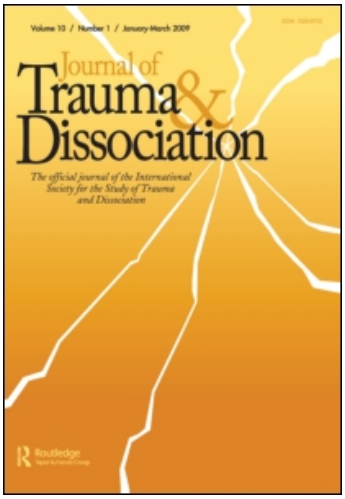

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Stroop Performance, Dissociation, and Trauma Exposure in a Community Sample of Children

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Stroop Performance, Dissociation, and Trauma Exposure in a Community Sample of Children

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ABSTRACT. Extending previous research with adults, the current study examined Stroop task performance under selective and divided attention demands in a community sample of school-age children (N = 97). Stroop interference scores in both attention conditions were calculated. Higher levels of child-reported dissociation were associated with better interference control under divided attention conditions and worse control under selective attention conditions; lower levels of dissociation were associated with the opposite pattern. Both family violence exposure and Stroop interaction scores explained unique variance in dissociation scores. Although research with adults has generally assumed or implied that cognitive correlates of dissociation are a consequence of dissociation, the current findings with school-age children suggest that future research should evaluate

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executive function performance (in this case, interference control) as a possible risk factor for dissociation.

KEYWORDS. Dissociation, attention, Stroop, violence, child abuse

Dissociation has been defined as a lack of integration among "psychobiological systems that constitute personality" (van der Hart, Nijenhuis, Steele, & Brown, 2004, p. 906), characterized "by profound developmental differences in the integration of behavior and in the acquisition of developmental competencies and metacognitive functions" (Putnam, 1997, p. 15). Although high levels of dissociation are associated with a host of information-processing difficulties (e.g., Freyd, Martorello, Alvarado, Hayes, & Christman, 1998; Putnam, 1997), recent work points to conditions under which highly dissociative adults actually outperform their less dissociative counterparts on laboratory tasks, depending on the cognitive demands of the task (DePrince & Freyd, 1999; Elzinga, de Beurs, Sergeant, van Dyck, & Phaf, 2000; Simeon et al., 2006).

DePrince and Freyd (1999) reported a Dissociation × Attention interaction such that undergraduate participants who scored high on a dissociation measure showed less Stroop interference when *dividing* their attention compared to *focusing* their attention; participants who scored low on dissociation showed the opposite pattern. Recently, this finding was replicated in dissociative patients relative to both depressed and healthy controls (Simeon et al., 2006), demonstrating that, even in a patient population, dissociative participants can show relative advantages under some conditions. Extending beyond interference to working memory tasks, Elzinga et al. (2007) reported that patients with dissociative disorders showed less of a decline in performance at higher levels of the n-back task (which requires keeping track of multiple pieces of information at one time) than a healthy control group.

Several ideas have been advanced to explain these findings. DePrince and Freyd (1999) proposed a cognitive environments conceptualization of dissociation that suggests that dissociation may be experienced, in part, as a state of chronically fragmented attention. From this view, dissociative experiences would, over time, lead highly dissociative individuals to become more practiced at performing under divided attention demands. In a different, though related, approach, Elzinga and colleagues (e.g., Elzinga et al., 2007) have argued that dissociation is associated with a

particular cognitive processing style that differs from the style characteristic of other related diagnostic conditions, such as posttraumatic stress disorder (PTSD). In particular, these authors argued that dissociative individuals are likely to show greater ability to inhibit trauma-related information, possibly at the expense of other cognitive processing (e.g., processing of identity-related information).

Both of these explanations (DePrince & Freyd, 1999; Elzinga et al., 2007) suggest that the dissociative capacities seen in the lab are in some way a response to coping with either trauma-related information (e.g., memories) or the very experience of dissociation (e.g., disintegrated information processing) across development into adulthood. As such, these explanations make considerable developmental inferences that should be tested in children to guide future investigations concerned with the development and nature of dissociation. For example, to the extent that a unique dissociative cognitive style develops over time into adulthood, one would expect dissociative adults, but not necessarily children, to show the Attention × Dissociation interaction. Replication of the Attention × Dissociation interaction in children would suggest that cognitive differences are present earlier in the development of dissociation than previously noted. The earlier that cognitive correlates are observed, the more pressing it will be to evaluate whether cognitive styles are a consequence of managing dissociation itself or trauma-related memories across development into adulthood or a risk factor for the development of dissociation.

If differential performance as a function of attentional demands is the consequence of pathological and/or chronic dissociation, one would expect to see interactions of task demands only with extreme groups (e.g., non- vs. pathological-dissociators). In the adult literature, researchers have generally divided participants into extreme groups, such as high versus low dissociation (e.g., DePrince & Freyd, 1999, 2001, 2004) or patient versus control (e.g., Elzinga et al., 2007; Simeon et al., 2006). If, however, differential performance as a function of attention demands is actually part of a risk factor for (rather than consequence of) pathological dissociation, one might expect continuous measures of dissociation to be associated with performance earlier in development.

In spite of the developmental inferences implied in the adult literature, few studies have examined dissociation and attention in children. A recent pilot study with 5- to 8-year-old children in foster care demonstrated that higher levels of childhood dissociation (per foster parent report) were strongly associated with deficits in tasks requiring inhibition

where cognitive load was low; however, dissociation was not associated with deficits in tasks that made greater cognitive demands on the child, such as those that required planning, strategy, and multiple rule sets (Cromer, Stevens, DePrince, & Pears, 2006). This study was limited in that the attentional demands of a single task were not manipulated (such as the Stroop manipulation in DePrince & Freyd, 1999; Simeon et al., 2006) and data were not available on trauma exposure. Given that a considerable literature links family violence exposure to higher levels of dissociation (for reviews, see Freyd, DePrince, & Gleaves, 2007; Putnam, 1997), trauma exposure status should be considered.

The current study extends research on interference control as a function of dissociation and attentional demands in adults to a community sample of school-age children. Extending DePrince and Freyd (1999) and Simeon et al. (2006), we predicted an interaction of Attention × Dissociation for Stroop interference scores in children, where Stroop interference is defined as the reaction time required to indicate the color of a word in incongruent trials (e.g., the word *red* appears in green) after subtracting the reaction time required to indicate the color of a word in neutral trials (e.g., the word *cloud* appears in green). Specifically, we hypothesized that higher dissociation scores would be associated with greater interference in selective attention conditions and less interference in divided attention conditions where the cognitive load is greater, relative to low dissociation scores, which would be associated with the opposite pattern.

METHOD

Participants

A total of 114 children aged 9 to 12 and their guardians were recruited for a two-session study through flyers advertising the "Children's Attention Research" project. Flyers stated the following: "We are studying how stressful events affect children's attention, memory, and school performance." Flyers were distributed in social service and mental health agencies, community centers, and local businesses in a large western city in the United States.

We excluded 17 children because either estimated full-scale IQ scores were less than 70 (n = 6), or we were missing either Stroop (n = 7) or trauma exposure (n = 4) data. This left a final sample of 97 children. Of

the 97 children reported on here, 51% were female; the average age was 10.39 (*SD* = 1.18). Parents described 4.1% of children as Asian, 29.8% as Black or African American, 33.0% as Hispanic, 6.2% as Native American, 46.4% as White or Caucasian, and 3.1% as members of another racial or ethnic group (percentages total more than 100% because guardians could check as many categories as applied). Parent–child dyads received $25 per session for their participation. In addition, children received small age-appropriate prizes during the testing session.

Materials

The Stroop task consisted of two separate blocks: selective attention and divided attention. The procedures associated with these blocks are described in further detail below. Five trial types were included in the Stroop task: rows of *x*'s, neutral, negative, positive, and incongruent. In all, 20 incongruent trials (10 per block) included the word *red* appearing in green or the word *green* appearing in red. Neutral trials (5 per block) included the following words: *coffee*, *hat*, *curtain*, *farmer*, and *button* (selective attention block); *garden*, *drum*, *moon*, *school*, and *bell* (divided attention block). Negative trials (5 per block) included *unhappy*, *sorrow*, *tears*, *upset*, and *mad* (selective attention block); *awful*, *nasty*, *hate*, *sadness*, and *anger* (divided attention block). Positive trials (5 per block) included *cheerful*, *fun*, *friendly*, *love*, and *playful* (selective attention block); *happy*, *lucky*, *enjoy*, *smile*, and *joy* (divided attention block). Neutral, negative, and positive words were randomly assigned to the two blocks. Positive, negative, and neutral words across both blocks (selective and divided) were matched for approximate average length, part of speech, and frequency.

For the purposes of testing the predicted interaction, we were interested in reaction time to neutral and incongruent trials. The number of positive, negative, and neutral words correctly recalled was used in a check of the attention manipulation. We also used comparisons between the neutral and positive/negative words as a check of the valence of the neutral words. Specifically, five research assistants who were not involved in this study were asked to rate all stimuli on a scale of 1 (*negative*) to 5 (*positive*), where 3 was neutral. We calculated the average rating across the five respondents for each word. Average ratings per word were then compared across the three categories: negative ($M = 1.40$; $SD = 0.18$), neutral ($M = 3.08$; $SD = 0.34$), and positive ($M = 4.55$; $SD = 1.33$). The one-way analysis of variance was significant, $F(2, 27) = 360.44$, $p < .001$, and

follow-up Tukey honestly significant difference tests indicated that ratings for each category differed from the others. Finally, a one-sample *t* test examining whether the average ratings of the 10 neutral words differed from 3 (the neutral point on the scale) was not significant, $t(9) = 0.76$, $p = .46$.

Guardians reported on children's trauma history using behaviorally defined questions from the UCLA (University of California at Los Angeles) PTSD Index (Pynoos, Rodriguez, Steinberg, Stuber, & Frederick, 1998). The measure has been shown to have good reliability (Roussos et al., 2005) and validity (Rodriguez, Steinberg, Saltzman, & Pynoos, 2001). Children were categorized in the familial trauma group if the guardian reported exposure to either physical maltreatment at home, sexual maltreatment by an adult, and/or the witnessing of domestic violence. Children were categorized in the nonfamilial trauma group if guardians reported no exposure to the previous three items and exposure to disasters, motor vehicle accidents, serious medical treatment, and/or community violence.

Dissociation was assessed using both parent and child report. The Child Dissociative Checklist (Putnam, 1997), a 20-item parent-report measure, assesses multiple types of observable, dissociative behaviors. The Child Dissociative Checklist has been demonstrated to have high reliability and validity (Putnam, 1997), with good internal consistency in the current sample (Cronbach's $\alpha = .82$). The Adolescent Dissociative Experiences Scale (Armstrong, Putnam, & Carlson, 1997) is a 30-item self-report measure that was developed for use with adolescents. Given the age of children in our sample, items were administered verbally and children responded by pointing to a Likert scale. Internal consistency of the child report of dissociation was excellent (Cronbach's $\alpha = .94$).

Procedure

Parents and children came to the laboratory for two 2-hr testing sessions as part of a larger study on children's attention and trauma exposure. All participants completed an extensive informed consent process; testing took place only after the mother consented and the child assented, both in writing.

Parents answered questionnaires in paper-and-pencil format in a quiet room with a research assistant present. Children were tested in a separate room by a graduate research assistant; they were encouraged to take breaks as needed. The Stroop task was administered via computer.

Children were asked to make a key press with their left index finger if words appeared in green and with their right index finger if words appeared in red. They were instructed to ignore the word meaning and focus only on the color of the words. All children completed a practice block of 10 trials with names as the stimuli (e.g., *ron*, *sally*, *kate*, *bob*, *danny*). They then completed the selective attention test block (consisting of the five trial types described above). Words appeared for 1,700 ms with a 2,000-ms intertrial interval. A filler list of children's names appeared at the beginning and end of the block. Children were then asked to write down all of the words they remembered from the list they just saw. Following this free-recall task, children were given new instructions for the divided attention test block. They were instructed to continue making key presses to indicate the color of words while also studying the words for a memory test at the end. They were reminded to do two things at once: Press the key to indicate the color and study the words. They saw a filler list of children's names and then test trials began, presented at the same rate as in the selective attention block. A filler list of children's names appeared at the end of the divided attention block. Children were then asked to complete another free-recall task. Following the free-recall task, they were directed to complete a recognition memory task. The 30 words from the selective and divided attention blocks as well as 30 similar distractor words were presented in random order. Children were directed to press one button to indicate if they had seen the word before (an "old" word) and another button if the word was new (a "new" word). At the end of the study, children completed a debriefing process that involved reporting on their responses to research participation.

RESULTS

Survey Measures

According to guardian report, 40 children were exposed to physical maltreatment at home, sexual maltreatment by an adult, and/or the witnessing of domestic violence (family trauma group); 32 children were exposed to nonmaltreatment traumas only, such as natural disasters, motor vehicle accidents, serious medical treatment, and/or community violence (nonfamilial trauma group); and 25 children were not exposed to trauma (no trauma group).[1] A planned contrast revealed that family violence was associated with higher levels of dissociation symptoms than

nonfamilial trauma and no trauma (weights: familial trauma = 2, nonfamilial trauma = –1, no trauma = –1) for both parent report, $t(94) = 2.48$, $p < .05$, $r_{\text{effect size}} = .25$; and child report, $t(94) = 2.03$, $p < .05$, $r_{\text{effect size}} = .21$.

Attention Manipulation Check

The divided attention instructions directed children to both respond to the colors and study words for a memory test. Thus, we tested the effect of attention condition on overall free recall to confirm that the manipulation worked. Indeed, children recalled more words in the divided attention condition (when they were instructed to name colors *and remember* words) than the selective, $F(1, 83) = 89.69$, $p < .001$, partial $\eta^2 = .52$.

Stroop Data

Reaction time data were cleaned to delete all trials in which either (a) the child made the wrong key press or (b) reaction times were greater than 2,500 or less than 200 ms. Following the procedure used by DePrince and Freyd (1999), individual data were cleaned such that reaction times were brought back to 2.5 *SD* above the mean for each individual in each condition before calculating group means. Means and standard deviations for incongruent and neutral conditions by group are reported in Table 1. The mean reaction time to neutral words was subtracted from the mean reaction time to the incongruent trial (i.e., *red* appears in green) for each individual to calculate a mean Stroop score.[2] Higher scores reflected interference caused by the incongruent trial relative to reading time for neutral words. By using the neutral words as the baseline condition (vs. a string of *xxx*'s as in DePrince & Freyd, 1999), we controlled for general reading processing speed, which is important in studies of school-age children where variation in reading skills is expected. One-sample *t* tests indicated that the interference scores differed from zero in the selective

TABLE 1. Mean (*SD*) reaction time by condition and trauma exposure group.

Group	No Trauma	Nonfamilial Trauma	Familial Trauma
Selective–Incongruent	729.76 (151.78)	707.24 (165.42)	761.75 (190.16)
Selective–Neutral	721.24 (171.41)	686.21 (149.16)	718.66 (148.55)
Divided–Incongruent	847.15 (181.13)	780.36 (151.62)	862.42 (230.26)
Divided–Neutral	859.18 (162.49)	794.73 (218.30)	892.81 (242.76)

attention, $t(96) = 2.09$, $p < .05$; but not divided attention, $t(96) = -1.02$, $p = .31$, versions of the task.

To test the interaction of Attention (selective vs. divided) × Dissociation, we could dichotomize dissociation into high versus low and conduct a 2 × 2 repeated measures analysis of variance. To avoid dichotomizing the dissociation score, however, we created an *interference difference score* by subtracting the divided Stroop score from the selective Stroop score. In this way, we were able to examine the relative performance under divided and selective attention conditions in a single score and, in turn, to use correlation and regression to test our hypotheses with a continuous predictor variable (dissociation scores). Bigger interference difference scores indicated greater interference in the selective attention condition and less in the divided condition; smaller scores indicated less interference in the selective condition and more in the divided condition. A significant positive correlation between dissociation and interference difference scores was equivalent to an interaction of Dissociation × Attention condition where high dissociators showed less interference in the divided attention condition and more in the selective attention condition, relative to low dissociators who showed the opposite pattern.

Correlations between trauma exposure status, parent- and child-reported dissociation, and the interference difference scores are reported in Table 2. As predicted, higher dissociation scores per child report were associated with higher interference difference scores. Guardian reports of dissociation were unrelated to interference difference scores.

TABLE 2. Correlations ($N = 97$) between parent- and child-reported dissociation and interference interaction scores.

Variable	Guardian-Reported Dissociation	Family Trauma Status	Stroop Interference Score
Child-Reported Dissociation	.47**	.21*	.24*
Guardian-Reported Dissociation		.25*	.11
Family Trauma Status			.10

Notes:
*$p < .05$.
**$p < .001$.

We next tested whether interference difference scores could predict variance in child-reported dissociation scores above and beyond family violence status. The interference difference score for incongruent trials and family violence exposure (weights: familial trauma = 2, nonfamilial trauma = −1, no trauma = −1) were regressed on child-reported dissociation scores with family violence entered on Step 1. At Step 1, the model was significant, $F(1, 95) = 4.18$, $p < .05$, $R^2 = .04$. When the interference interaction difference score for incongruent trials was added in Step 2, the model was again significant, $F(2, 94) = 4.81$, $p = .01$, $R^2 = .09$, with a significant increase in R^2, $\Delta F(1, 94) = 5.24$, $p < .05$. In Step 2, interference difference scores ($\beta = .23$, $p < .05$) explained unique variance in dissociation scores; family violence status ($\beta = .18$, $p = .07$) approached conventional significance levels.

DISCUSSION

The current study contributes to a growing body of research demonstrating differences in information processing as a function of both dissociation level and attentional task demands. In particular, children's reports of higher levels of dissociation were associated with *less* interference under divided attention demands (relative to those on selective attention); lower levels of dissociation were associated with the opposite pattern. This is the first study of which we are aware to report interactions between dissociation and attentional demands on interference control in children. Notably, though, we did not replicate the findings with parent report of dissociation. Although child and parent report of dissociation were related ($r = .46$), there is reason to believe that parents may underestimate children's dissociation levels because dissociation is an internal experience that may or may not manifest in visible behaviors for observers. In fact, the Child Dissociative Checklist (parent report) specifically taps observable dissociation-related behaviors (e.g., showing rapid changes in behavior), whereas the Adolescent Dissociative Experiences Scale (child report) taps internal experiences (e.g., feelings of confusion, feeling in a fog).

Several theorists have argued that dissociative style involves unique attentional abilities under particular cognitive demands in adult samples (e.g., DePrince & Freyd, 1999; Elzinga et al., 2000, 2007). These studies have generally depended on dividing participants into groups based on a dichotomized dissociation score or patient status (e.g., dissociative

disorder patients vs. healthy controls). Furthermore, authors have generally assumed that the cognitive performance observed was a byproduct of a dissociative processing style (e.g., DePrince & Freyd, 1999), a view that makes sense given that findings are generally observed when comparing extreme groups (e.g., patients vs. nonpatients, or high vs. low dissociators). For example, based on comparisons of participants who scored high and low on a measure of dissociation, DePrince and Freyd (1999) suggested that chronic dissociation over time might increase the individual's ability to deal with multiple streams of information.

The current study stands out amid this burgeoning literature because a *continuous* measure of dissociation interacted with attentional demands *in children*, raising important developmental considerations. Specifically, these data suggest that interactions between dissociation and attention occur earlier in development than previously described. Thus, these findings point to the need for future research to evaluate whether certain types of executive function alterations (in this case, interference control) might represent (or be a cognitive marker of) a risk factor for dissociation rather than (or in addition to) a consequence of dissociative experiences. Perhaps individual differences in executive function, in combination with trauma exposure, contribute to the development of dissociative tendencies. Furthermore, these findings stand out from the adult literature in that a *continuous* measure of dissociation (rather than extreme groups) interacted with attention demands to predict interference control performance. Thus, these findings raise interesting questions about the *nature* of dissociation at different points in development. Perhaps we see the interaction with a continuous measure of dissociation in childhood and extreme groups in adulthood because dissociation falls on a continuum earlier in development with transactions over time than separating individuals categorically into pathological and nonpathological dissociators.

Limitations

Interpretation of these findings should be cautious for several reasons. Self-selection biases inherent in community-based recruiting may create challenges in generalizing these findings. For example, we may have tapped more normative than pathological dissociative processes in this community-based sample relative to a clinic-referred sample. We relied on parent report of child trauma history and thus may have included false negatives given parents' potential concerns about mandated

reporting. Every effort was made to minimize false reports by developing procedures to allow parents to report on trauma history anonymously; however, the relationship between family violence exposure and dissociation scores may have been decreased because of error variance caused by false negatives. For six children reported to have been sexually abused by an adult, we did not have information on the victim–perpetrator relationship; thus, these children may have been misclassified and error variance increased. Furthermore, the questionnaire used to assess trauma exposure did not allow us to examine contextual factors, such as age of onset or frequency of exposure to potentially traumatic events, that may be important contributors to cognitive processing. However, given concerns that parents may underreport children's experiences or symptoms, a strength of the study was the use of both parent and child report of dissociation. We found that parent- and child-report scores were strongly related and that the internal consistency of child reports was excellent.

In terms of the Stroop task, we did not test whether children in the current sample found the neutral words to in fact be neutral in content. Research assistants not involved in this project rated the neutral words as neutral; however, future research should confirm the valence of words used in the specific population tested. Although children, on average, showed interference in the selective attention condition, their interference scores, on average, did not differ from zero in the divided attention condition. The use of key presses (rather than voice responses as used by DePrince & Freyd, 1999) may have created a less sensitive measure of interference. The field would benefit from additional research using different types of attentional manipulations and response formats with child samples.

The current study did not include trauma-related stimuli to examine interference related to the emotional content of words. This will be important in future research, particularly for clarifying directional relationships between information processing and dissociation. In particular, if differential performance of highly dissociative individuals results from chronic coping with trauma-related memories (e.g., Elzinga et al., 2007), one would expect to see larger effect sizes in response to trauma-related stimuli than neutral stimuli. If, however, differential performance is a risk factor for the later development of dissociative problems or a more general cognitive correlate of dissociation, one might expect effect sizes to be approximately the same, regardless of stimuli content.

Clinical Implications and Future Directions

In the current study, interference control improved under divided (relative to selective) attention conditions as dissociation level increased. Thus, consistent with the adult literature, there appear to be unique conditions under which dissociation is actually associated with improved performance (DePrince & Freyd, 1999; Elzinga et al., 2007; Simeon et al., 2006). As research further specifies these conditions, clinicians may have opportunities to help clients identify and select environments that support clients' information-processing styles. In the case of the current study, the advantage was seen in divided relative to selective conditions; however, many of the environments in which children must function (e.g., school settings) demand focused attention. Children may engage in behaviors that otherwise appear disruptive (e.g., fidgeting, talking in class) in an effort to manage or influence their attentional environment (Becker-Blease & DePrince, 2005; DePrince & Freyd, 1999). Thus, this body of research suggests that clinicians should evaluate the function of problem behaviors that may have their roots in regulating the attentional environment. Furthermore, as the number of empirical studies linking dissociation and attention variables increases, clinicians should consider assessing for dissociative problems when children are reported to have trauma histories and disruptions in attention.

We propose several directions for future research. First, empirical research on cognitive correlates of dissociation should be extended more fully to children. In the adult literature, the use of experimental methods to evaluate information processing in dissociation has been critically important to furthering researchers' understanding of dissociative phenomena. However, the adult literature makes considerable inferences about development. To test these developmental assumptions, research with children is urgently needed. Second, longitudinal methods should be used to test whether some of the unique cognitive correlates of dissociation (in this case, the interference interaction) are makers of preexisting individual differences that, when combined with certain types of trauma exposure, contribute to the development of dissociative tendencies. A handful of recent studies with adults suggest that performance on cognitive tasks prior to adult-onset trauma predicts PTSD (e.g., Kremen, Koenen, & Boake, 2007; Parslow & Jorm, 2007); however, these studies did not evaluate contributions of child trauma exposure or dissociation as an outcome. Longitudinal work with children, therefore, offers invaluable opportunities to test whether alterations in cognitive performance are risk factors for and/or consequences of dissociation.

NOTES

1. Of the 32 children in the family violence group, 6 were reported to have experienced sexual maltreatment only, and the nature of the relationship to the adult was not specified. Because familial trauma could not be ruled out in these six cases and exposure to sexual abuse was more similar to the events experienced by those in the familial trauma group than the nonfamilial trauma group (e.g., medical traumas, accidents), these 6 children were classified in the familial trauma group.

2. Not surprising given variability in children's reaction times, a handful of outlying data points were noted in interference scores. Analyses using winsorized data that brought outlying data points back to 3 *SD* above the group mean were comparable to those using the original interference scores.

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