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Decision-Making Deficits Among Maltreated Children

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Abstract

Although maltreated children involved with child welfare services are known to exhibit elevated levels of health-risking behaviors, little is known about their decision-making processes leading to these behaviors. Research findings suggest that maltreated children exhibit developmental delays in neurocognitive and emotional regulation systems that could adversely impact their abilities to make decisions under conditions of risk. Whereas prior researchers have examined risky decision making as a global construct, maltreated children's decision making was examined in two contexts in the present study: potential gains and potential losses. Comparing maltreated children ($n = 25$) and a nonmaltreated community group ($n = 112$), it was found that the maltreated children showed decision-making impairments for both domains: This impairment was especially prominent in the loss domain. The maltreated children took excessive risks and were insensitive to changes in expected value. Follow-up analyses revealed that these differences were primarily associated with insensitivity to changes in outcome magnitude for the risky option. Finally, response latency analyses indicated that the maltreated children were slower to make choices, reinforcing underlying differences in decision processes between groups. These results have implications for basic and translational science.

Keywords

Risk taking; decision making; expected value sensitivity; maltreated children; child welfare system

Numerous researchers have shown widespread disparities among children involved with child welfare services on indicators of physical and mental health and on developmental, social, and economic well-being (Barth, Gibbons, & Guo, 2006; Gunnar, Fisher, & The Early Experience, Stress, and Prevention Science Network, 2006; Kerman, Wildfire, & Barth, 2002; Pears & Fisher, 2005a, 2005b). In addition to the documented increased risks for engaging in maladaptive behaviors such as substance abuse, delinquency, and health-risking sexual behaviors, maltreated children exhibit evidence of long-term effects on neurocognitive functioning. This includes deficits on tests of inhibitory control and attention regulation (Beers & De Bellis, 2002; Lewis, Dozier, Ackerman, & Sepulveda-Kozakowski, 2007).

Although research findings have clearly demonstrated that maltreated children show increased risk taking at a global level, little is known about the basic decision-making processes underlying such tendencies in maltreated children. It follows that a broader

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conceptualization of how these children make decisions could help shape future intervention, risk communication, and public policy efforts. Hence, understanding how maltreated children process specific components of decisions such as outcome valence (i.e., outcomes presented as either a gain or loss), probability level, and outcome magnitude offer the potential to pinpoint specific areas of difficulty. By independently manipulating these variables within a study, our work represents an important step in this process. We investigated how maltreated children (ages of 9–12 years), compared to their nonmaltreated peers, approach risky decisions in terms of overall risk propensity and the ability to make advantageous choices under uncertainty (i.e., choices consistent with a normative standard).

Risky Decision Making and Expected Value Sensitivity in Typically Developing Children

The results from studies investigating risky decision making (i.e., choosing an option with a greater outcome variance) in childhood and adolescence suggest that, as individuals physiologically mature toward adulthood, they move toward more risk-averse preferences (see Boyer, 2006; Reyna & Farley, 2006). To assess risk preferences, most researchers examining behavioral decision making in children have employed laboratory-based gambling paradigms inspired by formal models of decision making such as Expected Utility Theory and Prospect Theory (Harbaugh, Krause, & Vesterlund, 2002; Kahneman & Tversky, 1979; Levin & Hart, 2003; Reyna & Ellis, 1994; von Neumann & Morganstern, 1947). In such studies, the children are presented with a choice between a sure option and an uncertain (risky) option that each has an equal expected value (EQEV; i.e., the product of the outcome probability and the outcome magnitude for a particular choice option). Thus, the results from these studies demonstrate child risk preferences; however, there is nothing disadvantageous per se about making a risky choice in the long-term given these circumstances.

When the expected value of one option is more favorable to another, however, consistently choosing that option leads to a more positive outcome over the long run. Thus, we consider the ability to make decisions consistent with the relative expected value between choice options (i.e., expected-value sensitivity) to be an index of advantageous decision making in that the relative expected value signals whether to approach or avoid a choice option. From a developmental perspective, researchers have demonstrated that the ability to make expected value–sensitive choices increases from childhood to adulthood. For instance, using a child-friendly analogue of the Iowa Gambling Task (IGT; Bechara, 2007), Crone and van der Molen (2004) found that, compared to adults, children (ages 6–12 years) made more choices that had a negative long-term expected value. Using another IGT variant, in which the participants chose to play (or pass) from advantageous or disadvantageous decks,Cauffman et al. (2010) found that preadolescents (ages 10–11 years) were more likely than older participants to play from decks offering large rewards but a negative long-term expected value (see also Burnett, Bault, Coricelli, & Blakemore 2010; Paulsen, Platt, Huettel, & Brannon, 2011).

Risk-taking and expected-value sensitivity for potential gains and losses

Theories of rational choice utility maximization assume that people hold stable preferences that are not influenced by contextual factors (Payne, Bettman, & Johnson, 1992). However, research findings suggest that this is rarely the case, leading to a more nuanced perspective of risky decision making. One specific contextual factor that influences risk preference is outcome valence (i.e., whether the risky choice is presented as a potential gain or loss). Generally, individuals take more risks to avoid potential losses than to achieve potential gains of equal magnitude, a phenomenon frequently referred to as the *reflection effect* or *preference shift* (Kahneman & Tversky, 1979). One prominent explanation is that the negative emotional impact of potential losses looms larger than the positive emotional impact of equal gains. Not only is the emotional impact presumed to be greater, but the processing of potential losses (vs. potential gains) has been suggested to require additional cognitive resources, induce more conflict, and activate a more complex neural system to process (Yechiam & Hochman, in press; Levin et al., 2012).

Although many researchers that have investigated children's decision making have employed decision-making tasks involving potential gains and losses within the same trial (e.g., Caufmann et al., 2010; Figner, Mackinlay, Wilkening, & Weber, 2009) or within only the context of one domain (i.e., gain/loss), few have separated gain- versus loss-related decision making within the same study. The few researchers that have done so have noted age-related differences as a function of outcome valence. Reyna and Ellis (1994) reported that 11-year-old children demonstrate the reflection effect, whereas younger children (ages 5–6 years) do not (cf., Levin & Hart, 2003; Schlottman & Tring, 2005). Levin, Weller, Pederson, and Harshman (2007) and Weller, Levin, and Denburg (2011) reported no preference shift effects for 8- to 11-year-olds using the Cups Task, a within-subject, repeated-gamble, risky–decision making task (see Procedure). Although no reflection effect was found in these studies, consistent with Reyna and Ellis (1994), Weller et al. found that progressive age-related risk taking to achieve gains declines across the lifespan, whereas overall risk taking to avoid losses remains relatively constant. These findings suggest fundamental differences in how individuals approach gain- versus loss-related decisions and reinforce the need to separately investigate decision making in both domains.

Research findings also indicate domain-specific age differences in terms of expected-value sensitivity (Levin et al., 2007; Schlottman & Tring, 2005; Weller et al., 2011). For instance, Weller et al. found that, in terms of overall risk taking, children (ages 5–11 years) make significantly more risky choices than older participants when it is disadvantageous to do so from an expected-value perspective. Additionally, for decisions involving potential gains, older children (ages 8–11 years) show no differences in expected-value sensitivity compared to college-aged students, even though children show a preference for the risky option. In contrast, expected-value sensitivity in the loss domain is not as refined at this age range, suggesting that the ability to make expected value-based decisions to achieve gains becomes more strongly developed at an earlier age (Schlottmann & Wilkening, 2012). Because we tested differences within a particular age group, we made no age-based hypotheses. However, the findings from past studies form the basis of what we expect to be normal decision-making performance in this population. Therefore, in the current study, we expected that nonmaltreated children would not demonstrate preference shift effects and would show greater evidence of expected-value sensitivity for decisions involving potential gains than for those involving potential losses.

Decision-Making Abilities of Maltreated Children

A large body of evidence demonstrates the deleterious effects of early childhood adversity, including maltreatment, on a host of negative outcomes (Dube, Felitti, Dong, Chapman, Giles, & Anda, 2003). For example, maltreated children are more likely to engage in sexual activity at a younger age (Tapert, Aarons, Sedlar, & Brown, 2001) and show elevated alcohol and drug abuse (Fergusson, Horwood, & Lynskey, 1994). These behaviors are not necessarily confined to adolescence but might continue or appear in adulthood (Shonkoff, Boyce, & McEwen, 2009).

Early maltreatment experiences have clear adverse neurobiological effects on the development of cortical structures such as the amygdala, anterior cingulate cortex, and the medial and lateral prefrontal cortex (e.g., Fisher, Stoolmiller, Gunnar, & Burraston, 2007; Gunnar et al., 2006), all of which are implicated in the ability to make advantageous choices under risk (Damasio, 1994). Further, research findings suggest that chronic activation of the neuroendocrine stress response system, which is often observed in maltreated children (Cicchetti & Rogosch, 2001; Gunnar & Vazquez, 2001), has adverse effects on many of the neurological structures believed to subserve executive function, learning, and memory (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007). In young children, early life stress (specifically, instability and unpredictability) has been associated with cognitive deficits (Lewis et al., 2007; Pollak et al., 2010). For instance,Spann et al. (2012) found physical abuse and neglect to be associated with an increased number of perseverative errors made on the Wisconsin Card Sort Task (Milner, 1963).

Moreover, maltreated children have been shown to preferentially attend to certain negative affective information (Pollak, Messner, Kistler, & Cohn, 2009; Pollak & Tolley-Schell, 2003). Essentially, this heightened sensitivity to punishment cues, coupled with cognitive delays in prefrontal function, might lead to heightened risk taking to avoid losses and less ability to make expected value-sensitive judgments in maltreated children. Thus, when presented with potential certain losses, these children might be more likely to attend to a small, certain loss and be more willing to take risks to avoid it even if the potential for a greater loss is present.

Designing research to better understand how the decision-making processes of maltreated children differ from their nonmaltreated peers could help explain the etiology of risk behavior at a process level. Although real-life risky decision making has been observed in maltreated children, there is a paucity of research investigating how they differ from the general population in how they make decisions. The first researchers, to our knowledge, who examined the relationship between maltreatment and decision making (i.e., Guyer et al., 2006) found that maltreated children (ages 8–14 years) showed no general behavioral differences in risk preference compared to their nonmaltreated peers but were quicker to select a risky option, suggesting a possible alteration in the reward processing system. However, Guyer et al. investigated decision making for potential gains but not for avoiding potential losses. Thus, the degree to which the decision making processes differ for potential gains and losses remains unanswered.

The Current Study

Our findings extend prior research in three meaningful ways. First, we independently tested risky decision making for potential gains and losses. Second, by including decisions in which it was favorable to take a risk, unfavorable to take a risk, and when the expected values were equated, we examined a broader range of expected-value sensitivity. Third, the design of the Cups Task allows for the independent examination of probability and outcome level. As a result, this design characteristic allowed us to further decompose any specific behavioral differences as the component level.

We expected that the nonmaltreated children would not demonstrate preference shift effects and would show greater evidence of expected-value sensitivity for decisions involving potential gains than for those involving potential losses. With this point in mind, we made three a priori hypotheses. First, we predicted that the maltreated children would show higher global risk taking compared to a community group of their nonmaltreated, same-age peers. Second, we predicted that the maltreated children would show reduced expected-value sensitivity for both domains. Third, we hypothesized that these effects would be accentuated in the loss domain, consistent with developmental studies that have showed similar deficits in young children (Weller et al., 2011).

Method

Participants

The participants were recruited via child-parent registries, newspaper and bulletin board notices, and collaboration with the relevant county child welfare service. The participants (*N* = 137) included 25 maltreated children: 12 (48%) female, 23 (92 %) Caucasian, and 2 (8%) Latino/Hispanic. The maltreated sample was collected as part of a larger, longitudinal study investigating children who were entering new foster care placements. This included children new to foster care, reentering foster care, and transitioning to new foster placements (each expected to last for 3 or more months). To be successfully recruited for the original study, the caseworker and the foster family had to consent to participation.

We also recruited two nonmaltreated community comparison groups: 39 low-income children and 73 middle-income children. Inclusion criteria for the low-income group were as follows: living with at least one biological parent, household income of less than $30,000, parental education of less than a 4-year college degree, and no previous involvement with child welfare services (as verified by child welfare service records). All children in the middle-income sample lived with at least one biological parent. All research protocols were approved by the appropriate IRBs. Approximately 77% (*n* = 30) and 93% (*n* = 68) of children in the low-income community and middle-income groups were Caucasian, respectively. In the low-income group, 3 were African American, 3 were Native American, and 3 were Hispanic/Latino. In the middle-income group, 2 were Asian American, and 2 were Hispanic/Latino.

For the inferential analyses, we conducted separate analyses comparing the low-income and middle-income groups and found no differences that systematically altered the interpretation of results comparing them to the maltreated group. Thus, we collapsed the nonmaltreated samples and report the results from the composite nonmaltreated sample (community group; *n* = 112; 56 females). The median age of the full sample was 10.67 years. The community group was slightly older (*M* = 10.53 years; range = 8.74–11.83 years) than the maltreated sample (*M* = 10.23; range 9.0–11.88 years), $t(135) = 2.14$, $p = .03$.

Maltreatment experiences—Maltreatment experiences were coded from child welfare services records using the Maltreatment Classification System (Barnett, Manley, & Cicchetti, 1993), which classifies each abuse incident according to maltreatment type and severity. We created a composite for abuse frequency and their mean severity. Severity was coded on a 5-point scale from less serious incidents to potentially life-threatening incidents. Mean frequency of abuse for these children was 10.83 (*SD* = 7.95), and mean severity was 3.10 (*SD* = .77).

Mood and anxiety disorders—For a subset of participants (the maltreated and the low-income community groups), we collected parental reports for child lifetime symptom counts for Axis I Mood and Anxiety Disorders using the Columbia Diagnostic Interview Schedule for Children (Shaffer, Fisher, Lucas, & Comer, 2003). The maltreated children did not significantly differ from the low-income community sample in terms of mood disorder symptoms, $t(60) = .69$, $p = .50$, or anxiety disorder symptoms, $t(60) = .61$, $p = .54$. Therefore, we did not examine this issue further.

General mental ability—Also, for the maltreated and community low-income groups only, we measured general mental ability using the Vocabulary subscale of the Wechsler Intelligence Scale for Children–4th edition (WISC-IV; Wechsler, 2003). The maltreated and low-income groups both scored in the average range, *M* = 9.2, *SD* = 2.9, and *M* = 9.9, *SD* =

2.2, respectively. There were no significant differences between groups $t(62) = -1.10$, $p = .28$.

Procedure

To investigate the study questions, we administered the Cups Task (see Figure 1; Weller, Levin, Shiv, & Bechara, 2007). Within this task, probabilities are conveyed by the number of cups in each array, providing a simple way to represent probabilities. The task consists of 54 trials representing 3 trials each of all combinations of two domains (gain/loss), three levels of probability (.20/.33/.50 [5/3/2 cups]), and three levels of outcome magnitude for the risky option (win/lose 2/3/5 quarters) compared to winning/losing one quarter for the riskless option.

On each trial, an array of 2, 3, or 5 cups is shown on each side of the screen. The participants are asked to select a cup from the side that they chose. One array is identified as the riskless side, in which one quarter will be gained/lost for whichever cup is selected. The other array is identified as the risky side, in which the selection of one cup will lead to a designated number of quarters gained/lost, and the other cups will lead to no gain/loss. At the bottom of the screen is a depiction of a bank where coins are shown being added or subtracted for each trial. The participants start each loss trial with enough quarters in the bank to ensure that they will not end up with a losing total.

Based on an independent manipulation of outcome magnitude and probability level, some combinations yield trials with EQEV, some trials are risk-advantageous (RA; expected value for the risky option is more favorable than that of the riskless option), and some are risk-disadvantageous (RD; expected value for the riskless option is more favorable than that of the risky option). Thus, the ability to avoid risks when the expected value favors the sure option and to take risks when the expected value favors the risky option (i.e., expected-value sensitivity) represents an index for advantageous decision making such that consistently choosing the option with a more favorable expected value will yield more positive outcomes in the long run. The gain and loss trials are presented as blocks, counterbalanced across all participants. A random process with $p = 1/(\text{number of cups})$ determines whether the risky choice leads to a gain or loss. When the participant completes all 54 trials, the total amount won appears on the screen.

Results

Correlations Between Demographics and Risky Decision Making

Because we examined decision making within a particular age group, we did not predict age differences in this sample. Nonetheless, we wanted to rule out its possible association with risky decision making. Age was not significantly correlated with overall risk taking to achieve gains, $r = .10$, $p = .24$, or for risk taking to avoid losses, $r = -.06$, $p = .49$. Additionally, age was not significantly correlated with expected-value sensitivity, an index calculated as the proportion of risky choices made on RA trials subtracted by the proportion of risky choices made on RD trials: $r = .06$ and .03 for the gain and loss domains, respectively. Additionally, child sex was not significantly correlated to any of these variables, $r = -.06$–.14, $p > .05$. Likewise, we did not observe any significant correlations between WISC-IV Vocabulary scores and the decision-making variables across the maltreated and low-income groups, $r = .11$ and .12 for the risk-taking and expected-value sensitivity variables, respectively. Given that we did not predict specific child age or sex differences and the lack of significant associations, we do not include these variables in the following inferential analyses.

Correlations Between Maltreatment Experiences and Decision Making

We also tested for correlations between maltreated experiences and risky decision making. Mean severity of abuse was neither significantly correlated with risk taking to achieve gains or avoid losses, $r = .21$, $p = .31$, and $r = .08$, $p = .70$, nor with expected-value sensitivity for either domain, $r = -.21$ and .17 for gains and losses, respectively. Likewise, frequency of abuse was not significantly correlated with risk-taking, $r = .05$ and −.18, or expected-value sensitivity, $r = .08$ and −.02, for the gain and loss domains, respectively.

Preference Shift Effects

Next, we tested whether maltreatment status was associated with the classic preference shift effect (i.e., risk taking to avoid losses > than risk taking to achieve gains). We conducted two parallel paired-samples *t*-tests, using the total number of risky choices made for the gain and loss domains, respectively. Consistent with past research findings (Weller et al., 2011), we found that the community group did not demonstrate this effect, $t(111) = 1.06$, $p = .28$, $d = .10$. In contrast, we found a trend for the maltreated children to show a small effect for heightened risk taking to avoid losses compared to the propensity to take risks in the gain domain, $t(24) = 1.60$, $p = .06$, $d = .32$. These findings suggest a difference in risk propensity as a function of maltreatment status.

Risky Decision Making and Expected Value Sensitivity for Potential Gains and Losses

To test whether the maltreatment group showed differences in advantageous decision making compared to the community group, we conducted two separate 3 (Expected-Value Level: RA/EQEV/RD) × 2 (Group: maltreatment/community) mixed-model ANOVAs following the analyses conducted inWeller et al. (2011). Because our focus was on expected-value level as a function of group, we used linear contrasts comparing RA trials with RD trials as a more powerful test.

Gain domain—In Panel A of Figure 2, we illustrate risky decision making as a function of expected-value level and group for the gain domain. We did not observe group-level differences in terms of overall risk taking, $F(1, 135) < 1$. Consistent with findings from previous investigations using the Cups Task, we found a strong main effect for expected-value level: Individuals were more likely to choose the risky option when it was advantageous to do so than when it was disadvantageous to do so, $F(2, 270) = 33.76$, $p < .001$, $\eta^2_p = .20$. The Expected-Value Level × Group interaction was marginally significant, $F(1, 135) = 2.38$, $p = .06$, $\eta^2_p = .02$. The effect size for expected-value sensitivity indicated a small group effect, $d = .34$. Thus, as predicted, the maltreatment group showed evidence of limited expected-value sensitivity compared to the community group.

Loss domain—In Panel B of Figure 2, we illustrate each group's risk taking as a function of expected value in the loss domain. In terms of overall risk taking, we found a marginal main effect for group membership, $F(1, 134) = 1.90$, $p = .08$, $d = .24$: The maltreatment group was more likely than the community group to take a risk to avoid a loss. We found a significant main effect for expected-value level, $F(1, 134) = 7.54$, $p < .01$, $\eta^2_p = 05$. However, these analyses need to be considered in light of a Group × Expected-Value Level interaction, $F(1, 134) = 4.67$, $p =.015$, $\eta^2_p = .03$. Whereas the community group showed age-appropriate expected-value sensitivity, the maltreatment group did not appear to adjust their decisions based on expected value. Effect size estimates of group-level differences on expected-value sensitivity for the loss domain suggest a medium effect, $d = .45$. In particular, the maltreatment group made more risky choices (75% of trials) than the community group (62%) for RD trials, $t(134) = 2.03$, $p = .02$, $d = .45$.

Probability × Outcome Analyses

To further examine these results, we explored whether the decision-making differences observed in the maltreatment group could be attributed to specific insensitivities to variations in probability level and outcome magnitude for each domain. To test this, we conducted generalized estimating equation analyses that allow a within-subjects analysis of the participants' decision-making behavior for each trial as a function of group membership (maltreated/community), probability level (.50/.33/.20), and outcome magnitude of the risky option for each domain (+/− .50/.75/.1.25 for the gain and loss domains, respectively) using each choice—0 (*riskless*) or 1 (*risky*)—as a dependent measure rather than as an aggregate sum of risky choices made at each broad expected-value level. Because the dependent variable was a binary response, we utilized a logit-link function in these analyses. Standard errors were estimated using a robust variance estimator. Analyses were conducted with a compound symmetry working correlation matrix, which assumes homogenous correlations between within-subject responses. Parameter estimates were achieved using hybrid maximum likelihood estimation.

As shown in Table 1, we observed differences in the probability level and the outcome magnitude as function of domain and maltreatment status. For the gain domain, we found significant effects for both. That is, as the probability level of winning by choosing the risky option became less favorable, the participants took fewer risks. Conversely, as the outcome magnitude of the risky option increased, the participants took more risks. However, the main effects for probability level must be considered in light of the significant Group × Probability Level interaction, which showed that the maltreated children were less likely than the community children to adjust their decisions based on the number of cups presented. The Group × Outcome Magnitude interaction was not significant.

For the loss domain, we observed a different pattern of results. Consistent with past research findings with children in this age range (Levin et al., 2007), we found a significant main effect for outcome magnitude but did not find a significant main effect for probability level. Thus, the children tended to utilize outcome magnitude information in the loss domain but were less influenced by changes in the probability level of realizing a potential loss. We also found a significant Group × Outcome Magnitude interaction (see Figure 3), in which the maltreated children were less likely to adjust their decision making in response to greater potential losses. The Group × Probability Level interaction was not significant.

Response Latency Analysis

We also examined whether the maltreatment group showed different response latencies (RT) when making their choices compared to the community group. Before proceeding, we examined the distributions of each individual trial. RTs that fell more than three standard deviations above the mean were trimmed. We then conducted a natural log transformation for all trials to reduce the positive skew associated with measuring response latencies. Composite RT scores were created by averaging the log-transformed RTs for gain and loss trials.

We correlated RTs and overall risk taking for each domain separately for the maltreatment and community groups. In the community group, we found that greater risk taking was associated with slower RTs for the loss domain, $r = .23$, $p < .01$, but not for the gain domain, $r = .15$, $p = .12$. In contrast, we observed no significant associations between risk taking and RTs in the maltreatment group for the gain and loss domains, $r = -.06$, $p = .77$, and $r = -.02$, $p = .95$, respectively. To test for differences in RT between groups as function of domain, we conducted two independent-samples t-tests. For the gain and loss domains, we observed that the maltreatment group showed generally slower responses compared to community group, $t(134) = 5.22$, $p < .001$, $d = 1.23$, and $t(134) = 5.63$, $p < .001$, $d = 1.29$, respectively.

Discussion

Child maltreatment has been shown to increase the risk of engaging in maladaptive, health-risking behaviors, yet the decision-making processes of these children that might underlie these behaviors are not well understood. In this preliminary study, we found that these children approach decisions of uncertainty in a different manner than their nonmaltreated peers. Whereas the community children showed age-appropriate risk taking when the outcomes were presented as a gain or a loss, the maltreated children showed increased risk taking to avoid losses. Further, the maltreated children were less likely to utilize the relative expected value of choice options to arrive at normatively appropriate decisions. This insensitivity appeared to be prominent when the children were faced with potential losses. Compared to the community children, the maltreated children were less likely to utilize contextual cues such as probability level (for both domains) and outcome magnitude (for the loss domain), leading to less normatively appropriate choices.

These results are consistent with past research findings showing disparities across many domains of cognitive, emotional, and social functioning for maltreated children. Our findings extend this prior work by documenting evidence of specific delays associated with advantageous decision making. In particular, the maltreated children tended to make riskier choices, and this was particularly apparent in the loss domain. These findings have several important implications. First, maltreated children might often find themselves in situations in which poor decision making can be quite impactful. These include peer conflict situations and contexts in which there is risk for physical injury in childhood as well as choices in adolescence that could involve drug or alcohol use and sexual behavior. Second, the tendency to choose risky options and a general insensitivity to the potential for loss might help explain why maltreated children often end up experiencing negative outcomes (e.g., pregnancy, addiction, arrest, and school failure). Third, these findings suggest that the increased risk taking observed in maltreated children is more associated with hypersensitivity to real or imagined punishments. This hypersensitivity might prompt steps to be taken to avoid this loss, even if the chance to realize an even more averse consequence exists. We emphasize that this does not suggest that these children are not responsive to efforts to improve their environments; rather, care should be taken when intervening to increase positive behavior and deliver consequences that do not overemphasize loss (e.g., natural or matter-of-fact consequences as opposed to punishments).

Moreover, our results with respect to the gain domain are strikingly consistent with those observed using the Wheel of Fortune Task used byGuyer et al. (2006). In EQEV and RA trials, there were no significant differences between the maltreated and community children. It is important to note, though, that the maltreated children (compared to their nonmaltreated peers) did not respond impulsively to the risky decisions as reported inGuyer et al. (2006), as evidenced by slower response latencies. However, this difference is likely due to the increased complexity of the Cups Task compared to the Wheel of Fortune Task. In this regard, the response latency findings reported in the current study challenge typical dual-process accounts of cognition, suggesting that compromised executive function leads to greater impulsive, associative behavior (Kahneman, 2011). Hence, one might expect that risk taking would be negatively associated with response latencies. In contrast, we observed that greater risk taking is associated with slower response times in community children. This finding resembles research reporting that adults respond more quickly than adolescents to questions about potential health risks (Baird and Fugelsang, 2004). Instead, slower response times might indicate developmental differences in inhibitory control function, increased attention to the prospect of a certain loss, or both (see also Reyna & Farley, 2006 for a memory-based account).

Although our study was not designed to test any neuropsychological hypotheses, we propose that these results might reflect underlying differences in the neural development of maltreated and community children. From a structural perspective, researchers have shown that maltreatment is associated with smaller hippocampal volumes and decreased cortical volumes, both white and gray matter, in the prefrontal cortex (Carrion et al., 2001; Carrion, Weems, Richert, Hoffman, & Reiss, 2010; De Bellis et al., 2002). From a functional perspective, researchers have suggested more diffuse brain activation in the neural circuitry subserving decision making and executive function in maltreated children. For instance, Fisher, Bruce, Abdullaev, Mannering, and Pears (2011) found that maltreated children do not differ behaviorally from healthy comparisons but show greater neural diffusion of activation when completing the task. In turn, this diffusion of activation could lead these children to make suboptimal decisions. The effects could become even more apparent when considering potential losses, which are believed to create greater conflict and require additional cognitive resources (Yechiam & Hochman, in press). We tentatively propose that maltreated children show a hypersensitivity to potential punishment, possibly mediated by functional differences in amygdala functioning (Pechtel & Pizzagalli, 2011). Consistent with neural models of decision making (Bechara, Damasio, Tranel, & Damasio, 1997), when the amygdala attempts to engage the prefrontal cortex, immaturity or dysfunction of either structure can result in suboptimal decision making. Thus, preadolescents might be less able to make expected value–sensitive choices for potential losses due to the normal physiological development of the dorsal and medial prefrontal cortex, which is believed to be protracted compared to the subcortical structures responsible for signaling rewards and punishments (Gogtay et al., 2004). This might especially be the case for children who demonstrate delays in executive function. In fact, for the maltreated children in the current study, expected-value sensitivity in the loss domain resembled that of 5- to 7-year-old nonmaltreated children rather than same-age peers (Weller et al., 2011). Subsequent research efforts would be well served to directly link behavior to neuropsychological functioning in these children.

Intervention Implications

Ultimately, the goal of this research is to better conceptualize the etiology of the decision-making impairments observed in these groups and, from there, to develop interventions that will help individuals make more appropriate choices. In this light, the current results have important implications for interventions with maltreated children. At present, the existing evidence-based interventions for maltreated children and adolescents (of which few exist) focus on reducing child problem behavior through social learning or relationship-based methods. There has been little or no consideration of whether the challenges that these children face might be the result of impaired decision making or of the extent to which interventions that directly target decision-making processes might impact outcomes positively. For example, having maltreated children practice decision making in situations in which potential losses are highly salient might greatly improve functioning in this area. This sort of training might work well as a stand-alone intervention but might be more effective if used to augment existing evidence-based approaches.

Limitations and Future Directions

Although our results are encouraging, we acknowledge several limitations in our results and suggest future research directions. First, because the Cups Task is a monetary task, risk taking within this context might not map onto risk taking in social situations. Future research is required to better link behavioral risk-taking tasks to social risk taking, though considerable research findings support links between real-life risk taking and monetary decision-making tasks. For instance, researchers have suggested that we encode the value of objects, money, and situations into a common neural currency (Montague & Berns, 2002). Also, accumulating research findings suggest that performance on a variety of behavioral decision-making tasks predict health-risking outcomes (Bruine de Bruin, Parker, & Fischhoff, 2007; Hunt, Hopko, Bare, Lejuez, & Robinson, 2005). Thus, despite not being directly tied to social situations, understanding how children approach decision making in a monetary task has the potential to illuminate the processes by which they subjectively value and evaluate choice options. However, we encourage future researchers to investigate whether maltreated children differentially approach decisions involving social versus monetary rewards.

Second, although our results support past developmental findings regarding decision making, they cannot directly speak to developmental trajectories of risky decision making for potential gains or losses. Longitudinal designs have the potential to document the hypothesis that risk taking peaks in adolescence and the degree to which differences are due to functional and structural changes in neural development (Somerville, Jones, & Casey, 2010; Steinberg, 2008). Central to translational science, the results from such studies could increase our understanding of the nature of decision-making impairments in these children and help determine whether early adversity results in developmental delays or permanent alterations in the underlying neural architecture subserving decision making. This crucial next step in the research process might help better tailor interventions for this population.

Finally, we acknowledge limitations with our sample. For instance, though we did not observe significant differences between the middle-income and low-income groups, our results cannot speak to the degree to which maltreatment status explains variance in risk-taking beyond family income. Although this might be a plausible explanation, we find it difficult to reconcile the observed domain-specific differences with a pure income disparity account. Also, because our middle-income community sample was not screened for maltreatment or child psychopathology, we cannot completely rule out the possibly of these variables in this subsample. Certainly, this is a potential concern. However, the greatest threat to validity would be if there were multiple maltreated children in this sample. Because this middle-income sample performed similarly to those from past studies of typically developing children in the same age cohort, we have increased confidence that the likelihood of maltreated children being part of our community sample were negligible. Even if maltreatment was present, the pattern of our reported results would indicate an attenuation of the true effect sizes rather than inflated results.

In sum, our results suggest that maltreated children process risky decisions differently as a function of outcome valence or domain. In particular, these children might have particular difficulties processing risks involving potential losses. We hope that our findings encourage future researchers to explicate how these children approach decisions under uncertainty and inform interventions and public policy efforts.

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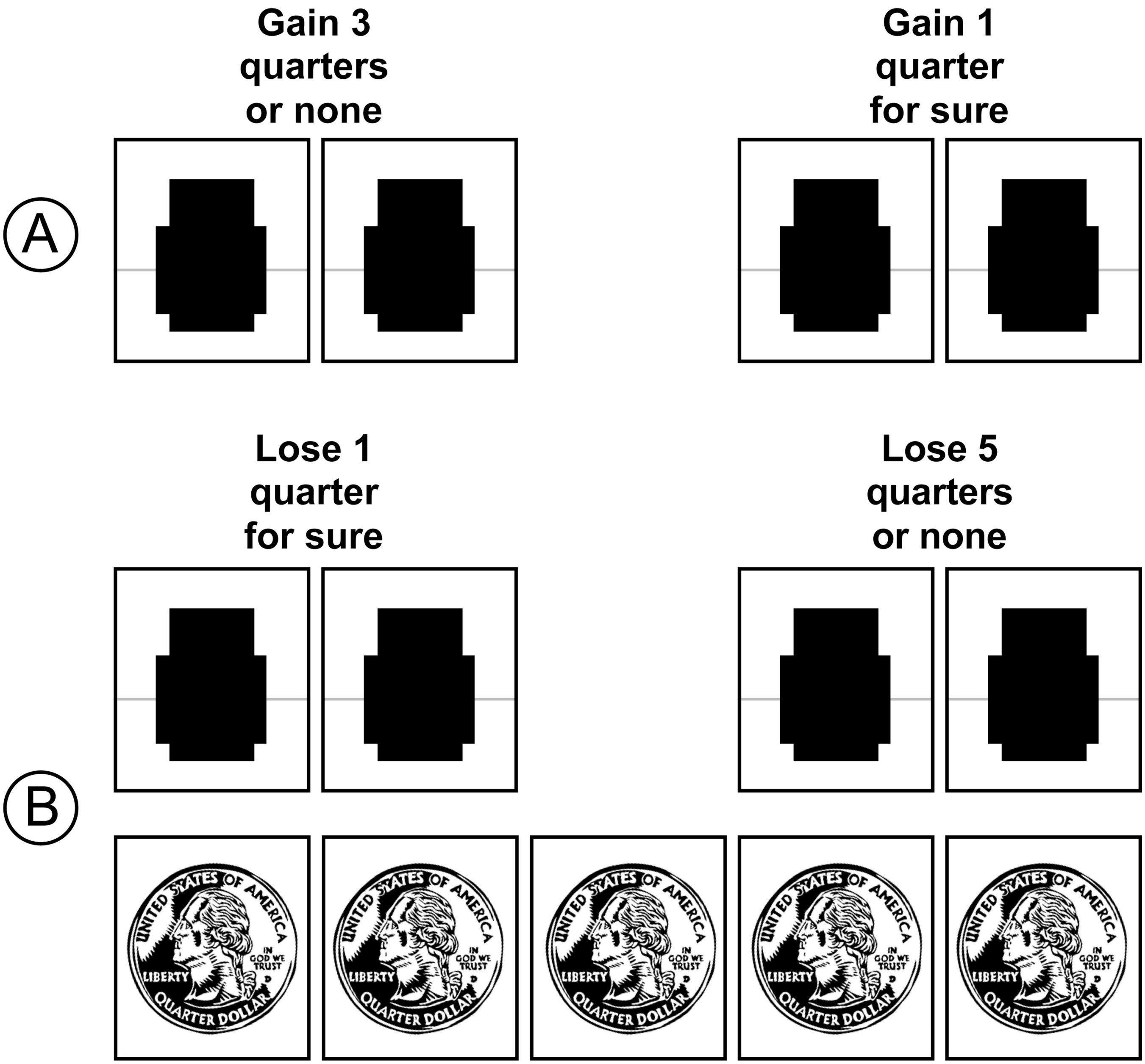

Figure 1. Cups Task paradigm

Note. In the Cups Task, participants see two arrays of cups. One array is designated as the *sure* side. If chosen, the participant wins/loses one quarter. The other array is *risky*, in that there is an uncertain outcome. Panel A displays an example of a *risk-advantageous* trial in the gain domain (expected value of the risky choice, 0.50 × \$0.75 = .375, is greater than the expected value of the riskless choice, 1.00 × \$0.25 = .25). Panel B displays an example of a *risk-disadvantageous* trial in the loss domain (expected value of the risky choice, 0.50 × −\$1.25 = −.625, is less than the expected value of the riskless choice, 1.00 × −\$0.25 = −\$.25). After selecting a cup from either array, the participants receive immediate feedback regarding the amount that they won or lost on that trial.

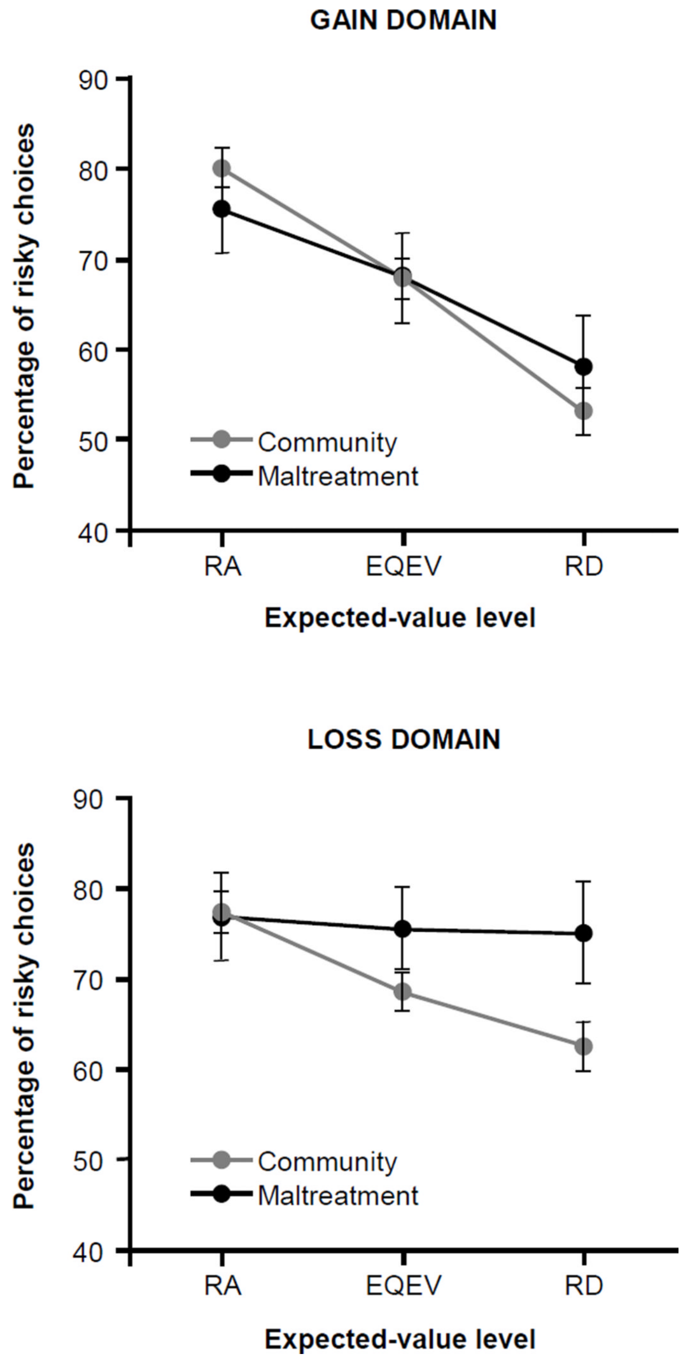

Figure 2. Advantageous decision making for risky gains and losses

Note. This figure displays the number of risky choices made as a function of expected-value level (RA, EQEV, or RD) and maltreated group status. The top portion of the figure represents risky decision making in the gain domain, whereas the bottom portion reflects risky decision making in the loss domain. Error bars reflect standard errors. RA = risk-advantageous trials; EQEV = equal expected value trials; RD = risk disadvantageous trials.

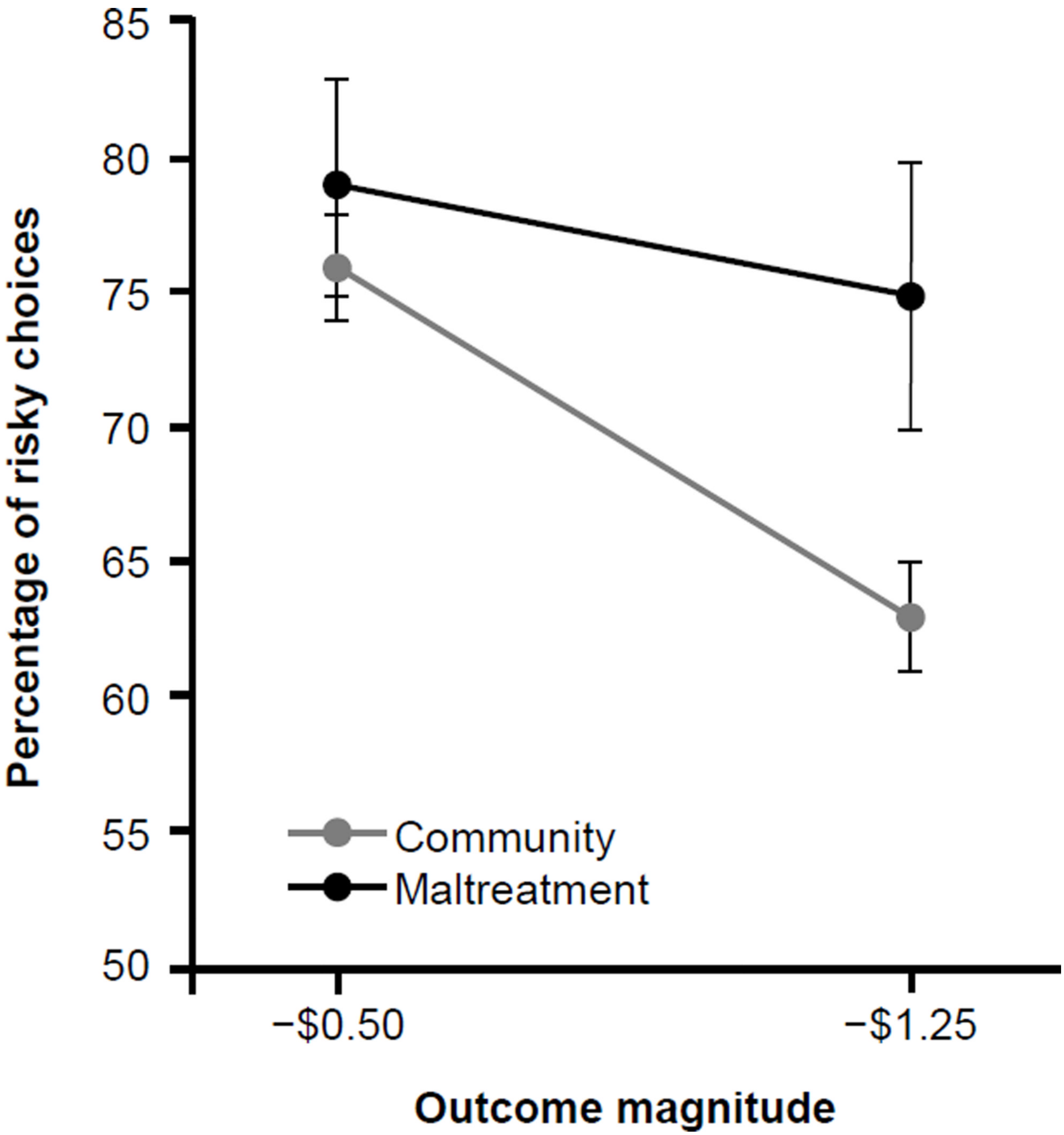

Figure 3. Proportion of risky choices as a function of outcome magnitude and maltreated group status—loss domain

Note. This figure illustrates risk propensity as a function of outcome magnitude and maltreated group status for the loss domain. The maltreated group showed greater risk taking and limited sensitivity to changes in outcome magnitude compared to the community group.

Table 1

Effects of Probability and Outcome Magnitude on Risky Decision Making as a Function of Outcome Valence and Foster Group Status

				95% CI	
Parameter	**Estimate**	***SE***	**Wald χ^2**	**Lower**	**Upper**
Gain domain					
Group (community = 0)	0.95	0.53	3.22	−0.09	1.98
Probability level	3.55	0.41	74.26**	2.74	4.36
Outcome magnitude	1.10	0.14	60.14**	0.82	1.40
Group × Probability Level	−2.05	0.93	4.84*	−3.86	−0.22
Group × Outcome Magnitude	−0.32	0.34	0.89	−0.99	0.35
Loss domain					
Group (community = 0)	−0.49	0.56	0.78	−1.58	0.60
Probability level	−0.78	0.47	2.72	−1.70	0.15
Outcome magnitude	0.79	0.14	31.75**	0.52	1.07
Group × Probability Level	0.89	0.99	0.81	−1.06	2.84
Group × Outcome Magnitude	−0.60	0.28	4.40*	−1.15	−0.04

* $p < .05$.

** $p < .01$