

THE RELATION BETWEEN ADOLESCENT DEPRESSION
AND INTERPERSONAL TRUST

A Thesis

Presented to

The Faculty of the Department

of Psychology

University of Houston

In Partial Fulfillment of

The Requirements for the Degree of

Master of Arts

By

William Mellick

August, 2014

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ABSTRACT

Depression has been conceptualized as a highly interpersonal illness. In the study of social cognition, behavioral economic games (or games of social exchange) provide a novel means to examine interpersonal relations in individuals with psychological disorder. Recently, there have been several behavioral economic studies of adult depression, and the current study downwardly extends this investigative approach to adolescent depression. $N = 76$ age-matched adolescent girls (depressed inpatients, $n = 38$; healthy controls, $n = 38$) played a modified version of the trust game to examine the prospective relations between adolescent depression and interpersonal trust. Depressed girls were found to make significantly larger mean investments in the trust game, as compared to healthy controls. This relation between depression and excessive trust was similarly found using another measure of depression by which the total sample was divided into groups based on severity of depressive symptoms. Severely depressed girls made significantly larger mean investments in the trust game, as compared to minimally depressed girls. Linear regression analyses revealed dimensional scores from the YSR affective problems scale to be a significant predictor of trust game performance. While further replication is needed, these preliminary findings suggest that adolescent depression may be characterized by excessive trust.

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The importance of the problem

Major depression has been ranked by the World Health Organization (WHO) as one of the most pressing global health concerns as evidenced by prevalence rates of 16.2% lifetime and 6.6% for 12-months, respectively (Kessler et al., 2003). Major depressive episodes are highly recurrent with more than 75% of individuals experiencing at least one subsequent episode, often within two years' time (Boland & Keller, 2009). Depression commonly emerges during adolescence (Forbes & Dahl, 2012), particularly between ages 11 and 14 (Lewinsohn, Rohde, & Seeley, 1998), with increasing prevalence in mid- to late- adolescence (Hankin, et al., 1998). An estimated 11.2% of adolescents are currently experiencing depression, of which 74.4% are reported as severe (Merikangas et al., 2010), and adolescent depression strongly predicts depression in adulthood, even among adolescents with sub-clinical depressive symptoms (Pine et al., 1999). Moreover, impairment during adolescence has adverse implications for future social cognitive and psychosocial functioning in occupational, interpersonal, and well-being domains (Lewinsohn et al., 2003). As adolescence is such a sensitive developmental period, a greater understanding of adolescent depression is imperative for more effective clinical treatment of depression across the lifespan.

Depression is an interpersonal illness

The interpersonal dysfunction associated with depression has led theorists to consider depression primarily as an interpersonal illness. Coyne (1976) posited that the very nature of the depressed individual greatly impairs interpersonal relations, which often result in rejection, and these troubling relationships further perpetuate the disorder. Coyne's landmark study found that healthy subjects who interacted with depressed individuals were significantly more depressed, anxious and hostile post-interaction, and were more rejecting of depressed individuals overall.

They described them as wishing to appear sadder, less pleasant, more negative, more uncomfortable, low, and passive. Results have been corroborated in other adult studies (Winer, Bonner, Bianey, & Murray, 1981; Boswell & Murray, 1981; Mullins, Peterson, Wonderlich, & Reaven, 1986; Strack & Coyne, 1983), and subsequent studies have since explored interpersonal deficits among depressed youth.

Through an observational study of depressed children, Altmann and Gotlib (1988) found that the social behavior of depressed children was exemplified by more frequent attempts at social contact while being approached more frequently, and these social interactions elicited more negative reactions resulting in greater time spent alone. The more frequent approaching of others was attributed to the fact that depressed children were alone more often and hence open to new social encounters, rather than a measure of popularity. In the evaluation of interpersonal style, Baker, Milich, and Manolis (1996) found dysphoric adolescent girls to be rated more negatively overall, making more critical comments about their peers, evoking more negative reactions, and negatively influencing their peers' behavior, all of which contributed to a greater likelihood of rejection. The pervasive negativity found in depressed adolescents' social interactions, not surprisingly, make them less likely to be rated as popular in their peer group (Connolly et al., 1992). Furthermore, frequent social rejection inevitably results in the depressed youth's negative perception of their social competence (Altmann & Gotlib, 1988; Baker, Milich, & Manolis, 1996; Lee, Hankin, & Mermelstein, 2010; Segrin, 2000). Though this negative self-perception may wane in remission, peers often still have an unfavorable view of the individual which may serve as a stressor for future episodes (Joiner, Coyne, & Blalock, 1999). As stress in depression has been shown to increase attempts at social contact (Altmann & Gotlib; Coyne, Aldwin, & Lazarus, 1981) and social interactions are often negative and rejecting (Coyne, 1976;

Altmann & Gotlib, 1988; Baker et al., 1996; Winer et al., 1981; Boswell & Murray, 1981; Mullins et al., 1986; Strack & Coyne, 1983), these interpersonal difficulties appear to be instrumental in the maintenance of depression.

Social cognition in depression

Given the strong interpersonal nature of depression, researchers have naturally looked to social cognition to explain the interpersonal difficulties associated with depression. Social cognition refers to the mental processes involved in perceiving, attending to, remembering, thinking about, and making sense of the people in our social world (Moskowitz, 2005), or the ability to understand ourselves and others as individuals with beliefs, feelings and personality (Mitchell, Macrae, & Banaji, 2004). The importance of these skills cannot be understated as they are essential for successful interpersonal functioning in that they provide a basis for understanding intentionality and predicting behavior (Brothers, 1990 as cited by Dziobek et al., 2006). Social cognition serves as an umbrella term for a variety of constructs (see Sharp & Fonagy, 2008 for a discussion) each being derived from a different theoretical and conceptual tradition. For the sake of brevity, the following discussion of social cognitive impairment in depression will focus on just two disrupted areas; cognitive processing and the ability to understand the emotions, beliefs, and intentions of others.

As the development of one's social cognitive capacity is closely tied to emotion (Adolphs, 2001), the affective dysfunction in depression can lead to a wide range of deficits (Tavares, Drevets, & Shahakian, 2003). One predominant feature of depression is a negatively biased cognitive processing style in which negative stimuli are elaborated upon, more difficult to disengage from, and associated with deficits in cognitive control (Gotlib & Joorman, 2010). Several studies have linked depression to this negative attentional bias (Tavares et al., 2003;

Kyte, Goodyer, & Sahakian, 2005; Gotlib et al., 2004) which is proposed to be instrumental in developing and maintaining depressive symptoms (Knuston, Bhanji, Cooney, Atlas, & Gotlib, 2008). No doubt, these negative biases have implications in the appraisal, interpretation, and construction of interpersonal events within the depressed individual's social world.

Depression has also been associated with impaired ability to understand the emotions, beliefs, and intentions of others. Regarding the ability to understand others' emotions, in terms of identifying facial affect, depressed individuals have been shown to exhibit a bias toward negative emotion, while misconstruing depictions of neutral affect as negative (Mandal & Bhattacharya, 1985; Gollan, Pane, McCloskey, & Coccaro, 2008; Leppänen, Milders, Bell, Terriere, & Hietanen, 2004). Longer response times for viewing negative faces have also been reported in depressed subjects (Gollan et al., 2008). These results appear to be fairly cohesive, at least within this methodology, but other research examining these depressive biases have led to discrepant findings. For example, although some studies using the Reading the Eyes in the Mind Task (REMT: Baron-Cohen et al., 2001), which requires one to determine the emotion of another based solely on the expression of their eyes, have shown significant impairment in depression (Lee, Harkness, Sabbagh, & Jacobson, 2005; Wang, Wang, Chen, Zhu, & Wang, 2008), while others studies suggest typical functioning in depression (Kettle, O'Brien-Simpson, & Allen, 2008; Wolkenstein, Schonenberg, Schirm, & Hautzinger, 2011). Despite some discrepancy across methods, these findings generally speak to the enhanced salience and elaboration of negative emotion within an interpersonal context.

In respect to the understanding of others' beliefs and intentions, deficits in depression have also been noted. Using a cartoon picture story with supporting questions, Inoue, Tonooka, Yamada, and Kanba (2004) found that remitted depressed participants were capable of

understanding others' beliefs, but showed impairment in their understanding others' intentions as evidenced by significantly poorer performance on a second-order false belief task. Expanding on these findings, using a cartoon story task with individuals experiencing depression, Zobel et al. (2010) found impairment across a spectrum of social-cognitive processes (i.e., understanding others' belief, intentions, and so forth). These findings suggest that a range of deficits in the skills required for healthy interpersonal functioning are present in depression, during episodes and in remission. Other studies with more ecologically valid tasks have led to mixed results. The Movie for the Assessment of Social Cognition (MASC: Dziobek et al., 2006) assesses the ability to contextually integrate a real-world social scene, and some studies utilizing this task have found impaired social reasoning in depression (Wolkenstein et al., 2011) while others have found no such deficits (Wilbertz, Brakemeier, Zobel, Harter, & Schramm, 2010).

Taken together it is clear that valuable research has been conducted to investigate the social-cognitive impairment associated with depression, using more traditional social cognitive paradigms as discussed above. While important, collectively, this body of literature is characterized by inconsistent findings, small effect sizes, and low predictive validity. Several theoretical and methodological limitations of traditional social cognitive measurement approaches have been identified (Sharp, 2012). First, these approaches fail to capture the dynamic interpersonal nature of social cognition and, given that they are largely hypothetical, are unlikely to fully gain participants' emotional and behavioral investment. Second, these approaches typically consider social cognition occurring within a single individual, rather than as an interaction between two or more individuals. Third, they are not administered in real-time, fail to sample real social interactions, and do not allow for the development of mathematically tractable models of social interaction. Since deficits in social cognition have been shown to be

highly predictive of relapse (Inoue, Yamada, & Kanba, 2006), the utilization of more ecologically valid measures is essential. To this end, the aforementioned limitations of more traditional social cognitive approaches can be accounted for by the use of behavioral economic games, which are discussed below.

Behavioral economic games as an investigative measure of social cognitive function in depression

Neuroeconomics is a relatively new multidisciplinary field that incorporates elements of behavioral economics, psychology, and neuroscience in an attempt to reveal the underlying processes of decision making in social and non-social contexts. Recently, the potential of neuroeconomics to provide a valuable alternative to traditional social-cognitive approaches has been explicated (Sharp, 2012; Sharp, Monterosso, & Montague, 2012). Central to the neuroeconomic approach is the use of behavioral economic games, which when combined with neuroimaging techniques are able to connect brain activity, behavior, and decision algorithms for the development of mathematically tractable models of social decision making processes; thus, allowing for multiple levels of analysis (Sharp, 2012). There are a variety of behavioral economic games that have been used in the study of social decision making, but for the purposes of the proposed study, we focus on the trust game, the ultimatum game, the dictator game, and the prisoner's dilemma. See table 1 for descriptions of games.

Through the manipulation of specific features of behavioral economic games (i.e., rules, currency, or context) researchers can investigate a variety of constructs that govern social cognition and social decision making: fairness, trust, reciprocity, intention consideration (intentionality), and pro-social behavior, among others. The utilization of behavioral economics to study social cognition allows for the same experimental stimuli to be used across different age

groups and lines of inquiry (Gummerum, Hanoch, & Keller, 2008), and numerous studies have examined social decision making with these tasks in typical child and adolescent development (Berg, Dickhaut, & McCabe, 1995; Murnighan & Saxon, 1998; Benenson, Pascoe, & Radmore, 2007; Belli, Rogers, & Lau, 2012; Fehr, Bernahrd, & Rockenbach, 2008; Goroglü, van den Bos, & Crone, 2009; Gummerum, Keller, Takezawa, & Mata, 2008; Harbaugh & Krause, 2000; Sally & Hill, 2006); however, little research has utilized these tasks in the study of developmental psychopathology.

Results from behavioral economic research in adults support the notion that social decision making is driven by emotional response (Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003), and it has been suggested that brain function in depression may be especially disrupted in the social domain (Forbes & Dahl, 2005). Since neuroeconomic games offer researchers the opportunity to identify the aberrant neural underpinnings of social pathologies as they are activated within a real-world social context (Rilling, King-Casas, & Sanfey, 2008), the interpersonal nature of depression lends itself worthy of exploration.

Behavioral economic findings: Social decision making in a transient sad mood versus the enduring negative mood found in depression

While few studies have used behavioral economic games to examine the role of chronic depressed mood in social decision making, several studies have assessed the role of transient sad mood state, via mood induction, in healthy individuals. Although these sad mood states are not necessarily equivalent to depression, they may recruit similar neural systems (Harlé & Sanfey, 2007) and such research is relevant in the discussion of depression. Moreover, comparison of the decision making of healthy versus depressed individuals may shed light on the underlying processes within both groups.

Collectively, in the ultimatum game, induced sadness with healthy participants acting as responders has resulted in higher rejection rates for unfair offers (Forgas & Tan, 2012; Harlé & Sanfey, 2007; Harlé et al., 2012; Meretti & di Pellegrino, 2010), which, in turn, elicit a greater negative emotional response (Harlé, et al., 2012). However, sad mood does not appear to be of influence in the acceptance rate of fair offers (Forgas & Tan, 2012; Harlé & Sanfey, 2007). In the dictator game, Tan and Forgas (2010) found that induced positive mood was negatively correlated to the amount allocated, representing an increase in selfishness. In contrast, negative mood was indicative of a greater sense of fairness and a more even allocation between players.

Harlé, Allen, and Sanfey (2010) conducted the first study to use the ultimatum game with depressed participants ($n = 38$; depressed = 15), placing them in the role of responder. In response to unfair offers, depressed participants exhibited a stronger negative emotional reaction than healthy controls and reported significantly higher levels of disgust and anger. Despite these negative emotions, they accepted more unfair offers (61% vs. 41% accepted, respectively), which resulted in greater total in-game earnings, \$50.30 for depressed vs. \$43.02 for controls. This economic gain may be explained a more “realistic” perspective of the impact of their decisions on game outcome (Harlé et al., 2010). While these findings replicate the negative emotional arousal found in transient sad mood, the acceptance of unfair offers of depressed individuals differs from the higher rejection rates of healthy participants.

Using a modified version of the ultimatum game, with a larger clinical sample ($n = 61$; depressed = 39), Destoop, Schrijvers, De Grave, Sabbe, De Bruijn (2012) had participants act as both proposer and responder with the same opposing player. As proposers, depressed participants showed greater fairness than healthy controls, but as responders they did not differ in their acceptance rates of offers. This implies that depressed individuals are just as capable of making

social decisions based on considerations of fairness (Destoop, et al., 2012); however, this may have been contingent on the sample being medicated. Regardless, the fact that results of this study conflict with the findings of Harlé et al (2010) implies that further investigation is needed.

In an extension of the basic trust game, Unoka, Seres, Áspán, Bódi, and Kéri (2009) investigated the interpersonal risk-taking (trust) and general risk-taking (lottery) behavior of patients with borderline personality disorder (BPD), major depressive disorder (MDD), and healthy controls. The sample ($n = 75$) was divided evenly with 25 participants per group. Participants played the game with two conditions. In the first condition, they were asked to invest any number of 12 points to a partner whom they believed were playing the game with them over the internet. In the second condition, they were asked to invest any number of 12 points in a lottery. In both conditions 5 trials were run. Results showed MDD patients did not differ from controls in their investment strategy in either game (trust game: $t(48) = -0.58, p = 0.56$; risk game: $t(48) = 0.14, p = 0.89$), and the three-way interaction (group, game type, and transactions) between groups was found to be non-significant ($p > 0.5$). Furthermore, both groups showed a similar linear trend of increased investment across the 5 transactions of each game. Although MDDs did exhibit increased investment in the trust game (6.5 vs. 6.1 monetary units transferred), the difference lacked significance. Lastly, MDD patients predicted a less favorable outcome in the lottery condition when compared with controls, which is consistent with prior studies linking negative mood with risk-aversion (Yuen & Lee, 2003; Grable & Roszkowski, 2008). The trust game findings, with MDD patients failing to differ from controls, may imply that depressed individuals do in fact trust in the cooperativeness of others (Unoka et al., 2009). It should be noted that 20 members of the MDD group were comorbid with other personality disorders; histrionic ($n = 11$), dependent ($n = 5$), avoidant ($n = 2$), and dependent and

avoidant ($n = 2$). The extent of which this comorbidity may have blurred the findings is unknown. Despite the null findings, results are preliminary and a depressed adolescent sample may prove to use different investment strategies across these two conditions.

Using a modified version of the Prisoner's Dilemma (PD), Hokanson, Sacco, Blumberg, and Landrum (1980) manipulated the relative social power (e.g., high vs. low) of participants, both depressed and non-depressed/other psychological problems, as they played the game with healthy same-sex partners. The goal of the study was to extend previous research characterizing the interpersonal deficits of depression, along with the reaction of others in social interactions. When depressed individuals were in a high-power role (with knowledge of the other player's choice), the game was characterized by non-cooperative and exploitive interactions. Additionally, depressed players were more communicative of their negative emotions (self-devaluation-sadness and helplessness), which elicited non-cooperativeness, extrapunitiveness, and helplessness in their healthy partners. Conversely, in a low-power role (lacking information about the other player's response), depressed player performance did not differ but they did communicate helplessness and self-devaluation while blaming their healthy partners for their condition which elicited ingratiation, perhaps serving to reinforce their interpersonal style. In a later adult study, Haley and Strickland (1986) used the PD game to determine how positive and negative social interactions affect the cognitive schemata of depressed women, focusing on self-evaluative processes. Results showed that women with elevated depressive symptoms reacted more aggressively following betrayal, reporting greater hostility, anxiety, and depression. Regardless of the game outcome (betrayal or positive interaction) depressed participants were more self-critical (although it did not affect performance), and this self-evaluative style appears to be enhanced during interpersonal interactions.

To summarize, as proposers in the ultimatum game, depressed adult participants have shown greater fairness in their allocation strategy, which is similar to the greater fairness of sad healthy participants in the dictator game. As responders in the ultimatum game, when presented with unfair offers both sad healthy and depressed participants respond with increased negative emotional arousal. However, their behavioral response to unfair offers differs. Sad healthy participants reject more unfair offers, while findings with depressed participants are mixed. Harlé et al. (2010) found that depression leads to the acceptance of more unfair offers, while Destoop et al. (2012) found no such difference. In a multi-round trust game, no significant differences between depressed participants and healthy controls were observed (Unoka et al., 2009). In the PD game, depressives responded with negative emotions during both cooperation and defection, and were characterized by self-devaluation and helplessness, while projecting more blame (Hokanson, Sacco, Blumberg, & Landrum, 1980) and greater hostility during betrayal (Haley & Strickland, 1986).

The downward extension of behavioral economic games to study depression in adolescents

In the downward extension of the PD, McClure et al. (2007) studied youth with internalizing disorders (clinically-diagnosed), comparing adolescents with anxiety/depressive disorders (A/D) and healthy counterparts in terms of performance and emotional response. Following co-player cooperation A/D adolescents were significantly more likely to cooperate; however, the groups did not differ following co-player defection. In terms of emotional response, A/D girls reported more anger than healthy girls. Anger ratings did not differ between A/D girls and A/D boys, nor was there any significant difference between A/D boys and healthy boys for anger ratings. Therefore, A/D girls, but not boys, reported a greater negative emotional response than their healthy same-sexed co-players. Behavioral and self-report measures suggest that while

A/D adolescents were more cooperative, their emotional responses were not typical of cooperative engagement. Rather, they were more indicative of a sociotropic response (e.g. seeking acceptance from others) paired with an anxiously depressed presentation (Robins, Bagby, Rector, Lynch, & Kennedy, 1997 as cited by McClure et al., 2007), suggesting they cooperate but they do not feel good doing it.

A follow up study by McClure-Tone et al. (2011) again revealed atypical social decision making with A/D adolescents in the PD game. However, results differed from the initial study. Although A/D was still associated with greater cooperation, this time it was more pronounced following co-player defection whereas before cooperation was only magnified during co-player cooperation. These results may have differed due to the extent of depressive comorbidity in each sample (43% in McClure et al., 2007 versus 23% in McClure-Tone et al., 2011) with generally more anxious adolescents showing greater cooperation in defection. Therefore when studied within a social context, anxiety and depression may be associated with different game playing behavior, and the discrepancy between the two may vary depending on the behavioral economic game and construct(s) it is designed to measure.

To summarize these PD game findings, A/D adolescents were more likely to cooperate (McClure et al., 2007; McClure-Tone et al., 2011), but they reported more anger while doing so (McClure et al., 2007). Anxiety has been associated with substantially greater risk-aversion (Maner et al., 2007) and anger has been shown to elicit greater risk-taking (Fessler, Pillsworth, & Flamson, 2004), so it appears as though pronounced anger in A/D adolescents may have promoted interpersonal risk-taking in the context of the PD (i.e., cooperating when it may not have been preferred).

Taken together, results in studies of social decision making in depression depend on the sample, developmental epoch, and the nature of the specific tasks. However, enough evidence exists to point to anomalies in social decision making associated with depression to warrant further investigation. Utilizing the trust game, the primary aim of the current study was to examine whether depressed adolescents would exhibit excessive trust (as suggested by the findings of Destoop et al., 2012; McClure et al., 2007; McClure-Tone et al., 2011) or reduced trust when playing the game with a peer co-player (as suggested by the findings Rottenberg, 1994). Below, a case is made for the former based on knowledge about the social reorientation that takes place in adolescence.

Excessive trust in depressed adolescents

In normative development, trust increases through adolescence (van den Bos et al., 2010) but decreases and stays rather constant during adulthood (Sutter & Kocher, 2007). This increased trust fits with the seemingly linear shift from self-interest to the consideration of fairness and increased perspective-taking in social decision making (Crone, 2013), which, in turn, results in more pro-social behavior (Eisenberg, Morris, McDaniel, & Spinrad, 2004). From childhood through adolescence, numerous behavioral economic studies support these findings (Lucas, Wagner, & Chow, 2008; Benenson, Pascoe, & Radmore, 2007; Fehr, Bernhard, & Rockenbach, 2008; Sutter & Kocher, 2007; Hoffman & Tee, 2003).

Consistent with other forms of pro-social behavior, van den Bos, Westenberg, van Dijk, and Crone (2010) found that trust and reciprocity generally increase from late childhood through young adulthood, but perceived benefit and risk was highly influential in determining in-game behavior. Overall, there were more trustworthy decisions when there was small risk for the proposer and a greater benefit for the responder. Greater benefit led to increased reciprocity in all

adolescent age-groups, and increased risk resulted in increased reciprocity in the 16 and 22-year old groups alone. It appears as though this increase in trust during adolescence develops concurrently with increases in perspective-taking and intention consideration (Güroğlu, van den Bos, & Crone, 2009). Whereas numerous studies of depression have found deficits in these areas of social cognition (Inoue et al., 2004; Lee et al., 2005; Wang et al., 2008; Wolkenstein et al., 2011), it has yet to be examined whether adolescent depression effects interpersonal trust.

Since adolescence is a time when increased importance is placed on social acceptance (Connolly et al., 1992), the depressed adolescent may exhibit excessive trust during the developmental period in which trusting behavior is already at its peak. The study of how typical and atypical development may intersect to confer risk for psychological disorder is one of the basic tenets of developmental psychopathology (Cicchetti & Cohen, 2006). We expect that since a high degree of trust is characteristic of typical adolescents, a deviation will be found in adolescent depression. Specifically, we propose that in the case of depression excessive trust would be associated with deviation from a normative trajectory as opposed to reduced trust, which appears to be a hallmark feature of externalizing problems (Sharp, 2012; Sharp, Ha, & Fonagy, 2011).

In support of this hypothesis, depressed adults have displayed elevated levels of fairness in the ultimatum game (Destoop et al., 2012), they made higher offers. This increased fairness may be due to a number of reasons, of which we can only speculate. First, this strategy may be driven by risk-aversion (i.e., “If I make a higher offer, there’s a reduced likelihood that it will be rejected,” or “I should take the sure thing, and take less”), and decreased risk-taking has been linked to depression (Yuen & Lee, 2003; Grable & Roszkowski, 2008). Second, this increased fairness may be driven by heightened interpersonal sensitivity (see Boyce et al., 1993). Third,

higher offers may stem from the depressed individuals decreased responsiveness to reward (Henriques & Davidson, 2000; Pizzagalli, Iosifescu, Hallett, Ratner, & Fava, 2009). Lastly, higher offers may be indicative of the depressed individual appreciating any gain over no gain; in the ultimatum game, if a low offer is rejected both players get nothing. In other words, any increase in utility leaves the depressed individual better off, which may conceptually be in accordance with depressed realism (Harlé et al., 2010). Regarding depressed adolescents' performance in the current study, we expected these rationales to contribute to higher investments in the interpersonal context of the trust game. Furthermore, consistent with Unoka et al. (2009), we expected that depressed and healthy participants would exhibit a linear trend of increased investment across the 5 transactions of each game.

The Current Study

The purpose of the current study is to further our understanding of the social-cognitive processes associated with depression in adolescence through a powerful medium, interpersonal trust. To summarize, depression is an interpersonal illness and the way in which the depressed individual navigates their social relationships has been shown to have major implications for present symptoms and future episodes (Lewinsohn et al., 2003). Therefore, studying the interpersonal deficits of depression within a real-world social context is important.

Despite the valuable research thus far exploring social cognition in depression, traditional methodologies typically lack this real-world context and have resulted in inconsistent findings, small effect sizes, and low predictive validity (Sharp, 2012). Behavioral economic games provide a valuable alternative for the study of social cognition, allowing for greater ecological validity and the development of mathematically tractable models in the study of social behavior (Sharp, 2012). Since adolescence is a sensitive developmental period, during which vulnerability

for depression dramatically increases (Hankin et al., 1998; Lewinsohn et al., 1998), elucidating the interpersonal deficits of depression at this time may have great implications as it is such a highly recurrent illness (Boland & Keller, 2009). Despite a lack of research investigating interpersonal trust during adolescence (Szczesniak, Colaco, & Rondon, 2012), this area may provide insight into one of the mechanisms by which depressed adolescents come to experience negative interpersonal interactions. Adolescent girls experience a heightened vulnerability to depression and they more often become depressed than adolescent boys (Rose & Rudolph, 2006). Therefore, examining the relations between depression and interpersonal trust in depressed girls, specifically, is warranted.

Aims and hypotheses

Major aims of the current study were: 1) To compare trust game and lottery condition investment strategies (within and) between depressed adolescent girls and healthy controls; and 2) To explore the relation between severity of depression and investments in the trust game and lottery conditions. A subsidiary and exploratory aim included, 3) An examination of whether self-reported trust correlates with investment in the trust game. Hypotheses for these aims were as follows:

H1a. A main effect of group was expected for the trust game such that depressed girls would invest more on average than healthy controls.

H1b. An interaction effect was expected for group x game type such that depressed girls would invest more points in the trust game and fewer points in the lottery condition, in relation to healthy controls.

H1c. A main effect for trials (time) was expected such that investment, across groups, would increase over the 5 trials of the game.

H1d. No interaction effect for group x trials (time) was expected. Groups' investments would similarly increase over trials.

H2a. Severity of depression (minimal, mild, moderate, and severe) as determined by the BDI-II would be related to increased investments in the trust game.

H2b. Severity of depression (minimal, mild, moderate, and severe) as determined by the BDI-II would be related to decreased investments in the lottery condition.

H3. Self-reported trust behavior would be positively correlated with mean investment across all 5 trials in the trust game.

Methods

Participants

A total of $N = 76$ adolescent girls ($M_{\text{age}} = 14.96$, $SD = 1.17$) were recruited for this study. Two age-matched diagnostic groups were formed among these girls, depressed ($n = 38$) and healthy controls ($n = 38$). The depressed girls, whom scored above clinical cut-off for DSM-IV defined depression, were recruited from an acute inpatient psychiatric unit serving an indigent population in Houston. Many participants recruited from this treatment facility were experiencing acute (or chronic) stress at the time of assessment, $n = 16$ were admitted to treatment for a recent suicide attempt. Healthy controls were recruited from the community, predominantly from a local college preparatory high school. The overall sample was racially diverse, composed of 38.2% Hispanic, 28.9% African-American, 22.4% Caucasian, 7.9% Asian, and 2.6% Multiracial. For participant characteristics by group, please see Table 2 (results section).

Inclusion criteria for the study required participants to be: (a) female, (b) between the ages of 12 and 17, (c) fluent in English, and (d) have adequate capacity to participate. Inadequate

capacity to participate was defined by severe psychosis, mental retardation, or a 4th grade or below reading level (as determined by the Wide Range Achievement Test–Version 4, WRAT-IV; Wilkinson & Robertson, 2006). For healthy control group assignment, girls were required to report no clinically-significant elevations on the YSR, specifically on the Affective Problems (t-score cut-off of 65), Internalizing Problems (t-score cut-off of 65), or Externalizing Problems scales (t-score cut-off of 69); one healthy control girl reported a t-score ≥ 65 on Externalizing Problems. Additionally, all healthy controls were required to score below the cut-off for mild depression on the BDI. In addition to being above cut-off on the YSR affective problems scale, depressed girls were required to be below clinical cut-off for YSR Externalizing problems, given the relations between externalizing disorders and reduced trust (Sharp, et al., 2011). Failure to meet all stated requirements will result in exclusion from the study.

Measures

Trust Game. Originally developed by Berg, Dickhaut, and McCabe (1995), Kosfeld, Heinrichs, Zak, Fischbacher, and Fehr (2005) modified the trust game and the current study uses an extension of that version (Unoka et al., 2009), which has two conditions. The first condition assesses interpersonal trust, and consists of 5 exchanges between the participant and an anonymous peer co-player (fictional) over the internet. In each round, the participant, always acting as the investor, will allocate any number up to 12 points ($X = 12$) to the other player (the trustee). The investor may keep as many points as they desire (x), and send the remaining points ($12 - x$) to the anonymous trustee. As points are sent from the investor to the trustee, they are tripled along the way $3(12 - x)$, and the trustee may then return some or none of the total points for each round. The goal of the game is to earn as many points as possible over the course of the 5 rounds, but participants were not be made aware of their cumulative earnings before

completing the game. Given that the other player is fictitious, there are no cumulative earnings to report, and deception was used.

The second condition is a lottery game which is identical to the trust game, with one modification. Rather than investing with an anonymous player, the participant is investing with a lottery that randomly determines the amount of points to be returned during each round. The goal of the lottery game is the same as the trust game: earn as many points as possible over the course of 5 rounds. The key difference is that the lottery game is a measure of general risk-taking, rather than interpersonal risk-taking (trust game).

Administration. The rules of the trust and lottery games were explained to the participant via power-point presentation, and the assessor asked pertinent questions to ensure sufficient understanding of game rules. The participant was told that they would not know how many points were being sent back to them by the trustee/lottery until after completing the task, and that the goal in each game was to accrue as many points as possible. Prior to administration, the assessor pretended to make contact with a colleague, via phone call or text message, to ensure that the other player was also logged on to the game. Task administration (trust vs. lottery) was counterbalanced, and the participant was informed that the order of games would be randomly determined. The games were played on Inquisit 2.0 software (Seattle, WA) and were designed to mimic an online game. Based on whichever game was played first, instructions were presented to review the rules. The participant was then presented with a screen that confirmed they were connecting to the online game. For example, in the trust game, the message read “Please wait while the other player logs on...” Five trials were played for each game, in which the player made their investment and were then presented with a screen that told to please wait while the other player (or lottery) determines how many points were sent back. Since the games required

deception, participants were debriefed following administration and asked not to share details about the task with others. They remained uninformed of their total earnings from the games.

Youth Self-Report. The Youth Self-Report (YSR; Achenbach & Rescorla, 2001), a questionnaire for use with adolescents between ages 11 and 18, was used to assess depressive symptoms. The self-report measure is composed of 112 problem items, each scored on a 3-point scale: 0 = *not true*, 1 = *somewhat or sometimes true*, or 2 = *very or often true*. Example items include: “I feel that no one loves me,” “I am not liked by other kids,” and “I am unhappy, sad, or depressed.” The Affective problems subscale, with a T-score cut-off of 65, was used to determine girls with clinically-significant depressive symptoms in the psychiatric sample. In addition to the YSR affective problems subscale, YSR Internalizing Problems and Externalizing Problems scales were used to ensure that healthy controls were free from any clinically-significant elevations. The Externalizing Problems scale was also used to ensure that depressed girls did not have any clinically-significant elevations for externalizing problems. In the current study, internal consistency, as measured by Chronbach’s alpha, for these YSR scales was as follows: Affective problems, $\alpha = 0.88$; Internalizing problems, $\alpha = 0.87$; Externalizing problems, $\alpha = 0.90$.

Beck Depression Inventory-II. In addition to the YSR, the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) was used to separate individuals according to severity of depressive symptoms. The self-report questionnaire consists of 21 group statements assessing severity of depressive symptoms, over a prior two-week period, and is aligned with DSM-IV criteria. Nearly all items are rated on a 4-point Likert scale. For example, measuring sadness includes the following responses: 0 = *I do not feel sad*, 1 = *I feel sad much of the time*, 2 = *I am sad all the time*, and 3 = *I am so sad or unhappy that I can’t stand it*. Though not a diagnostic

measure, scores are totaled to indicate depressive symptom severity with specified ranges for minimal (13 or lower), mild (14 to 19), moderate (20 to 28), and severe (29 to 63). Both internal consistency ($r = .92$) and stability ($r = .93$) have been demonstrated to be strong (Beck et al., 1996). In the current study, internal consistency, as measured by Chronbach's alpha, was 0.96.

Rotenberg Trust Scale. Interpersonal trust beliefs were assessed using the children's generalized trust beliefs scale (CGTB; Rotenberg et al., 2005), which was developed according to Rotenberg's three bases of trust: reliability, emotionality, and honesty. The 24-item self-report measure assesses these bases of trust as they apply to four target groups; mother, father, teacher, and peer. For example, an item for peers: "Mark asks Todd to lend him \$1 and he does. The next day, Todd sees mark with a new ball. How likely is it that Mark will pay Todd back?" Responses are reported on a 5-point Likert scale composed of: 1 = *very unlikely*, 2 = *somewhat unlikely*, 3 = *neither likely or unlikely*, 4 = *somewhat likely*, and 5 = *very likely*. The total scale and subscales of the CGTB have demonstrated acceptable internal consistency and stability across time (Rotenberg et al., 2005). In the current study, internal consistency, as measured by Chronbach's alpha, was 0.85.

Procedures

This study was approved by the appropriate institutional review boards. Depressed participants for the study were recruited from the 16-bed adolescent unit of an acute inpatient county psychiatric hospital. On the day of admission, parents were asked to provide consent (in English or Spanish) and if given, adolescents were approached for assent. Since the study required English fluency, adolescents were required to consent in English if they wish to participate. Healthy controls were recruited separately, from the community, through several sources including: advertisements on craigslist; local youth organizations, and other suitable

institutions; and from families who have participated in our lab's research that requested to be contacted for new research opportunities. For both samples, participants were informed that they could withdraw at any time and their participation was completely voluntary. Age-matching of participants (depressed vs. healthy controls) was performed post-data collection, with nearly all of the girls matched with another girl of the same age (in years); the few that remained were matched within one year.

Data analytic strategy

Preliminary analyses. All analyses were performed using SPSS version 18.0 (Chicago, IL). Exploratory analyses were conducted to assess for outliers and to test for normality of distributions for all study variables. To confirm normal distributions of the variables, graphical procedures were employed such as histograms, box-plots, and/or q-q plots. Values of skewness and kurtosis confirmed whether or not the distribution of scores were normal. The further the value is from zero, the greater the chances for the data not being normally distributed (Field, 2005). Frequencies were examined to assess for possible data entry errors and/or outliers. A Levene's test was conducted to assess for homogeneity of variance. Assuming normally distributed data, homogeneity of variance and statistical independence, parametric tests were employed. If violations of normality were found, then non-parametric tests were utilized.

A range of statistical tests, including Chi-square tests of independence, independent sample t-tests, Analyses of Variance (ANOVA), and Analyses of Covariance (ANCOVA) were performed to examine bivariate relations, determine covariates, and compare groups. In terms of covariates, age did not significantly differ between groups (age-matching) nor was it significantly related to any investment outcome variables, and therefore was excluded from analyses. Race, however, significantly differed between groups and was significantly related to

investment outcomes. Therefore, race served as our sole covariate in group-based analyses. As such, race was dummy-coded into separate variables so that SPSS would treat it as a qualitative, rather than quantitative, variable in analyses. In general, appropriate statistical corrections were employed as needed (i.e., if statistical assumptions were not met). For example, for repeated measures ANCOVAs, if Mauchly's sphericity test was significant then Greenhouse-Geisser corrections were used for data interpretation.

Aim 1. To compare trust and lottery game investment strategies (within and between depressed and healthy control groups. Trust and lottery game investment strategies of depressed girls vs. age-matched healthy controls were compared through repeated measures analyses of covariance (ANCOVAs), followed by planned contrasts. The dependent variable in both cases was the number of points sent to the trustee (trust game and lottery condition). ANCOVAs, controlling for race, were used to compare overall performance on games, and linear regression was used to establish predictors of game performance. In all cases, alpha was set at < 0.05 for significance.

Aim 2. To explore the relation between severity of depressive symptoms and investments in the trust and lottery games. Across the total sample, participants were grouped according to BDI-II scores (minimal, mild-to-moderate, and severe), and the same data analytic strategy from Aim 1 was repeated across these 3 depressed groups. Post-hoc Tukey HSD tests were used to examine group differences for overall performance on games.

Aim 3. To examine whether self-reported trust correlated with investment in the trust game. The mean investment for the trust game was calculated for each participant, regardless of group membership, and correlated with self-report trust total score, as measured by the Rotenberg Trust Scale, using a Pearson correlation. Since race was significantly related to

trust game performance, partial correlations between said variables were computed, controlling for race.

Results

Demographic and psychopathological differences in depression

See Table 2 for an overview of participant characteristics and group differences. With matching of groups, there was no significant difference between depressed girls ($M_{\text{age}} = 14.82$, $SD = 1.23$) and healthy controls ($M_{\text{age}} = 15.11$, $SD = 1.11$) in terms of age, $t(74) = 1.078$, $p = .284$. Groups significantly differed in racial composition, $\chi^2(4, N = 76) = 14.234$, $p = .003$. Race variables were significantly related to mean investments in the trust game, and lottery condition, and were therefore controlled for as needed. Regarding dimensional scores of depression, groups were compared on the YSR affective problems scale and BDI. For both comparisons, the Levene's test was violated ($p < .001$) so equal variances could not be assumed; therefore, Welch-Satterthwaite values were examined. The depressed girls ($M = 74.26$, $SD = 8.85$) scored significantly higher than healthy controls ($M = 51.26$, $SD = 2.61$) on the YSR, $t(74) = 15.37$, $p < .001$. Similarly, on the BDI depressed girls ($M = 31.12$, $SD = 10.22$) scored significantly higher than healthy controls ($M = 5.27$, $SD = 3.32$), $t(74) = 14.83$, $p < .001$.

The second aim of this study required the formation of groups, across the total sample ($N = 76$), based on severity of depression as indicated by BDI scores. The use of established BDI cut-offs (see measures) resulted in limited power due to an insufficient sample size in the mild depression group ($n = 3$), so mild and moderately depressed groups were combined. Thus, three groups were formed: minimal ($n = 40$), mild-to-moderate ($n = 13$), and severe ($n = 23$). Mean BDI scores for each group were as follows: minimal ($M = 5.60$, $SD = 3.55$), mild-to-moderate ($M = 22.41$, $SD = 4.53$), and severe ($M = 37.72$, $SD = 6.34$). There were no significant differences

between groups on age, $F(2, 73) = 1.593, p = .210$; however, they differed in terms of racial composition, $\chi^2(4, N = 76) = 21.169, p = .007$.

Testing for an order effect of game condition

Before examining group differences on game performance, we determined whether an order effect was present, such that investment strategy was at least partially determined by whether the trust game or lottery condition was played first. The mean investments of players did not significantly differ as a result of counterbalancing: trust game, $F(1, 74) = 2.724, p = .103$, lottery condition, $F(1, 74) = 0.668, p = .416$. Repeated measures analyses revealed no significant main effects or interactions effects when using game order as the between subjects factor: game, $F(1, 74) = 0.462, p = .499$, trials, $F(3, 250) = 1.948, p = .115$, counterbalancing group, $F(1, 74) = 1.620, p = .207$, game x counterbalancing group, $F(1, 74) = 2.246, p = .138$, trials x counterbalancing group, $F(3, 250) = 1.860, p = .130$, game x trials, $F(3, 240) = 0.571, p = .648$, game x counterbalancing group x trials, $F(3, 240) = 1.489, p = .215$.

Trust game and lottery condition performance

Depressed and healthy control groups were first compared on overall game performance, controlling for race. In the trust game, depressed girls ($M = 4.41, SD = 1.87$) made a significantly higher mean investment than healthy controls ($M = 2.87, SD = 1.60$), $F(1, 71) = 9.408, p = .003$. Results were similar with the lottery condition, with depressed girls ($M = 4.41, SD = 1.91$) investing significantly more than healthy controls ($M = 3.01, SD = 1.70$), $F(1, 72) = 7.261, p = .009$.

Three-way repeated-measures ANCOVA analyses were conducted with group (depressed vs. healthy control) as the between-subjects factor and game (Trust vs. Lottery) and trials (5 trials; time) as the within-subjects factors, controlling for race. There was a significant main

effect of group, $F(1, 71) = 8.761, p = .004$, such that depressed girls invested 1.184 more points (on average) than healthy controls (95% CI = 0.386 to 1.982). There was also a main effect of trials (time), $F(4, 71) = 2.934, p = .029$, such that investment, across groups, increased between trial 1 ($M = 3.424, SD = 1.788$) and trial 5 ($M = 3.612, SD = 2.472$). There was a significant interaction effect of group x trials, $F(4, 71) = 3.663, p = .010$, such that groups differed in their investment strategies, across games, over time. While the depressed girls invested more over time (trial 1, $M = 3.551$; trial 5, $M = 4.457$), healthy controls invested less over time (trial 1, $M = 3.298$; trial 5, $M = 2.767$). There was also a significant interaction effect of game x trials, $F(4, 71) = 4.141, p = .005$, such that the amount of difference in mean investment from trial to trial (i.e., trial 2 mean investment vs. trial 3 mean investment) differed between games. There were generally larger differences between mean investments on trials in the trust game vs. lottery condition, i.e. the difference from in investment from trial 2 to trial 3 was significantly greater in the trust game, $F(4, 71) = 7.244, p = .009$. No other main effects or interactions were significant. See figure 1.

Figure 1

The relation between depression severity and investment strategy in the trust game (and lottery condition)

Before examining potential group differences in game investments based on severity of depression, descriptive statistics were computed. The minimally depressed group ($n = 40$) had a mean trust game investment of 2.88 points (pts) ($SD = 1.63$) and a mean lottery investment of 3.06 pts ($SD = 1.71$). The mild-to-moderately depressed group ($n = 13$) had a mean investment of 3.74 pts ($SD = 1.79$) in the trust game, and a mean lottery investment of 4.11 pts ($SD = 2.20$). Finally, the severely depressed group ($n = 23$) had a mean trust game investment of 4.90 pts (SD

= 1.75) and a mean lottery investment of 4.62 pts ($SD = 1.79$). One-Way ANCOVAs, controlling for race, revealed that the severely depressed group invested significantly more than the minimally depressed group in the trust game, $F(2, 71) = 5.302, p = .007$; however, the difference between these groups for mean investment in the lottery condition was non-significant, $F(2, 71) = 2.614, p = .080$. The mild-to-moderately depressed group did not significantly differ from either group in terms of mean investment in the trust game ($ps \geq .368$) or lottery condition ($ps \geq .594$).

Similar to our first aim, a three-way repeated-measures ANCOVA, controlling for race, was performed with BDI severity groups as the between-subjects factor and game and trials as the within-subjects factors. There was a significant main effect of group, $F(2, 71) = 4.081, p = .021$, such that girls with severe depression invested 1.279 more points (on average) than girls with minimal depression (95% CI = 0.171 to 2.387). There was also a significant main effect of trials (time), $F(4, 68) = 3.666, p = .011$, such that investment, across groups, increased from trial 1 ($M = 3.424, SD = 1.788$) to trial 5 ($M = 3.612, SD = 2.472$). No other main effects and no interactions were significant. See figure 2.

Figure 2

Predictors of investment strategies

Bivariate correlations between demographic variables (age and dummy-coded race), dimensional measures of depression, and mean investments were examined. YSR affective problems scores were significantly correlated with mean investment in the trust game ($r = .364, p = .001$) and lottery condition ($r = .291, p = .011$), as well as BDI scores ($r = .925, p < .001$). Asian and Caucasian race were significantly related to mean investment in each game condition. Asian race correlated with mean trust game ($r = -.358, p = .001$) and lottery investment ($r = -$

.367, $p = .001$), and Caucasian race correlated with mean trust game ($r = .365$, $p = .001$) and lottery investment ($r = .246$, $p = .032$). Age was not significantly related to either investment outcome ($ps > .465$).

Linear regression analyses were then performed to determine whether continuous, non-manipulated (e.g. non-dichotomized), scores of depression were predictive of investment strategies. Given that YSR affective problems and BDI scores were significantly correlated, examining whether symptoms of depression were a significant predictor was only performed with YSR scores. Thus, YSR affective problems scores and race variables were entered as predictor variables, and trust game mean investment as the outcome. The model was significant, $F(3, 72) = 8.979$, $p < .001$, and accounted for 27% of the variance in mean trust game investment, $R^2 = .272$. YSR affective problems scores were a significant predictor, $\beta = 0.230$, $p = .035$, and accounted for 5% of the variance in mean trust game investment. We then examined whether YSR affective problems scores would similarly predict mean lottery condition investment. While the model, which included YSR affective problems scores and race variables, was significant, $F(3, 72) = 5.887$, $p = .001$ ($R^2 = .197$), YSR affective problems scores were a non-significant predictor, $\beta = 0.170$, $p = .135$.

The relation between self-reported trust and investment in the trust game

A subsidiary aim was to examine whether self-reported trust, on the Rotenberg trust scale, was significantly related to mean investment in the trust game. Given the significant relations between race and trust game performance, partial correlations were examined. Partial correlations, computed across the sample, revealed a non-significant relation between Rotenberg total score and mean trust game investment ($r = -0.069$, $p = .560$). Since the participants believed they were playing with a peer in the trust game, we examined the relation between the peer

subscale of the Rotenberg trust scale and mean trust game investment as well. Similarly, the relation was non-significant ($r = .046$, $p = .700$).

Discussion

The present study was the first known investigation of the relations between adolescent depression and interpersonal trust utilizing the trust game, specifically focusing on adolescent girls. The first aim of this study was to compare trust game (and lottery condition) investment strategies between depressed and healthy adolescent girls in an effort to characterize the trust behavior of adolescents with clinically-significant depression. We hypothesized that there would be a main effect of group such that depressed girls would make significantly higher investments in the trust game. We also hypothesized that there would be a significant interaction between group and game type such that the depressed girls would invest more in the trust game and less in the lottery condition. These primary hypotheses received partial support. Repeated measures analyses revealed a significant main effect of group; however, there was no significant interaction between group and game type. While depressed girls invested significantly more in the trust game, they also invested significantly more in the lottery condition. Thus, our findings differ from those of Unoka et al. (2009) which found non-significant differences in investment strategies between MDD adults and healthy controls in the trust game ($p = .56$) and lottery condition ($p = .89$). Although our results may appear somewhat anomalous, findings from our second aim may help substantiate this significant positive relation between depression and excessive trust in adolescent girls.

Our second aim was to investigate how depression severity was related to trust game investment strategies, and we found that severely depressed girls invested significantly more than minimally depressed girls. Thus, the relation between depression and elevated trust was

found using another commonly-used and well-validated measure of depression, the BDI. The inability to detect a difference between the mean trust game investments of the mild-to-moderate group and the minimally or severely depressed groups of girls may have been due to a small sample size ($n = 13$), or the wide variability of BDI scores in this group. Alternatively, and perhaps more likely, excessive trust may only be a notable feature of severe depression in adolescent girls, as minimal to moderate depression may not be associated with significant elevations of trust. Thus, degree of trust may increase in parallel with elevations in depression, peaking during the presence of a major depressive episode. Excessive trust may therefore be more of a state-like feature of depression in adolescent girls; however, further investigations are needed to examine whether causal or correlational relations between trust and depression do in fact exist. Moreover, future studies should seek to employ more advanced statistical analyses, such as latent variable modeling, to examine the dimensional relations between depression and trust.

In offering plausible explanations for these trust game findings, a developmental psychopathology approach may be taken. It might be that the relation between excessive trust and depression unfolds as an exaggeration of a normal feature of adolescent development. During typical healthy development, trust increases and peaks during adolescence (Crone, 2013). Adolescent depression, a deviation from a healthy trajectory, may be a condition in which this typical feature of adolescent development is magnified in an atypical fashion in depressed girls. Such developmental considerations may provide at least a partial explanation for why depression in adults was not associated with significantly higher levels of trust. MDD participants in Unoka et al.'s (2009) study, with an average age of 30.1 years ($SD = 9.3$), were mature well past the adolescent years in which trust develops and significantly increases (van den Bos, Westenberg,

van Dijk, & Crone, 2010; Sutter & Kocher, 2007). Therefore, those participants were not experiencing a period of vulnerability in which drastic developmental changes are occurring (e.g., increasing trust). To this end, depressed mood and other features of depression may have differential effects on trust in different age groups.

Evidence has accumulated in support of depressed mood influencing decision making during games of social exchange. When healthy participants undergo negative mood induction, it has been shown to significantly alter their performance in behavioral economic games (i.e., Forgas & Tan, 2013). Additionally, the few behavioral economic studies of adult depression have found that depression may be associated with a wide range of anomalous social decision making strategies (Harlé et al, 2010; Destoop et al., 2013; Hokanson et al., 1980). The field of behavioral economics has revealed numerous psychological principles govern typical social exchanges between people. For example, the *endowment effect* refers to the fact that when people are in possession of an item (e.g., a coffee mug), they require greater payment than it's actually worth if they are to part with it (Kahneman, Knetsch, & Thaler, 1990). In other words, they will only sell their coffee mug if someone is willing to pay them *more* than they themselves paid for it. Results from an experiment using induced sadness with healthy participants, engaging in actual financial trades, suggest that depression may be associated with a reverse endowment effect such that depressed individuals may actually be more willing to part with an item in their possession (see Lerner, Small, & Loewenstein, 2004). The notion of a reversed endowment effect may be at play into our findings with the trust game. Perhaps depressed adolescent girls are willing to invest more in the trustee because they ascribe a lesser value, than do their healthy counterparts, to the game points in their possession. Low self-esteem and feelings of worthlessness may also influence higher trust game investment. In an interpersonal context, the

depressed adolescent may feel as though she is not deserving of the points in her possession and they then bestow more to the other player, than would a typical adolescent girl (with greater self-worth). The extent to which depression may influence social decision making and other psychological principles that govern social exchange is clearly worthy of further investigation. In such investigations, depression may interact with features of typical adolescent social-cognitive development, leading to unique findings in relation to adult depression.

Next, we turn to a discussion of our findings in terms of lottery investment. Although depressed girls invested more on average than controls on the lottery task was unexpected, our hypothesis that depressed girls would invest significantly less was predominantly drawn from the adult depression literature. Prior research has found adult depression to be associated with risk-aversion in non-social, monetary reward-related contexts, specifically as measured by behavioral decision making (Smoski et al., 2008). Negative mood induction in healthy adults has also been associated with risk-aversion (Yuen & Lee, 2003; Grable & Roszkowski, 2008); however, the risk-taking context has not been limited to non-social monetary reward, which makes these findings somewhat less informative to the current study. Furthermore, these studies were not female-specific. In contrast to these adult findings, we found depressed girls to exhibit a greater willingness to take risks in the lottery condition when repayment was uncertain and randomly determined. The association between risk-aversion and depression may develop over time, and may not be present in the early course of depression. Adolescence is a period marked by heightened risk-taking and novelty seeking (Galván, 2013), and these typical developmental characteristics may still be particularly dominant in some of the depressed adolescent girls in our sample. However, the fact that the association between depression and increased investment in the lottery condition was not found using groups based on BDI scores, suggests that meaningful

conclusions cannot be drawn at this point.

Our subsidiary aim, exploring the relations between self-reported trust and performance in the trust game revealed that the two measures did not correlate with one another. Rotenberg et al.'s (2005) trust beliefs scale is based on a theoretical framework which includes a behavior-dependent dimension of interpersonal trust. Within this dimension of Rotenberg's (2001) model of trust lies emotional and cognitive/affective bases of trust, and these aspects of trust are not captured in the trust game (Nowakowski, Vaillancourt, & Schmidt, 2010). Thus, trust is operationalized differently in each of these measures. Also, the nature of each task is substantially different as one is purely hypothetical, using vignettes to illustrate trust-related scenarios, while the other is behaviorally-based and occurs in real-time, in a real-world context. Our finding of an absence of any relationship between these measures supports the differential utility of each method in examining aspects of interpersonal trust.

Lastly, while several theorists have considered depression to be a highly interpersonal disorder (i.e., Coyne, 1976; Joiner et al., 1999), our results fail to provide support for such theoretical frameworks. The depressed girls exhibited similar investment strategies in the trust game ($M = 4.41$, $SD = 1.87$) and lottery condition, ($M = 4.41$, $SD = 1.91$), suggesting that the interpersonal context of the trust game (vs. the non-interpersonal context of the lottery condition) was not associated with a different investment strategy, bringing the interpersonal nature of depression somewhat into question. An alternate conceptualization of depression deems it as a disorder that is highly associated with disruption of the reward system (Russo & Nestler, 2013). Impaired reward function is associated with a range of clinical characteristics found in depression, including decreased motivation for reward, a reduced likelihood of engaging in rewarding experiences, and reduced salience of reward (Ernst, 2012). Several studies have

examined non-social reward in adolescent depression (i.e. Forbes et al., 2006); however, this line of research has yet to be appropriately extended to social reward. Future studies should seek to examine social vs. non-social reward-related decision making in depressed adolescent girls to provide evidence for (or against) the interpersonal nature of depression using behavioral economic games.

While this study offers novel findings, it is not without limitations. Perhaps most notably, depressed status among the girls was determined by self-report. While the fact that depressed girls were recruited from an inpatient facility somewhat addresses this limitation, the utilization of a diagnostic structured interview to determine the presence (or absence) of clinically-significant depression would have been preferred. Importantly, to this end, the acute nature of the treatment center from which we recruited our clinical sample leaves in question whether these girls were experiencing severe (acute or chronic) stress at the time of assessment, rather than depression. Additionally, we were unable to determine the extent to which the depressed sample was medicated during assessment. Despite the absence of structured interviews and the characteristics of our sample, we utilized two well-validated and highly reliable measures of depression in our examination of trust game performance. In terms of the behavioral task, the trust game we employed provided no feedback to participants during gameplay. A potential limitation of these types of games is that participants must act under uncertainty, e.g., trustworthiness of the other player remains unestablished, and this may influence investment strategies (Kiyonari, Yamagishi, Cook, & Cheshire, 2006). Another limitation of the task was that we did not tie participant compensation to game performance, which may have reduced emotional and behavioral engagement. This study lacked a measure of socioeconomic status (SES), and SES has been associated with different decision making strategies in behavioral

economic games (Benenson, et al., 2007). SES may also have been an important factor that differed between groups, as members of the depressed sample were likely more indigent overall. This study also would have benefitted from a pubertal measure, as pubertal stage has been considered to be a better marker of adolescent development than chronological age (Goddings, Burnett Heyes, Bird, Viner, & Blakemore, 2012).

Although depression is highly prevalent in adolescent girls (Rudolph, 2009), the fact that boys were not included in this study reduces the generalizability of these findings. There are known sex differences in trust game investment strategies (Slonim & Guillen, 2010). In fact, men have been found to be more trusting than women (Buchan, Croson, & Solnick, 2008), and the extent to which depression may affect trusting behavior in adolescent boys remains unknown. Another important factor to consider is that different (and greater) degrees of cognitive vulnerability and/or stress may be required for depression to manifest in boys (Mackrell, Johnson, Dozois, & Hayden, 2013). As such, if depressed boys do in fact exhibit excessive trust it may be a greater deviation from what is considered healthy, as compared to the difference we found with depressed vs. healthy girls.

Limitations notwithstanding, this was the first known trust game study of adolescent depression. Although results are preliminary, these findings suggest that depressed adolescent girls exhibit excessive trust and severity of depression in girls may be associated with increased levels of trust. If future investigations replicate this study, excessive trust may come to serve as a characteristic feature of adolescent depression thus supporting a revised taxonomy of the depressive condition. The notion that depression is related to excessive trust complements the finding that adolescent externalizing disorders are associated with reduced trust (Sharp et al., 2011). Further studies are needed, but a larger picture may begin to emerge in which

interpersonal trust serves as a distinguishing feature between adolescent internalizing and externalizing psychopathology. In the treatment of adolescent depression, clinicians may be able to utilize excessive trust as a means to strengthen the therapeutic relationship. Social support serves as a protective factor against depression (Stice, Ragan, & Randall, 2004) and the patient's ability to trust in others may improve such support, leading to more favorable treatment outcomes.

References

- Achenbach, T.M. & Rescorla, L.A. (2001). *Manual for the ASEBA School-Age Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- Adolphs, R. (2001). The neurobiology of social cognition. *Current Opinion in Neurobiology*, *11*, 231-239.
- Altmann, E. O., & Gotlib, I. H. (1988). The social behavior of depressed children: An observational study. *Journal Of Abnormal Child Psychology*, *16*(1), 29-44.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). doi:10.1176/appi.books.9780890423349.
- Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The 'Reading the mind in the eyes' Test revised version: A study with normal adults, and adults with Asperger syndrome or high-functioning autism. *Journal Of Child Psychology And Psychiatry*, *42*(2), 241-251. doi:10.1111/1469-7610.00715
- Baker, M., Milich, R., & Manolis, M. (1996). Peer interactions of dysphoric adolescents. *Journal of Abnormal Child Psychology*, *24*(3), 241-255.
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory*, 2nd ed. San Antonio, TX: The Psychological Corporation.
- Belli, S.R., Rogers, R.D., Lau, J.Y.F. (2012). Adult and adolescent social reciprocity: Experimental data from the trust game. *Journal of Adolescence*, *35*, 1341-1349.
- Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, Reciprocity, and Social History. *Games And Economic Behavior*, *10*(1), 122-142. doi:10.1006/game.1995.1027
- Boland RJ, Keller MB. 2009. Course and outcome of depression. In *Handbook of Depression*, ed. IH Gotlib, CL Hammen, pp. 23–43. New York: Guilford. 2nd ed.

- Boswell, P.C. & Murray, E.J. (1981). Depression, schizophrenia, and social attraction. *Journal of Consulting and Clinical Psychology, 49*(5), 641-647.
- Benenson, J.F., Pascoe, J., Radmore, N. (2007). Children's altruistic behavior in the dictator game. *Evolution and Human Behavior, 28*, 168-175.
- Boyce, P., Hickie, I., Parker, G., Mitchell, P., Wilhelm, K., & Brodaty, H. (1993). Specificity of interpersonal sensitivity to non-melancholic depression. *Journal of Affective Disorders, 27*, 101-105.
- Buchan, N. R., Croson, R. T., & Solnick, S. (2008). Trust and gender: An examination of behavior and beliefs in the Investment Game. *Journal of Economic Behavior & Organization, 68*(3), 466-476.
- Cicchetti, D. & Cohen, D.J. (ed.) (2006). *Developmental Psychopathology, Vols 1, 2, 3*. New York: John Wiley.
- Connolly, J., Geller, S., Marton, P., & Kutcher, S. (1992). Peer responses to social interaction with depressed adolescents. *Journal of Clinical Child Psychology, 21*(4), 365-370.
- Coyne, J.C. (1976). Depression and the response of others. *Journal of Abnormal Psychology, 85*(2), 186-193.
- Coyne, J. C., Aldwin, C., & Lazarus, R. S. (1981). Depression and coping in stressful episodes. *Journal Of Abnormal Psychology, 90*(5), 439-447. doi:10.1037/0021-843X.90.5.439
- Crone, E. A. (2013). Considerations of fairness in the adolescent brain. *Child Development Perspectives, 7*(2), 97-103.

- Destoop, M., Schrijvers, D., De Grave, C., Sabbe, B., & De Bruijn, E. A. (2012). Better to give than to take? Interactive social decision-making in severe major depressive disorder. *Journal of Affective Disorders, 137*(1-3), 98-105.
- Dziobek, I., Fleck, S., Kalbe, E., Rogers, K., Hassenstab, J., Brand, M., & ... Convit, A. (2006). Introducing MASC: A Movie for the Assessment of Social Cognition. *Journal Of Autism And Developmental Disorders, 36*(5), 623-636. doi:10.1007/s10803-006-0107-0
- Eisenberg, N., Morris, A., McDaniel, B., & Spinrad, T. L. (2009). Moral cognitions and prosocial responding in adolescence. In R. M. Lerner, L. Steinberg (Eds.) , *Handbook of adolescent psychology, Vol 1: Individual bases of adolescent development (3rd ed.)* (pp. 229-265). Hoboken, NJ US: John Wiley & Sons Inc.
- Ernst, M. (2012). The usefulness of neuroeconomics for the study of depression across adolescence into adulthood. *Biological Psychiatry, 72*(2), 84-86.
doi:10.1016/j.biopsych.2012.02.027
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*, 1149-1160.
- Fehr, E., Bernhard, H., Rockenbach, B. (2008). Egalitarianism in young children. *Nature, 454*:28, 1079-1084.
- Fessler, D. T., Pillsworth, E. G., & Flamson, T. J. (2004). Angry men and disgusted women: An evolutionary approach to the influence of emotions on risk taking. *Organizational Behavior And Human Decision Processes, 95*(1), 107-123.
doi:10.1016/j.obhdp.2004.06.006
- Field, A. (2005). *Discovering statistics using SPSS—second edition*. Sage: London.

- Forbes, E.E., Dahl, R.E. (2005). Neural systems of positive affect: Relevance to understanding child and adolescent depression? *Development and Psychopathology*, *17*, 827-850.
- Forbes, E.E., May, C., Siegle, G.J., Ladouceur, C.D., Ryan, N.D., Carter, C.S., Birmaher, B., Axelson, D.A., Dahl, R.E. (2006). Reward-related decision-making in pediatric major depressive disorder: an fMRI study. *Journal of Child Psychology and Psychiatry*, *47:10*, 1031-1040.
- Forgas, J. P., & Tan, H. (2013). To give or to keep? Affective influences on selfishness and fairness in computer-mediated interactions in the dictator game and the ultimatum game. *Computers In Human Behavior*, *29(1)*, 64-74. doi:10.1016/j.chb.2012.07.017
- Galván, A. (2013). The teenage brain: Sensitivity to rewards. *Current Directions In Psychological Science*, *22(2)*, 88-93. doi:10.1177/0963721413480859
- Goddings, A. L., Burnett Heyes, S., Bird, G., Viner, R. M., & Blakemore, S. J. (2012). The relationship between puberty and social emotion processing. *Developmental science*, *15(6)*, 801-811.
- Gollan, J. K., Pane, H. T., McCloskey, M. S., & Coccaro, E. F. (2008). Identifying differences in biased affective information processing in major depression. *Psychiatry Research*, *159(1-2)*, 18-24. doi:10.1016/j.psychres.2007.06.011
- Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: Current status and future directions. *Annual Review Of Clinical Psychology*, *6*, 285-312. doi:10.1146/annurev.clinpsy.121208.131305
- Gotlib, I. H., Kasch, K. L., Traill, S., Joormann, J., Arnow, B. A., & Johnson, S. L. (2004). Coherence and Specificity of Information-Processing Biases in Depression and Social

Phobia. *Journal Of Abnormal Psychology*, 113(3), 386-398. doi:10.1037/0021-843X.113.3.386

Grable, J.E. & Roszkowski, M.J. (2008). The influence of mood on the willingness to take financial risks. *Journal of Risk Research*, 11(7), 905-923.

Gummerum, M., Hanoch, Y., Keller, M. (2008). When child development meets economic game theory: An interdisciplinary approach to investigating social development. *Human Development*, 51, 235-261.

Gummerum, M., Keller, M., Takezawa, M., & Mata, J. (2008). To give or not to give: Children's and adolescents' sharing and moral negotiations in economic decision situations. *Child Development*, 79(3), 562-576.

Guth, W., Schmittberger, R., & Swarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior*, 3, 367-388.

Güroğlu, B., van den Bos, W., & Crone, E.A. (2009). Fairness considerations: Increasing understanding of intentionality during adolescence. *Journal of Experimental Child Psychology*, 104, 398-409.

Haley, W.E., & Strickland, B.R. (1986). Interpersonal betrayal and cooperation: Effects on self-evaluation in depression. *Journal of Personality And Social Psychology*, 50(2), 386-391.

Hammen, C. (1992). Cognitive, life stress, and interpersonal approaches to a developmental psychopathology model of depression. *Development and Psychopathology*, 4, 189-206.

Hammen, C. (1999). The emergence of an interpersonal approach to depression. In T.E. Joiner & J.C. Coyne (Eds.), *The interactional nature of depression*. Washington, D.C.: American Psychological Association.

- Hankin, B. L., & Abramson, L. Y. (2001). Development of gender differences in depression: An elaborated cognitive vulnerability–transactional stress theory. *Psychological Bulletin*, *127*(6), 773-796. doi:10.1037/0033-2909.127.6.773
- Hankin, B.L., Abramson, L.Y, Moffitt, T.E., Silva, P.A., McGee, R., & Angell, K.E. (1998). Development of depression from preadolescence to young adulthood: Emerging gender differences in a 10-year longitudinal study. *Journal of Abnormal Psychology*, *107*(1), 128-140.
- Harbaugh, W.T. & Krause, K. (2000). Children’s altruism in public good and dictator experiments. *Economic Inquiry*, *38*(1), 95-109.
- Harlé, K.M., Allen, J.B., Sanfey, A.G. (2010). The impact of depression on social economic decision making. *Journal of Abnormal Psychology*, *119*:2, 440-446.
- Harlé, K.M., Chang, L.J., van’t Wout, M., Sanfey, A.G. (2012). The neural mechanisms of affect infusion in social economic decision-making: A mediating role of the anterior insula. *Neuroimage*, *61*, 32-40.
- Harlé, K.M., Sanfey, A.G. (2007). Incidental sadness biases in social economic decision in the ultimatum game. *Emotion*, *7*, 876-881.
- Hartley, C.A. & Phelps, E.A. (2012). Anxiety and decision-making. *Biological Psychiatry*, *72*, 113-118.
- Henriques, J.B. & Davidson, R.J. (2000). Decreased responsiveness to reward in depression. *Cognition and Emotion*, *14*(5), 711-724.
- Hoffmann, R., Tee, J.-Y., (2006). Adolescent–adult interaction and culture in the ultimatum game. *Journal of Economic Psychology*, *27*, 98–116.

- Hokanson, J.E., Sacco, W.P, Blumberg, S.R., & Landrum, G.C. (1980). Interpersonal behavior of depressive individuals in a mixed-motive game. *Journal of Abnormal Psychology*, 89(3), 320-332.
- Inoue, Y., Tonooka, Y., Yamada, K., & Kanba, S. (2004). Deficiency of theory of mind in patients with remitted mood disorder. *Journal Of Affective Disorders*, 82(3), 403-409.
- Inoue, Y. Y., Yamada, K. K., & Kanba, S. S. (2006). Deficit in theory of mind is a risk for relapse of major depression. *Journal Of Affective Disorders*, 95(1-3), 125-127.
doi:10.1016/j.jad.2006.04.018
- Joiner, Jr., T.E., Coyne, J.C., & Blalock, J. (1999). Overview and synthesis. In T.E. Joiner & J.C. Coyne (Eds.), *The interactional nature of depression*. Washington, D.C.: American Psychological Association.
- Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1986). Fairness and the assumptions of economics. *Journal of Business*, 59(4), S285-S300. doi: 10.1086/296367
- Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *The journal of economic perspectives*, 193-206.
- Kessler, R.C., Berglund, P., Demler, O., Robert, J., Koretz, D., Merikangas, K.R., Rush, A.J., Walters, E.E., & Wang, P.S. (2003). The epidemiology of major depressive disorder: Results from the national comorbidity survey replication (NCS-R). *JAMA*, (289)23, 3095-3105.
- Kettle, J. L., O'Brien-Simpson, L., & Allen, N. B. (2008). Impaired theory of mind in first-episode schizophrenia: Comparison with community, university and depressed controls. *Schizophrenia Research*, 99(1-3), 96-102. doi:10.1016/j.schres.2007.11.011

- Kiyonari, T., Yamagishi, T., Cook, K. S., & Cheshire, C. (2006). Does trust beget trustworthiness? Trust and trustworthiness in two games and two cultures: A research note. *Social Psychology Quarterly*, *69*(3), 270-283.
- Knutson, B., Bhanji, J.P., Cooney, R.E., Atlas, L.Y., & Gotlib, I. H. (2008). Neural responses to monetary incentives in major depression. *Biological Psychiatry*, *63*(7), 686-692.
- Kosfeld, M., Heinrichs, M., Zak, P. J., Fischbacher, U., & Fehr, E. (2005). Oxytocin increases trust in humans. *Nature*, *435*(7042), 673-676. doi:10.1038/nature03701
- Kyte, Z. A., Goodyer, I. M., & Sahakian, B. J. (2005). Selected executive skills in adolescents with recent first episode major depression. *Journal Of Child Psychology And Psychiatry*, *46*(9), 995-1005. doi:10.1111/j.1469-7610.2004.00400.x
- Lee, A., Hankin, B.L., & Mermelstein, R.J. (2010). Perceived social competence, negative social interactions, and negative cognitive style predict depressive symptoms during adolescence. *Journal of Clinical Child & Adolescent Psychology*, *39*(5), 603-615.
- Lee, L., Harkness, K. L., Sabbagh, M. A., & Jacobson, J. A. (2005). Mental state decoding abilities in clinical depression. *Journal Of Affective Disorders*, *86*(2-3), 247-258. doi:10.1016/j.jad.2005.02.007
- Leppänen, J. M., Milders, M., Bell, J., Terriere, E., & Hietanen, J. K. (2004). Depression biases the recognition of emotionally neutral faces. *Psychiatry Research*, *128*(2), 123-133. doi:10.1016/j.psychres.2004.05.020
- Lewinsohn, P.M., Rohde, P., & Seeley, J.R. (1998). Major depressive disorder in older adolescents: Prevalence, risk factors, and clinical implications. *Clinical Psychology Review*, *18*(7), 765-794.

- Lewinsohn, P., Rohde, P., Seeley, J., Klein, D., & Gotlib, I. (2003). Psychosocial functioning of young adults who have experienced and recovered from major depressive disorder during adolescence. *Journal of Abnormal Psychology, 112*(3), 353-363.
- Lerner, J. S., Small, D. A., & Loewenstein, G. (2004). Heart strings and purse strings carryover effects of emotions on economic decisions. *Psychological Science, 15*(5), 337-341.
- Lucas, M.M., Wagner, L., Chow, C. (2008). Fair game: The intuitive economics of resource exchange in four-year olds. *Journal of Social, Evolutionary, and Cultural Psychology, 2*(3), 74-88.
- Mackrell, S. V., Johnson, E. M., Dozois, D. J., & Hayden, E. P. (2013). Negative life events and cognitive vulnerability to depression: Informant effects and sex differences in the prediction of depressive symptoms in middle childhood. *Personality and Individual Differences, 54*(4), 463-468.
- Mandal, M. K., & Bhattacharya, B. B. (1985). Recognition of facial affect in depression. *Perceptual And Motor Skills, 61*(1), 13-14. doi:10.2466/pms.1985.61.1.13
- Maner, J. K., Richey, J., Cromer, K., Mallott, M., Lejuez, C. W., Joiner, T. E., & Schmidt, N. B. (2007). Dispositional anxiety and risk-avoidant decision-making. *Personality And Individual Differences, 42*(4), 665-675. doi:10.1016/j.paid.2006.08.016
- McClure, E.B., Parrish, J.M., Nelson, E.E., Easter, J., Thorne, J.F., Rilling, J.K., Ernst, M., Pine, D.S. (2007). Responses to conflict and cooperation in adolescents with anxiety and mood disorders. *Journal of Abnormal Child Psychology, 25*, 567-577.
- McClure-Tone, E.B., Nawa, N.E., Nelson, E.E., Detloff, A.M., Fromm, S.J., Pine, D.S., & Ernst, M.E. (2011). Preliminary findings: Neural responses to feedback regarding betrayal and

- cooperation in adolescent anxiety disorders. *Developmental Neuropsychology*, 36(4), 453-472.
- Merikangas, K., He, J., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., & ... Swendsen, J. (2010). Lifetime prevalence of mental disorders in U.S. adolescents: Results from the National Comorbidity Survey Replication-Adolescent Supplement (NCS-A). *Journal Of The American Academy Of Child & Adolescent Psychiatry*, 49(10), 980-989.
- Mitchell, J. P., Macrae, C., & Banaji, M. R. (2004). Encoding-Specific Effects of Social Cognition on the Neural Correlates of Subsequent Memory. *The Journal Of Neuroscience*, 24(21), 4912-4917. doi:10.1523/JNEUROSCI.0481-04.2004
- Moretti, L., di Pellegrino, G. (2010). Disgust selectively modulates reciprocal fairness in economic interactions. *Emotion*, 10:2, 169-180.
- Moskowitz, G. B. (2005). *Social cognition: Understanding self and others*. New York, NY US: Guilford Press.
- Mullins, L.L., Peterson, L., Wonderlich, S.A., & Reaven, N.M. (1986). The influence of depressive symptomatology in children on the social responses and perceptions of adults. *Journal of Clinical Child Psychology*, 15(3), 233-240.
- Murnighan, J.K. & Saxon, S.S. (1998). Ultimatum bargaining by children and adults. *Journal of Economic Psychology*, 19, 415-445.
- Nowakowski, M. E., Vaillancourt, T., & Schmidt, L. A. (2010). Neurobiology of interpersonal trust. *Interpersonal trust during childhood and adolescence*, 28-55.
- Pine, D.S., Cohen, E., Cohen, P., Brook, J. (1999). Adolescent depressive symptoms as predictors of adult depression: Moodiness or mood disorder? *American Journal of Psychiatry*, 156, 133-135.

- Pizzagalli, D.A., Iosifescu, D., Hallett, L.A., Ratner, K.G., & Fava, M. (2009). Reduced hedonic capacity in major depressive disorder: Evidence from a probabilistic reward task. *Journal of Psychiatric Research, 43*, 76-87.
- Rilling, J. K., King-Casas, B., & Sanfey, A. G. (2008). The neurobiology of social decision-making. *Current Opinion In Neurobiology, 18*(2), 159-165.
doi:10.1016/j.conb.2008.06.003
- Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological Bulletin, 132*(1), 98-131. doi:10.1037/0033-2909.132.1.98
- Rotenberg, K.J. (1994). Loneliness and interpersonal trust. *Journal of Social and Clinical Psychology, 13*(2), 152-173.
- Rotenberg, K.J. (2001). Trust across the life-span. In N. J. Smelser and P. B. Baltes (eds.), *International encyclopedia of the social and behavioral sciences* (pp. 7866–7868). New York: Pergamon.
- Rotenberg, K.J., Fox, C., Green, S., Ruderman, L., Slater, K., Stevens, K., & Carlo, G. (2005). Construction and validation of a children's interpersonal trust belief scale. *British Journal of Developmental Psychology, 23*, 271-292.
- Russo, S. J., & Nestler, E. J. (2013). The brain reward circuitry in mood disorders. *Nature Reviews Neuroscience, 14*(9), 609-625.
- Sally, D., & Hill, E. (2006). The development of interpersonal strategy: Autism, theory-of-mind, cooperation and fairness. *Journal Of Economic Psychology, 27*(1), 73-97.
doi:10.1016/j.joep.2005.06.015

- Sanfey, A. G., Rilling, J. K., Aronson, J. A., Nystrom, L. E., & Cohen, J. D. (2003). The neural basis of economic decision-making in the Ultimatum Game. *Science*, *300*(5626), 1755-1758. doi:10.1126/science.1082976
- Segrin, C. (2000). Social skills deficits associated with depression. *Clinical Psychology Review*, *(20)*3, 379-403.
- Sharp, C. (2012). The use of neuroeconomic games to examine social decision making in child and adolescent externalizing disorders. *Current Directions In Psychological Science*, *21*(3), 183-188. doi:10.1177/0963721412444726
- Sharp, C., Ha, C., & Fonagy, P. (2011). Get them before they get you: Trust, trustworthiness, and social cognition in boys with and without externalizing behavior problems. *Development And Psychopathology*, *23*(2), 647-658. doi:10.1017/S0954579410000003
- Sharp, C., Monterosso, J., & Montague, P. (2012). Neuroeconomics: A bridge for translational research. *Biological Psychiatry*, *72*(2), 87-92.
- Slonim, R., & Guillen, P. (2010). Gender selection discrimination: Evidence from a trust game. *Journal of Economic Behavior & Organization*, *76*(2), 385-405.
- Smoski, M. J., Lynch, T. R., Rosenthal, M. Z., Cheavens, J. S., Chapman, A. L., & Krishnan, R. R. (2008). Decision-making and risk aversion among depressive adults. *Journal of behavior therapy and experimental psychiatry*, *39*(4), 567-576.
- Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends In Cognitive Sciences*, *9*(2), 69-74. doi:10.1016/j.tics.2004.12.005
- Stice, E., Ragan, J., & Randall, P. (2004). Prospective relations between social support and depression: Differential direction of effects for parent and peer support?. *Journal of abnormal psychology*, *113*(1), 155.

- Strack, S. & Coyne, J.C. (1983). Social confirmation of dysphoria: Shared and private reactions to depression. *Journal of Personality and Social Psychology*, *44*(4), 798-806.
- Sutter, M., Kocher, M.G. (2007). Trust and trustworthiness across different age groups. *Games and Economic Behavior*, *59*, 364-382.
- Szcześniak, M., Colaço, M., & Rondón, G. (2012). Development of interpersonal trust among children and adolescents. *Polish Psychological Bulletin*, *43*(1), 50-58.
doi:10.2478/v10059-012-0006-5
- Tan, H.B., Forgas, J.P. (2010). When happiness makes us selfish, but sadness makes us fair: Affective influences on interpersonal strategies in the dictator game. *Journal of Experimental Social Psychology*, *46*, 571-576.
- Tavares, J., Drevets, W. C., & Sahakian, B. J. (2003). Cognition in mania and depression. *Psychological Medicine*, *33*(6), 959-967. doi:10.1017/S0033291703008432
- Unoka, Z., Seres, I., Áspán, N., Bódi, N., & Kéri, S. (2009). Trust game reveals restricted interpersonal transactions in patients with borderline personality disorder. *Journal of Personality Disorders*, *23*(4), 399-409.
- van den Bos, W., Westenberg, M., van Dijk, E., Crone, E.A. (2010). Development of trust and reciprocity in adolescence. *Cognitive Development*, *25*, 90-102.
- Wang, Y., Wang, Y., Chen, S., Zhu, C., & Wang, K. Theory of mind disability in major depression with or without psychotic symptoms: A componential view. *Psychiatry Research*, *161*, 153-161.
- Wilbertz, G., Brakemeier, E., Zobel, I., Härter, M., & Schramm, E. (2010). Exploring preoperational features in chronic depression. *Journal Of Affective Disorders*, *124*(3), 262-269. doi:10.1016/j.jad.2009.11.021

Wilkinson, G. S., & Robertson, G. J. (2006). *Wide Range Achievement Test 4 professional manual*. Lutz, FL: Psychological Assessment Resources.

Winer, D.L., Bonner, T.O., Blaney, P.H., & Murray, E.J. (1981). Depression and social attraction. *Motivation and Emotion*, 5(2), 153-166.

Wolkenstein, L., Schönenberg, M., Schirm, E., & Hautzinger, M. (2011). I can see what you feel, but I can't deal with it: Impaired theory of mind in depression. *Journal Of Affective Disorders*, 132(1-2), 104-111. doi:10.1016/j.jad.2011.02.010

Yuen, K. & Lee, T. (2003). Could mood state affect risk-taking decisions? *Journal of Affective Disorders*, 75, 11-18.

Zobel, I., Werden, D., Linster, H., Dykieriek, P., Drieling, T., Berger, M., & Schramm, E. (2010). Theory of mind deficits in chronically depressed patients. *Depression And Anxiety*, 27(9), 821-828. doi:10.1002/da.20713

Table 1. Descriptions of behavioral economic games

Game	Description
<p>Trust game (Berg, Dickhaut, & McCabe, 1995)</p> <p><i>Constructs:</i> Trust, reciprocity</p>	<p>A game between two players in which the “investor” decides how much of their \$10 to send to the “trustee,” an anonymous counterpart in another room. Each dollar sent is tripled along the way, and the trustee then decides how much of the tripled money to keep and return to the investor. Numerous researchers have since modified this game in terms of currency, number of rounds, conditions, etc.</p>
<p>Ultimatum game (Guth, Schmittberger, & Swarze, 1982)</p> <p><i>Constructs:</i> Fairness, altruism</p>	<p>A game between two players, a “proposer” and a “responder.” Using a predetermined sum of money, the proposer may allocate any portion of that sum to the responder. The responder then decides whether to accept or reject the proposer’s offer. With an accepted offer, both players receive the agreed upon amounts. With a rejected offer, both players receive nothing.</p>
<p>Dictator game (Kahneman, Knetsch, & Thaler, 1986)</p> <p><i>Constructs:</i> Cooperation, altruism</p>	<p>A game between two players, the “dictator” and the “recipient.” Using a predetermined sum of money, the dictator decides how much of that sum the recipient shall receive. The recipient, in turn, has no power over the situation and must accept whatever is given.</p>
<p>Prisoner’s Dilemma</p> <p><i>Constructs:</i> Cooperation, competition, exploitation</p>	<p>Put simply, the Prisoner’s Dilemma involves two participants engaged in a predicament with one another. They must choose between predetermined options that promote their own benefit, their co-player’s benefit, or their mutual benefits respectively. Each decision strategy has different results for the players.</p>

Table 2. Participant characteristics and group differences

	Depressed (<i>n</i> = 38)	Healthy control (<i>n</i> = 38)	<i>p</i> ^a
Age (in years)	14.82 (1.23)	15.11 (1.11)	.284
YSR affective problems	74.26 (8.85)	51.26 (2.61)	< .001
BDI-II	31.12 (10.22)	5.27 (3.32)	< .001
CGTB	75.02 (13.20)	82.08 (12.15)	.018
Trust game investment	4.41 (1.87)	2.87 (1.60)	.003
Lottery condition investment	4.41 (1.91)	3.01 (1.70)	.009
WRAT	47.91 (10.63)	56.54 (5.82)	.002
Race			
Black	7 (18.4%)	15 (39.5%)	$\chi^2 = 14.234;$ $p = .003$
White	12 (31.6%)	5 (13.2%)	
Hispanic	17 (44.7%)	12 (31.6%)	
Asian	0	6 (15.8%)	
Multiracial	2 (5.3%)	0	

Note: Data are mean (standard deviation), except for race. YSR affective problems = Youth self-report, Affective problems subscale; BDI-II = Beck depression inventory-II; CGBT = Children’s generalized trust belief scale (Rotenberg self-report measure of trust); Trust game investment = Mean investment from 5 trials of trust game; Lottery condition investment = Mean investment from 5 trials of lottery condition; WRAT = Word reading total score on Wide Range Achievement Test 4 (note: depressed, *n* = 22; healthy control, *n* = 37).

^a p-value of independent samples t-tests, otherwise noted as Chi-Square test.

Figure 1. Comparison of mean trust game and lottery condition investment strategies of depressed vs. healthy control groups

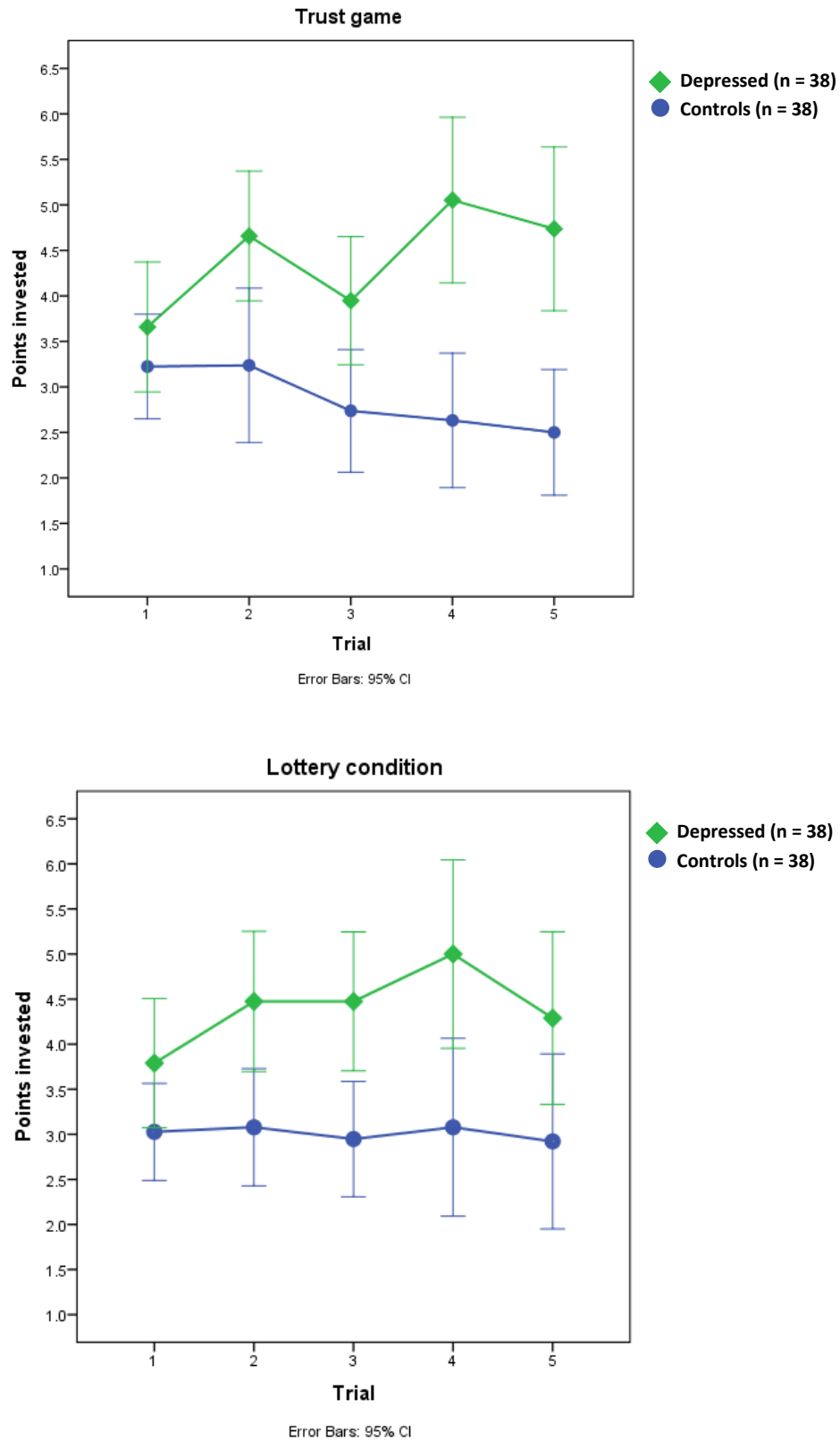
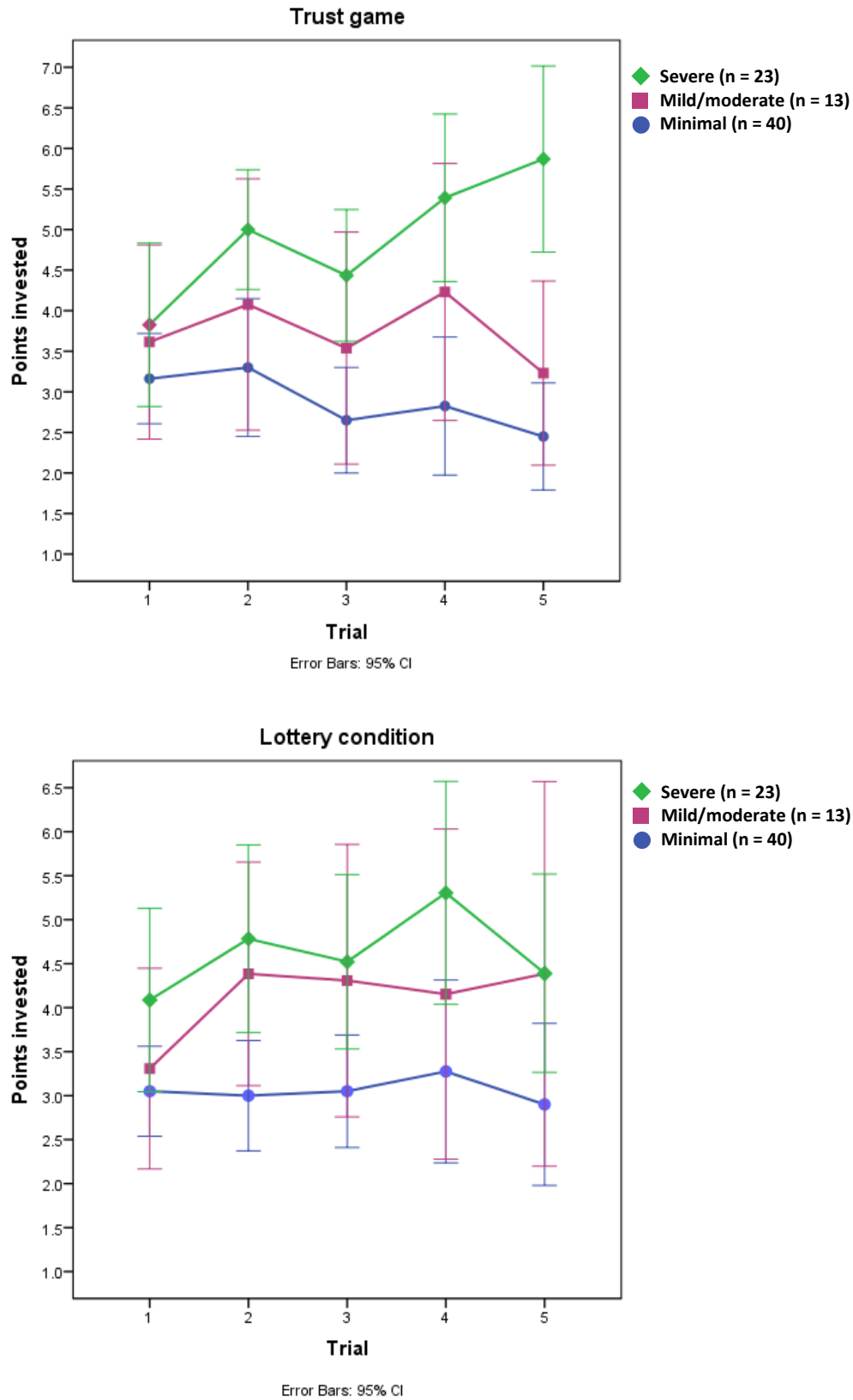


Figure 2. The relation between depression severity and mean investment strategies in the trust game and lottery condition



Appendix A

Power analyses

Power analyses were based on the study by Unoka et al. (2009) which used the same trust game with BPD, MDD, and healthy controls. This study utilized the same research design; however, the current study had 2 groups for primary analyses, depressed girls and healthy controls. With this study design as our model, power analyses were conducted using G*Power 3 (Faul, Erdfelder, Buchner, & Lang, 2009). With a small to moderate expected effect size of 0.3 and a power of 0.8, we expected a sufficient sample size to consist of 28 participants (depressed, $n = 14$; healthy controls, $n = 14$). However, we increased our total sample size to $N = 76$ for additional power.