquainted participants to explore their trust and cooperative behaviors in a more ecologically valid setting.

Each pair of participants played the roles of investor and agent, respectively, completing 10 rounds together. The order of roles was randomized and balanced. In each round, the investor (trustor) received a monetary endowment of 10 and decided to invest a portion of the money  $X$  ( $0 < X \leq 10$ ) with the agent (trustee). The invested endowment was then tripled to  $3X$  and given to the agent, who decided how much money  $Y$  ( $0 \leq Y \leq 3X$ ) to return to the investor. After each round, the investor's total was  $10 - X + Y$ , and the agent's total was  $3X - Y$ . This procedure was repeated for 5 rounds, after which roles were exchanged for another 5 rounds. Consistent with previous studies, the amount of money returned to the investor was unknown until the final round.

In this study, trust behavior was operationalized as the investment amount, with more money invested indicating greater trust in others; cooperative altruistic behavior was operationalized as the repayment rate ( $Y/3X, X \neq 0$ ), with a higher rate representing more cooperative behavior.

### 1.4 Procedure

Fifty-four college students were recruited in pairs. Each pair of participants first completed a comprehensive online questionnaire assessing depression (BDI-II), anxiety (GAD-7), locus of control (IPC), and demographic information. They were then instructed to play the Trust Game. During the Trust Game, each pair of participants played as Investor and Trustee in a virtual investment game. In each round, the Investor received an endowment of a given amount of money and decided how much to invest. The invested endowment was then tripled and given to the Trustee, who decided how much repayment to return. This procedure was repeated for 5 rounds, after which roles were exchanged for another 5 rounds.

Finally, participants completed the Interpersonal Trust questionnaire. The two participants were prohibited from meeting or communicating throughout the entire process.

## 1.5 Data Analysis

We performed descriptive statistical analysis of the relationships between demographic variables, questionnaire measures, and behavioral indicators. Hierarchical regression analysis was used to examine the relationship between depressive symptoms and trust behavior. The SPSS PROCESS macro program (Hayes, 2013b) was used to analyze the moderating effects of locus of control on the relationships between depression, trust, and cooperative behavior. The normality of the data distribution was tested using the Shapiro-Wilk test. The significance level for all statistical analyses was set to  $\alpha =$

## 2.1 Descriptive Statistical Analysis

Descriptive statistics revealed that depression was positively related to anxiety and internal control ( $p < 0.01$ ) while negatively related to investment and external control ( $p < 0.01$ ). Investment was positively related to trait trust ( $p < 0.05$ ) and cooperative altruistic behavior, though the latter relationship was not statistically significant. Cooperative altruistic behavior was positively related to internal control ( $p < 0.05$ ) and negatively correlated with external control, especially with powerful others ( $p < 0.01$ ). Trait trust and anxiety were also positively related ( $p < 0.01$ ), but neither was related to cooperative altruistic behavior. The means, standard deviations, and correlation coefficients for each major variable are shown in Table 1 .

## 2.2 Depressive Symptoms and Investment Behavior

A hierarchical regression model was used to analyze the relationship between depressive symptoms and investment behavior. In the first step of this analysis, demographic variables (gender and age) were included. Correlation analysis showed that investment amount was related to trait trust, and depressive symptoms were also related to anxiety symptoms. To control for differences in anxiety symptoms and trait trust tendencies among subjects, anxiety and trait trust were added in the second step. In the third step, the model incorporated depressive symptoms. The results showed that after controlling for demographic variables, anxiety symptoms, and trait trust scores, higher levels of depression predicted less investment, indicating that depressive symptoms can reduce trust behavior ( $B = -0.40$ ,  $t(48) = -2.49$ ,  $p < 0.05$ ,  $R^2 = 0.33$ ). The results of the hierarchical regression are shown in Table 2 .

### 2.3 The Moderating Role of the Locus of Control

Using the moderation analysis method proposed by Hayes (Hayes, 2013a) and adopting a percentile-based confidence interval, bootstrap resampling was set to 5,000 iterations with a 95% confidence interval. With depressive symptoms as the independent variable, return rate as the dependent variable, and powerful others orientation (external control tendency) as the moderator, the moderation effect analysis showed that the moderating effect was significant ( $R^2 = .517$ ,  $p < 0.01$ ), and depressive symptoms significantly predicted return rate: higher depression levels predicted higher return rates ( $B = 0.446$ ,  $t(43) = 4.415$ ,  $p < 0.001$ ). In addition, the interaction between external control tendency and depressive symptoms was also significant ( $B = -0.014$ ,  $t(43) = -4.700$ ,  $p < 0.001$ ). Moreover, the model remained significant after controlling for demographic variables and anxiety symptoms ( $R^2 = 0.551$ ,  $p < 0.001$ ).

Further simple slope analysis (Aiken, West, & Reno, 1991) examined the relationship between depressive symptoms and cooperative altruistic behavior at high (+1 SD) and low (-1 SD) levels of external control propensity. The results demonstrated that depressive symptoms significantly weakened cooperative altruistic behavior ( $B = -0.114$ ,  $t(9) = -4.002$ ,  $p < 0.001$ ) when external control tendency was higher. When external control tendency was lower, depressive symptoms enhanced cooperative altruistic behavior ( $B = 0.040$ ,  $t(8) = 1.720$ ,  $p = 0.09$ ), though this effect was not significant.

### Discussion

This study examined the relationships between depressive symptoms, trust behavior, and cooperative altruistic behavior using a novel Trust Game paradigm. Consistent with previous studies (Wehebrink et al., 2018), depression symptoms showed a negative relationship with trust behavior, indicating that depressed individuals tend to express less trust in social interactions. Further regression analysis revealed that trust behavior is affected not only by depressive symptoms but also by trait propensity to trust. With trait trust controlled, the predictive effect of depressive symptoms on trust behavior remained significant, and the predictive power of the regression model was substantially improved ( $\Delta R^2 = 0.113$ ,  $p < 0.05$ ). This finding provides a possible explanation for the null results of some past studies (Unoka et al., 2009) in which the effects of depressive symptoms on trust behavior might have been confounded by individual differences in trait trust.

Previous studies found that patients with depression during remission showed more cooperative altruistic behavior than healthy individuals (Ong et al., 2017; Pulcu et al., 2015), whereas patients in a depressive episode showed the opposite effect: their cooperative altruism was not significantly different from that of healthy individuals (Clark et al., 2013). The present study found no significant correlation between depression symptoms and cooperative altruistic behavior.

However, further regression analysis showed that the relationship between de-

pressive symptoms and cooperative altruistic behavior was moderated by external control tendency. Specifically, when individuals' external control tendency was stronger, the effect of depression on cooperative altruism was weakened or even reversed, and vice versa. These findings suggest that depression indeed promotes cooperative altruism, but this effect is inhibited by an external locus of control. This result is consistent with the view that externally controlled individuals show less tendency to cooperate when they need to make active choices (Boone et al., 2002), and that depressed patients fail to transform their intrinsic moral and altruistic intentions into external prosocial behaviors (Morris & Kanfer, 1983; Pulcu et al., 2015).

One surprising finding that warrants discussion is that depressive symptoms were negatively related to external control tendency. A recent meta-analysis demonstrated that depression was positively related to external control tendency, but many other studies have not found the same pattern or have even found the opposite (Cheng et al., 2013). Thus, it is clear that depressive symptoms do not simply impair or promote control tendency. For example, symptoms of hopelessness and helplessness were found to be positively related to external control—a belief that life circumstances are determined by others or environmental factors rather than oneself—whereas other symptoms such as self-accusation and guilt were positively related to internal control—a belief that life circumstances are determined by oneself (Abramson & Sackheim, 1977). The ambiguous relationship between depressive symptoms and locus of control, as well as the influence of perceived control on cooperation, may together account for the contradictory conclusions regarding the depression-cooperation relationship in previous studies.

Some limitations should also be addressed. The primary drawback concerns the sample size. Although post-hoc statistical power analysis showed that the observed power of the regression analysis in this study was greater than 0.8, future studies should replicate our findings with larger sample sizes. Another limitation relates to sample characteristics. All participants in this study were college students of similar ages, which was intended to avoid the problem of high heterogeneity in clinical samples. Future research should include more diverse and clinical samples to verify the generalizability of these results.

## Conclusion

Depression is often accompanied by impaired social functioning and reduced interpersonal interactions. However, previous research had not reached consistent conclusions regarding the effect of depression on trust behavior and cooperative altruistic behavior. For the first time, the present work clarified the equivocal relationships between depression and both trust and altruistic cooperation by introducing trait factors such as propensity to trust and locus of control. Our results showed that depressive symptoms can impair trust behaviors independently of trait propensity to trust. Moreover, elevated depressive symptoms may enhance altruistic cooperative behaviors, but only in those who believe

that life can be controlled by themselves. Our findings also provide broader insights for research on social functioning in depressive disorders. Given the complexity and variability of depressive symptomatology, it is unlikely that depression affects trust and cooperation through simple impairment or promotion. Rather, different depressive symptoms may have different effects on social functions. For example, guilt and self-blame may promote intentions of altruistic cooperation, while symptoms associated with externality such as hopelessness and despair may hamper the transition of these intentions to actual altruistic cooperative behaviors. Further studies are needed to examine the relationships between specific depressive symptoms and trusting/cooperative intentions and behaviors.

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