

## Trust and general risk-taking in externalizing adolescent inpatients versus non-externalizing psychiatric controls

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### Abstract

**Background:** Interpersonal trust is an important target for the conceptualization, identification, and treatment of psychiatric disorders marked by interpersonal difficulties. A core feature of adolescent externalising disorders is interpersonal impairment. However, research investigating trust is scarce. A relatively novel approach for studying trust in psychopathology is through examination of social decision making using behavioural economic games.

**Objective:** To employ a modified trust game in order to determine whether externalising adolescents exhibit perturbed decision making in social and/or nonsocial contexts.

**Methods:** Externalising inpatient adolescents ( $n = 141$ ) and non-externalising psychiatric controls ( $n = 122$ ) completed self-report measures of psychopathology and invested in an iterative trust game played under two conditions: social (trust) and nonsocial (lottery condition), each consisting of five consecutive trials.

**Results:** Externalising adolescents showed a limited increase in trust investments, compared to a significant increase in lottery investments, across early game trials relative to psychiatric controls. This significant three-way interaction between experimental group, game condition, and trials became most evident at the second trial of games. Between-group differences on trust investments were non-significant. However, externalising adolescents invested significantly less in the trust relative to lottery condition, an effect unobserved in psychiatric controls.

**Conclusions:** This study tentatively suggests that adolescent externalising disorders may be associated with an insensitivity to normative social exchange which may arise, in part, from a lack of anticipated co-player reciprocity. It is not the level of trust that may distinguish externalising adolescents but perhaps the form of which the trust exchange takes shape. Conclusions are tempered by the fact that the employed trust game did not include feedback in the form of co-player repayments.

**Keywords:** Externalising disorder; conduct disorder; trust game; social reward; decision making

### Introduction

Externalising disorders refer to a class of psychiatric disorders characterised by antisocial behaviour, aggression, rule-breaking, impulsivity, and overactivity (1-3) and typically include conduct disorder, oppositional defiant disorder, ADHD, antisocial personality disorder, psychopathy, and features of borderline personality disorder (BPD). Interpersonal difficulties form a core feature of most externalising disorders. An important target for the conceptualization, identification, and treatment of psychiatric disorders with interpersonal impairment, such as externalising disorders, is interpersonal trust (hereon referred to as trust) which can be measured through behavioural decision making (4). Research

investigating the association between behavioural trust and externalising disorders, however, has been scarce.

Historically, a leading approach for understanding interpersonal problems associated with externalising disorders in children and adolescents has been to examine the social-cognitive deficits and distortions associated with these disorders. These studies have been guided by either the social information processing (SIP) or theory of mind (ToM) approaches (5). While the impact of the SIP and ToM has been substantial in elucidating the deficits and distortions underlying social decision making in child and adolescent externalising disorders, there are theoretical and methodological limitations to these

approaches (6). Both are based on the theoretical assumption that social cognition is a property of the person and not the relationship or the interaction between two or more people. This approach ignores the stochastic (online) nature of social interaction, which is intrinsically dynamic with one's thoughts and actions depending upon moment-to-moment changes in others' actions (and mental states) (7). Conceptualising social cognition as a person-characteristic results in utilisation of tasks that are typically "off-line" by virtue of reliance on hypothetical scenarios thereby limiting participant investment. Tasks are not administered in real time, do not sample actual social interactions, and are unlikely to elicit full emotional and behavioural engagement. Most social-cognitive tasks are also characterised by an over-reliance on self-report, thereby "pulling for thinking" and eliciting socially desirable responses (8).

To address some of these limitations, there has been a steady increase in the use of behavioural economic tasks to provide more ecologically valid paradigms for examining social decision making in externalising disorders (6). These paradigms allow for the mathematical parameterisation of constructs such as trust, fairness, reciprocity, social discounting and so on. All of these constructs and their associated experimental paradigms have mostly been developed from game theory, such that games consist of a set of real or imagined players who have a series of options or strategies to choose from in order to maximise pay-off. By varying task characteristics, seemingly simple games can be adapted to probe a remarkable range of social phenomena including social influence, prosocial behaviour, trust, social norm violations, social-cognitive biases, and higher-order social cognition (9).

In the context of behavioural economics, trust is defined as an exchange between two players in which cooperation and defection can be parametrically encoded as the amount of money designated for the partner. The basic one-shot trust game was initially proposed by Camerer and Weigelt (10) and further developed by Berg et al. (11). One player (the Investor) is endowed with a certain amount of money (or points as proxies for money). The Investor can keep all the money or decide to "invest" some amount with the partner (the Trustee). The amount invested is tripled in value as it is sent to the Trustee, who then decides what portion to return to the Investor.

The trust game has been used in several studies of healthy children and adolescents (e.g., ages 8 through 17+) (12-14). In the first study to use the trust game to study externalising behaviour problem in youth (15), two groups of boys (externalising vs. non-externalising; ages 8-18) recruited from the

community played a one-shot (single round) trust game under two conditions: an anonymous version where the identity of the trust game partner was not known and a "known identity" version where identities were revealed prior to the game. Results showed that boys with externalising problems exhibited similar trust behaviour (mean investments) compared to non-externalising boys regardless of condition. While this study is informative, a community sample of boys was recruited thereby limiting generalisations to clinical populations and the disease mechanisms associated with externalising behaviour. Moreover, the one-shot nature of the game utilised does not fully exploit the fact that models (representations) of interaction partners build over time and multiple rounds (16).

An additional consideration stems from the fact that since heightened risk taking is characteristic of externalising disorders (17, 18), it is therefore important to distinguish in which context(s), specifically, risk taking is elevated. The multi-trial trust task developed by Kosfeld et al. (19) offers a useful opportunity to do just that by providing the means to examine sensitivity to social risk taking versus risk taking in general. This task was utilized by Unoka et al. (20) with adult participants who were asked to invest money in an internet game where the pay-off depended on the intention of another person (trust game) or on luck (risk "lottery" condition). Interestingly, adults with BPD in this study showed a non-linear increase in investments across trials in the lottery condition, without similar investment increase in the trust game, whereas healthy control comparison adults showed a linear increase in investments regardless of condition. In other words, individuals with BPD exhibited different investment strategies over time as a function of game condition.

Against this background, the current study had two aims. The first aim was to use a multi-round trust task (19) in a clinical sample of adolescents to examine trust behaviour in relation to externalising problems. Given our prior work (15) demonstrating a non-significant association between externalising problems and trust, we did not expect a main effect for externalising problems such that those above cut-off on externalising problems would invest similar to non-externalising adolescents in the trust game. We did, however, expect that adolescents with externalising problems would be insensitive to task type compared to non-externalising subjects who would show differential investments as a function of game condition (trust versus lottery), exhibiting a linear increase when playing with a person (versus the lottery). Therefore, we expected a significant three-way interaction effect between group, task type (trust versus lottery), and trials. Such an interaction effect would fit with our prior research demonstrating a

general insensitivity to normative social exchange for externalising problems (15, 21) and other disorders with externalising features like BPD (22). Hypotheses were tested only after considering the potential confounding effects of age (14) and sex (23) as both variables associate with adolescent trust game investment.

## Methods

### *Participants*

Participants were recruited from the acute adolescent inpatient psychiatric unit of a county hospital serving the indigent population of a large metropolitan area in the USA. Inclusion criteria required participants to be between 12 and 17 years old and possess English fluency. Participants were excluded if the attending psychiatrist determined s/he did not have adequate capacity to participate in the study, which included the presence of mental retardation, active psychosis, or posing physical risk to research staff. The inpatient setting did not allow for structured intelligence assessments; however, participants were excluded if s/he repeated one or more academic grade which served as a proxy for intellectual/cognitive functioning. It was important to exclude any potentially low-functioning adolescents as it was critical that s/he fully understand the experimental task and instructions for gameplay.

A total of 345 adolescent inpatients were recruited for the present study. However, 37 participants providing consent/assent were excluded for repeating one or more school years, 25 were not administered the experimental task, 16 did not complete psychopathology self-report measures, two did not complete both the task and self-reports, and two provided consent but were unavailable to participate due to assessment scheduling difficulty. Thus, a remaining sample of 263 adolescents was included in analyses. In total, 141 adolescents (53.6%) met inclusion criteria for externalising problems and 122 (46.4%) did not, which designated them as psychiatric controls. The average participant age was 14.75 years ( $SD = 1.50$ ) and 67.7% were female. The racial/ethnic breakdown of the total sample was 34.6% Hispanic, 26.6% African-American, 30.4% white, and 5.4% multiracial with 3% self-identifying as other.

## Measures

### *Experimental task*

Unoka et al.'s (20) modified trust game was played under two counterbalanced conditions, each consisting of five consecutive trials. One condition (social condition) assessed interpersonal trust exchanges between the participant and an anonymous (fictional) peer co-player. A fully anonymous co-player was used as anonymity begets

generalised trust, which underlies all social interactions (14, 24). In each round, the participant, always acting as the investor, allocated anywhere between 0 and 12 monetary units (MUs) to their co-player (the trustee). As MUs were sent, they were tripled along the way. Participants were told that the trustee would then decide how many MUs to send back to the investor for each trial. In the second condition (nonsocial condition), the structure of the game was identical though instead of a co-player a computerised lottery system randomly determined repayment. The amount of MUs invested by the participant indicated the degree of trust in the other player or degree of general risk taking in the lottery condition. During both conditions, subjects did not receive feedback after each trial regarding the amount of repayment of investments. The absence of feedback creates uncertainty in the outcome of the decision making therefore ensuring risk taking (19).

### *Task administration*

Games were explained to participants via PowerPoint presentation, and participants were informed that the objective of each game was to earn as many MUs as possible and that MUs were equally valuable to both players, but that they would not be told of their cumulative earnings until afterwards. Players were informed that the order of games would be randomly determined. Participants' demonstration of understanding of game rules was required prior to administration. The assessor then pretended to make contact with a co-administrator via cell phone to ensure that the (fictional) trustee was "logged on" to play. Games were designed to mimic an online computer game and were played on Inquisit 2.0 software (25). Participants were first presented with a screen that confirmed they were being connected to the game (i.e. "Please wait while the other player logs on..."). After each trial investment, participants were told to please wait while the other player (or lottery) determined how many points were sent back. Given that deception was used (there was no trustee and cumulative points were not calculated), players were debriefed immediately following administration, in compliance with ethical standards (26). S/he was specifically asked not to share details about the experimental task with other patients to avoid contamination. High turnover rates on the unit further protected against contamination. No adolescent reported any negative feelings about the deception or the experiment.

### *Psychopathology*

The Youth Self Report (YSR) (27) is a well-established evidence-based assessment instrument that assesses global and specific psychopathology over the preceding six months among youth ages 11

to 18 years. The YSR consists of 112 problem items rated 0 (Not true), 1 (Somewhat or Sometimes true), or 2 (Very true or Often true). Relevant sample items, among others, include “I disobey my parents,” “I steal at home,” “I drink alcohol without my parents approval,” and “I run away from home.” For the present study, the externalising problems scale (includes rule-breaking behaviour and aggressive behaviour subscales) was used in order to explore broadband, rather than disorder specific, relations with trust behaviour in keeping with the focus of the study on externalising problems as a broader category of psychopathology. The recommended cut-off for clinical threshold ( $t$ -score  $\geq 65$ ) was used to delineate adolescents with and without externalising problems (27). Internal consistency for the externalising problems scale, as measured by Cronbach’s  $\alpha$ , was 0.88 in the current study.

### Procedures

The study was approved by the appropriate institutional review board. Adolescents admitted to the 16-bed adolescent acute inpatient unit psychiatric unit at a county hospital where the average length of stay is three–four days were approached on the day of admission about participating in this study. Parents were asked to provide consent, and, if given, adolescents were approached for assent. Assessments on the unit were routinely completed within two–three days of admission in quiet, private rooms well removed from the unit’s community area. Clinical psychology graduate students (or other

research staff) conducted assessments only after completing training under supervision of the principal investigator. Participation was completely voluntary and withdrawal was permitted without justification. Gift cards to a popular nation-wide retail department store chain were provided as compensation.

### Data analytic strategy

$\chi^2$  tests of independence and independent samples  $t$ -tests compared groups on sociodemographic and clinical variables with effect sizes reported in Cohen’s  $d$  and Cramer  $V$  statistics, respectively. Game order effects (a potential result of counterbalancing) were tested prior to conducting primary analyses. A three-way full-factorial repeated measures ANCOVA, with group as the between-subjects factor and game type and trials as within-subject factors, was then performed for primary analyses with effect sizes reported in partial-eta squared ( $\eta^2$ ). Effect sizes for  $\eta^2$  were considered small, medium, or large at values of 0.01, 0.06, and 0.14, respectively (28). In addition to Bonferroni-corrected *post hoc* tests, within-group paired-samples  $t$ -tests were conducted to tease apart significant interactions. The identification of age and sex as covariates was a priori and objective (29).

### Results

#### Sample characteristics

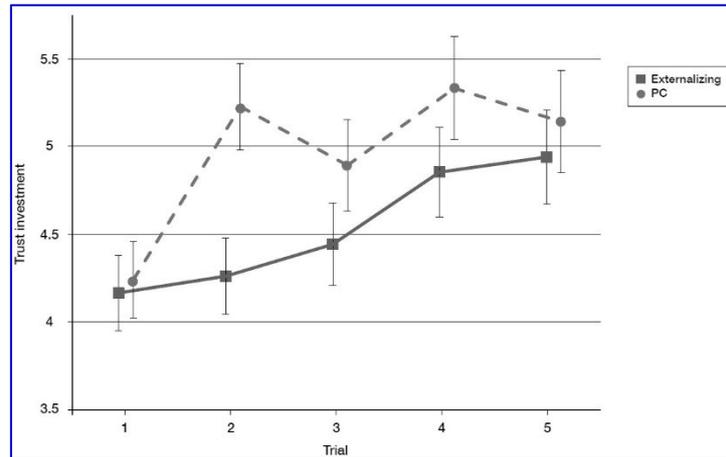
See Table 1 for sample sociodemographic characteristics, externalising problems, and mean investments per game condition.

**TABLE 1.** Sample characteristics and group comparison results

	Externalizing problems ( $n = 141$ )	Psychiatric controls ( $n = 1.22$ )	$t/\chi^2$	$p$	$d$
Age (in years)	14.78 (1.43)	14.70 (1.58)	0.164	0.686	0.053
Sex (% female)	68.80	66.40	0.172	0.678	0.026
YSR externalizing	71.54 (5.97)	54.66 (7.25)	429.159	<0.001	2.542
Mean Trust investment	4.56 (2.32)	4.95 (2.39)	1.736	0.189	0.166
Lottery investment	4.87 (2.40)	4.82 (2.13)	0.037	0.847	0.022
<i>Race</i>			6.56	0.341	0.163
African-American	40 (28.40%)	30 (24.60%)			
Caucasian	42 (29.80%)	38 (31.10%)			
Hispanic	44 (31.20%)	47 (38.50%)			
Multiracial	10 (7.10%)	4 (3.30%)			
Other	5 (3.50%)	3 (2.50%)			

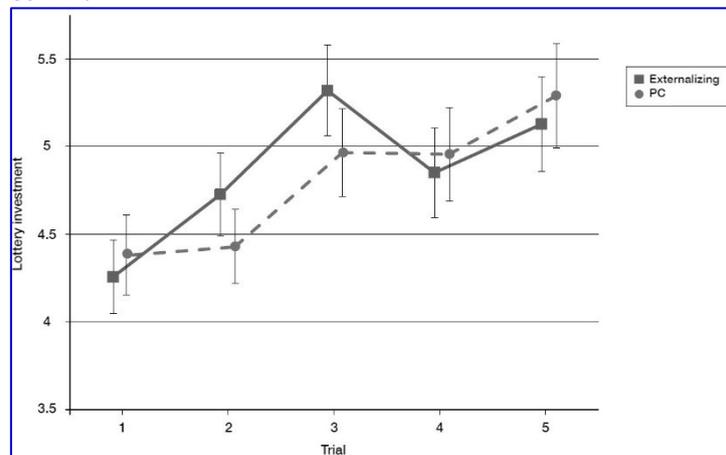
Note. Data are mean (standard deviation) unless otherwise specified. Independent-sample  $t$ -tests and  $\chi^2$  tests of independence were performed with effect sizes reported as Cohen’s  $d$  and Cramer’s  $V$  statistics, respectively

FIGURE 1 a



Trust and lottery investments by experimental group

FIGURE 1 b



Trust and lottery investment = mean investment per group per trial with 95% CI standard error bars

#### Testing for game condition order effects

Game condition order effects were tested (i.e. trust followed by lottery, lottery followed by trust) prior to conducting primary analyses. There was no significant association between group and game condition order,  $p = 0.761$ . There were also non-significant associations between order and mean investments in either game condition,  $p$ 's  $\geq 0.189$ . Moreover, there were no significant main effects or interactions between game condition order and other factors,  $p$ -values  $\geq 0.052$ .

#### Trust and lottery investments

A full-factorial three-way ANCOVA, controlling for age and sex, was conducted revealing a significant group  $\times$  game  $\times$  trials three-way interaction,  $F(4; 259) = 2.57$ ,  $p = 0.039$ ,  $\eta^2 = 0.010$ . Specifically, adolescents with externalising problems exhibited a

greater linear increase in investments in the lottery condition versus trust game, whereas psychiatric controls' investments showed a greater increase in the trust game versus lottery condition. As shown in Figure 1a and 1b, this interaction effect was pronounced over the first three trials of the game conditions. This significant three-way interaction precluded meaningful interpretation of the group  $\times$  game interaction effect,  $F(4; 259) = 4.84$ ,  $p = 0.029$ ,  $\eta^2 = 0.018$ , and the main effect of group was non-significant,  $p = 0.551$ . *Post hoc* Bonferroni-corrected tests showed that, despite starting at similar levels in trust game investment on Trial 1, it was at Trial 2 when adolescents with externalising problems (marginal mean (MM) = 4.29, standard error (SE) = 0.23, 95% confidence interval (CI) = 3.83 to 4.75) invested significantly less than psychiatric controls (MM = 5.22, SE = 0.25, 95% CI = 4.72 to 5.71),  $p =$

0.007,  $\eta^2 = 0.027$ . Within-group paired-samples  $t$ -tests were conducted to further tease apart the three-way interaction. Clarifying the group  $\times$  game interaction, externalising adolescents invested less on average in the trust game compared to the lottery condition,  $t(140) = -2.09$ ,  $p = 0.039$ , whereas psychiatric controls invested similarly in each game condition,  $p = 0.318$ . Between games, clarifying the three-way interaction, externalising adolescents invested comparatively less in the trust game versus lottery condition in Trial 2,  $t(140) = -2.00$ ,  $p = 0.048$ , and Trial 3,  $t(140) = -3.31$ ,  $p = 0.001$ . Psychiatric controls, in contrast, invested comparatively more in the trust game versus lottery condition in trial 2,  $t(121) = 3.30$ ,  $p = 0.001$ . Additionally, considering sex, there were non-significant differences between girls and boys mean investments in either game condition ( $p$ 's  $\geq 0.055$ ). Full-factorial three-way analyses were repeated controlling for game condition order, given the trend-level effects observed in preliminary analyses, and results remained similar with a still significant group  $\times$  game  $\times$  trials interaction,  $p = 0.036$ ,  $\eta^2 = 0.010$ .

## Discussion

The present study was the first to use a modified trust game with social (trust) and nonsocial (lottery) conditions to examine the association between adolescent externalising problems and trust behaviour. Consistent with hypotheses and prior work conducted by our research group (15), adolescents with externalising problems did not differ in terms of mean trust game investments versus non-externalising adolescents. However, the present study extends those prior findings by showing that mean trust among externalising adolescents is comparable to controls in a multi-round format. Because real-life social interaction often occurs over several exchanges, rather than in single shots (16), the use of a multi-round format arguably increases ecological validity. Convergent results between the present study and our prior findings (21) indicate that disrupted interpersonal relations in externalising adolescents may not necessarily be due to a blanket mistrust in others as previously stipulated (31). Instead, interpersonal impairment in externalising disorders may be more about the form of the trust exchange (i.e. the rise and fall of investments) that is distinguishing. A caveat, perhaps, is that the present trust game was played with an anonymous co-player rather than one with a known identity. However, the choice to utilise co-player anonymity was in effort to tap into generalised trust, which is thought to underlie all social interactions (14, 24). This design consideration suggests findings may relate to

broader interpersonal functioning. An important aside, given that the present sample was approximately 70% female, is that similar mean trust investments among externalising adolescents and controls does not appear to be exclusive to boys as shown in Sharp et al. (21). Non-significant effects of sex on mean investments in consistent with prior studies using this particular trust task (20, 32) but deviates from non-psychiatric research showing males to trust more than females (33, 34), including when interacting with unknown co-players (35).

The observed three-way group  $\times$  game condition  $\times$  trials interaction provides mixed support for our second hypothesis. The statistical distinction between game condition investment strategies over time, albeit of a small effect size, paired with prior findings (15, 21) tentatively suggests that externalising adolescents may demonstrate an insensitivity to normative social exchange. This working hypothesis is of course tempered by the fact that the trust game employed did not include feedback in the form of co-player repayments and, furthermore, investments in trial 2 specifically appear to have been instrumental to the significant interaction effect. However, early in-game deviations from normative trust game behaviour, such as a failure to increase investments in early game rounds, could dissolve the social exchange as the trustee co-player will likely be less likely to cooperate; a social breakdown previously observed in adult studies of externalising disorder (22, 36). To this end, externalising adolescents invested approximately 10–20% less during rounds 2 and 3 of the trust game relative to psychiatric controls who conformed to normative trust game investment strategies (allocating roughly half of game points; 11). As the actualised impact of externalising adolescents' investment strategy on co-player behaviour remains unknown in present context, a natural extension of this study that could clarify the speculative nature of these considerations would include a multi-round format trust game with an online peer co-player to capture the dynamic nature of trust social interaction.

Contrary to hypotheses, externalising adolescents did in fact distinguish between tasks, demonstrating a lack of increased trust game investment compared to a sharper increase in investments in the lottery condition over multiple rounds. The comparatively reduced within-group investment across trust game rounds 2 and 3 potentially indicates externalising adolescents' reduced anticipation of, or insensitivity and/or lack of responsivity to, "trustworthiness" (reciprocity) received from the trustee co-player. Given that it was not during the first trial when effects were observed suggests that perhaps

externalising adolescents were not simply being less altruistic or spiteful in their behaviour from the game's start. Several factors may potentially help explain this phenomenon. For instance, externalising adolescents may expect malevolence on the part of the trustee, making them more averse to potential betrayal in the social exchange (16, 19, 37). This point is affirmed by the fact that youthful trust game players generally recognise that repeated interactions with the same co-player present opportunities for cooperative social exchange (30). Externalising adolescents may have a negative, myopic view in this respect. Regarding the small effect size of the described three-way interaction, it may be important to consider that the control group was composed of psychiatric inpatients rather than healthy community controls. Had the sample been composed of the latter, perhaps a greater effect size would have been evidenced. Coming full circle, reciprocity has been found to be a strong predictor of subsequent increases or decreases in trust behaviour (16) and diminished anticipation of reciprocity could be conceptually relevant for externalising adolescents. Per Unoka et al. (20), the absence of in-game feedback may have been a determinant. More broadly, considering economic theory, perhaps externalising adolescents elected to maximise their gains early on, whereas non-externalising adolescents play the "long game," relying on co-player reciprocity to help maximise their in-game earnings. Finally, individual differences associated with externalising disorders such as elevated reward sensitivity and impulsivity (38) may also have been a contributor to observed effects.

Groups' investment strategies for the lottery condition were surprisingly similar. The linear increase in investments observed among psychiatric controls contradicted our hypothesis that their investment increase would be unique to the trust game. There could be several plausible explanations for this finding. Perhaps, for instance, the computerised lottery sufficiently activated "trustworthy" expectancies (anticipated reciprocity) in turn resulting in a comparable increase in investments to trust game trials. The present control sample could also have had clinical and/or sociodemographic characteristics making them more susceptible, than other samples, to the manipulation of the lottery condition. What partially distinguished externalising adolescents, however, was the discrepancy between investments by game conditions. The limited increase (or relative decrease) in trust game investments among adolescents with externalising problems parallels findings by Sharp et al. (15) showing externalising

adolescents to more strongly discount social reward compared to controls.

Despite its strengths, the present study is not without important limitations. The portion of game points' value attributed to the social interaction, rather than the economic value of the game points themselves, could not be isolated; however, this does not interfere with measuring the intended constructs (39). In an effort to increase participants' emotional and behavioural engagement with the task, it would have been ideal had payout been tied to in-game performance (40). Then again, the same task administration has been successfully used in other studies without this payout contingency in place (32, 41). Although SES went unmeasured, it may well have affected investment strategies and future studies may elect to include integrative measures such as the Hollingshead Four Factor Index of Social Status (42). Whether present findings generalise to clinically diagnosed inpatients is uncertain as group assignment relied on self-report rather than structured clinical interviews. Furthermore, to this end, any conclusion drawn with respect to the associations between trust and risk taking in specific externalising disorders is limited. Finally, the present trust game included an anonymous co-player, specifically, and future adolescent trust game studies may wish to include known and anonymous co-player conditions as executed by Venta et al. (32).

Limitations notwithstanding, an especially notable strength of the present study includes the utilisation of a modified trust game allowing for the joint examination of social (trust) and nonsocial (general risk taking) reward decision making, a consideration taken by relatively few behavioural economic studies to date. This distinction is important because such findings may help to clarify the particular circumstance(s) under which perturbations in reward system functioning in externalising adolescents may be evident.

### **Clinical significance and conclusions**

In conclusion, externalising adolescents did not differ in mean investments in either game condition, be it social (trust) or nonsocial (lottery condition), as compared to non-externalising psychiatric controls suggesting trust and general risk taking is similar between patient groups. However, externalising adolescents did exhibit some potential form of an insensitivity to normative trust social exchange as shown by differential investment strategies across trials between game types relative to psychiatric controls. Although preliminary, this seemingly perturbed pattern of decision-making, captured uniquely in an interpersonal context, provides scientists and treatment providers alike with a highly specific, discrete aspect of interpersonal dysfunction

that appears associated with adolescent externalising disorders. In turn, clinicians are provided with what could be adopted as a new, precise target for therapeutic intervention for adolescents with externalising problems which, if made malleable, may serve as a foundational component in treatment for improved interpersonal functioning. Study findings may also assist in the future development of novel diagnostic and clinical behavioural decision-making assessment tools. Such tools could be applied at the onset of treatment with future administrations thereby serving as a measure of treatment progress in conjunction with other commonly used symptom measures and measures of interpersonal functioning.

### Acknowledgement

The authors would like to thank the parents and teens who took part in the study.

### Financial disclosures

This research received partial support through general start-up funding provided by the University of Houston.

### Conflicts of interest

The authors declare no conflicts of interest.

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