Investigating the Relationship Between Adverse Experiences and Memory in Children

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Abstract

There is a considerable amount of research linking adverse childhood experiences (ACEs) to poor mental and physical outcomes in adulthood. Little research, however, has examined how these adverse childhood experiences effect children. Early stress has been found to have a lasting effect on brain structure, particularly in areas of the brain linked to declarative memory functioning in adults. Children who have experienced traumatizing events have been found to show impaired declarative memory functioning. However, this finding of early memory impairment continues to be a topic of debate as some findings have shown this relationship is only apparent in adulthood. The purpose of this study was to investigate the relationship between the number of ACEs a child reports and their declarative memory functioning while controlling for IQ. Data was collected in children between the ages of 7 and 16 in a low SES community. Additionally, we wanted to determine if PTSD symptoms moderate the relationship between ACEs and declarative memory. Finally, because research investigating children and ACEs is so scarce, it was important to determine if measuring self-report ACEs in children is feasible and valid.

Results (N=29) showed a significant relationship between ACEs and memory functioning. However, PTSD was not found as a moderator in this relationship. A significant association was found between the number of ACEs and PTSD symptoms reported, demonstrating the validity of children’s self-reported data of this nature. This finding shows that memory deficits in children who have experienced cumulative stress are apparent in childhood suggesting a need for early intervention.
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Adverse childhood experiences (ACEs) are potentially traumatic experiences occurring during the first 18 years of life (Felitti et al., 1998). These events could include things like emotional and physical abuse, neglect, parental incarceration, and parental separation or divorce. Adverse experiences often co-occur and are common in the population. Nearly two-thirds of the American adult population reports an experience of at least one of these ACEs (Anda et al., 2007). The definition of ACEs has expanded to include peer victimization, witnessing violence or other traumatic events, and theft.

The cumulative number of adverse childhood experiences a person reports has been linked to many poor outcomes in adulthood, including both mental and physical health (Scott, Smith, & Ellis, 2010; Danese et al., 2009). Among these poor outcomes in adulthood is cognitive impairment. Specifically, memory functioning in adults who report experiencing ACEs has been found to be impaired (Majer, Nater, Capuron, & Reeves, 2010; Brown et al., 2007). High levels of stress have been shown to be associated with reduced hippocampal size and impaired declarative memory functioning in adults (Schwabe & Wolf, 2012; Henckens, Hermans, Joels, & Fernandez, 2009). While there is significant evidence supporting the link between ACEs and memory impairment in adulthood, much less research has examined whether these deficits can be observed as early as childhood.

Research investigating the relationship between ACEs and declarative memory functioning in childhood is minimal and the existing literature shows mixed results. Early stress has been shown to affect spatial working memory and reduce prefrontal cortex size.
in childhood, demonstrating cognitive functioning deficits are apparent in children who experience high levels of adversity (Hanson et al., 2012). The immediate impacts of stress on memory were found in a study where children assigned to a stress condition performed more poorly on a memory task than children assigned to a control group (Quesada, Wiemers, Schoofs, & Wolf, 1999). However, several studies have shown memory in children is only hindered if the child also shows symptoms of PTSD (Beers & De Bellis, 2002; Yasik, Saigh, Oberfield, & Halamandaris, 2007). This finding suggests the lasting negative implications of ACEs may be contributing to memory deficits, rather than simply the stress these experiences induce.

Prior research has also failed to obtain evidence for a difference in memory performance between children who have experienced high levels of stress due to maltreatment and those who have not (Howe, Cicchetti, & Toth, 2006). Animal research has shown that the memory deficits in rats that have experienced early life stress cannot be observed until after puberty (Brunson et al., 2005). These findings suggest that there is inconsistent evidence on the timing in which memory impairment in those who have experienced childhood trauma is measurable and apparent.

Much of the existing literature examines cognitive functioning in children who have either been maltreated or not maltreated. Jaffee and Maikovich-Fong (2011) found that children who have been maltreated during more than one developmental period show poorer memory functioning than those children who had only been maltreated during one developmental period. This finding demonstrates the cumulative effects of adversity. Because ACEs tend to co-occur, it is important to look at their cumulative impact
(Herrenkohl & Herrenkohl, 2007). We wanted to extend research on… by investigating the relationship between ACEs and declarative memory functioning in children.

In the current study, we chose to analyze the early effects of ACEs on declarative memory functioning in children between the ages of 7 and 16. We used a retrospective, self-report measure of ACEs, a current assessment of children’s declarative memory and a current assessment of children’s PTSD symptoms. We chose to examine the list A long-delay free recall portion of the CVLT-C measure of declarative memory, because of the association between this score and PTSD symptoms found in the Beers and De Bellis (2002) study. Our main goal was to test whether there is a significant correlation between adverse childhood experiences and declarative memory in children while controlling for IQ, and to determine if this relationship was moderated by the number of PTSD symptoms the child reported. The secondary aim of this study was to determine if measuring self-reported ACEs in children is feasible and valid using convergent validity between the ACEs and PTSD measures. This secondary aim is necessary considering this kind of research is so scarce. Our prediction was that the number of ACEs a child reported would be negatively correlated with his or her declarative memory performance and PTSD symptoms would serve as a moderator in this relationship. We also predicted that the number of ACEs reported would be positively correlated with a child’s score on the PTSD measure, indicating convergent validity of the measure for ACEs.
Methods

Participants

Participants were recruited from an after-school program that primarily serves a lower socioeconomic status community. The children attended the program on a regular basis. The sample comprised of 29 children between the ages of seven and 16 ($M=9.48$, $SD=2.37$). The gender distribution of the sample was nearly equal with 48.3% females and 51.7% males. Children were primarily of African American (62.1%) and Hispanic (17.2%) ethnicity. Children received monetary compensation for their participation. Parents consented children’s participation. Only two children were excluded from the study due to non-completion. These children did not differ from the remaining sample on collected variables.

Measures

Declarative memory was measured using the California Verbal Learning Test for Children (CVLT-C; Delis et al, 1994). The measure begins by the experimenter reading aloud a list of words to the child followed by the child recalling as many of these words as possible in any order. This pattern occurs 5 consecutive times. Next, a new interference list is then read aloud to them one time. The child is then asked to recall the original list of words, once to measure free recall and once to measure cued recall. After a 20 minute intermission, the child is asked to recall the original list of words again three separate times to measure long-delay free recall, long-delay cued recall and recognition of the words. The measure is scored using CVLT-C software, which uses a z distribution comparing each child to other children similar in age.
The vocabulary and Block Design subtest of WISC III was used to estimate full scale IQ (Wechsler, 1991). During the vocabulary portion of the measure, a word is read aloud by the experimenter and the child is asked to define the word. The block design portion asks children to recreate a pattern they see on paper using blocks. These two subtests have been shown to be a valid assessment of full scale IQ.

Cumulative exposure to ACEs was measured using selected questions from the original ACEs questionnaire, The Juvenile Victimization Questionnaire and questions assessing non-victimization trauma and adversity from Turner, Finkelhore and Ormrod’s (2006) study (Felitti et al., 1998; Finkelhore, Hamby, Ormrod & Turner, 2005). Particularly sensitive questions, especially those including maltreatment, were removed from the measure. If children reported a particular event occurred, that question was coded as a 1. Questions were summed to determine the total number of adverse experiences each child reported having. The maximum score for this measure is 34.

The final portion of the UCLA PTSD Index was used to measure the number of PTSD symptoms a child is experiencing (Pynoos & Steinberg, 2013). The measure asks children how many days within the last month they experienced a number of PTSD symptoms on a 5-point likert scale (0-none and 4-most). Scores were computed using the reactions index score sheet included with the measure. The maximum score on this measure is 80.

Procedure

Children who received consent as well as assented to be a part of the study were assessed at two separate sessions. The data was collected while the child was present in
the after school program. Both sessions took place within a two-week time period. Separate experimenters collected data from each session in order to avoid bias. 

During session one, children completed a simple demographic questionnaire, the CVLT-C, and the Vocabulary and Block Design subtests from the WISC-III. The two subtests were completed during the 20-minute delay in the CVLT-C. At session two, children completed the modified ACEs questionnaire and the UCLA PTSD Index.

**Results**

The data was inspected for normality and outliers. No measures used in the analysis required a transformation. Analyses using linear regression included the centered measures of ACEs, IQ, PTSD, and the interaction term between ACE and PTSD as predictors, and long-delay free recall as the dependent variable. Results indicated that there was no significant interaction between PTSD symptoms and ACEs ($p=.142, b=.001$). However, ACEs significantly predicted long-delay free recall when controlling for IQ ($p=.02, b=-.443$).

In this low-income community sample, both IQ scores ($M=88.5, SD=12.3$) as well as the list A long-delay free recall portion of the CVLT-C ($M=-1, SD=.7$) are below average compared to the population value. A high number of ACEs ($M=10.3, SD=5.5$) and PTSD symptoms ($M=28.4, SD=18.4$) were reported. There was also a significant, positive association between ACEs and PTSD symptoms; $r(29)=.69, p=.000$.

**Discussion**

The results of this study provide mixed support for our hypothesis. Consistent with our predictions, ACEs was negatively correlated with scores on the List A Long-
Delay Free Recall portion of the CVLT-C when controlling for IQ, similar to other research (e.g., Beers & De Bellis, 2002). This finding demonstrates that children who experience a high number of ACEs show signs of impaired memory functioning, net the effect of IQ. However, this was the only portion of the CVLT-C that demonstrated a significant relationship with ACEs, suggesting the full impact of early stress on memory functioning may not be observable early in life.

In contrast to our expectations, PTSD symptoms did not serve as a moderator between ACEs and List A Long-Delay Free Recall scores of the CVLT-C while controlling for IQ. This finding does not support the literature showing impaired memory functioning is more severe in children who also express symptoms of PTSD (Yasik, Saigh, Oberfield & Halamandaris, 2007).

A strong, significant relationship was found between the ACEs measure and PTSD symptoms. This relationship supports the convergent validity of the ACEs questionnaire. This suggests that research involving children and self-report of adverse experiences is valid and feasible as well as necessary.

A high number of ACEs was reported in this low SES sample. Given these findings, it is important to create policies to reduce the number of ACEs children experience. Given that an association was found between ACEs and memory functioning in childhood, it is important to develop interventions to reduce this negative outcome. Intervention in childhood is especially important considering literature shows this deficit is clearly seen into adulthood (Brown et al., 2007). Though literature on this topic shows mixed results thus far, results from this study show that teachers, doctors, and other professionals working with children would benefit from information on trauma exposure.
There are some limitations to consider when interpreting these findings. Because the data was collected from a low SES sample, the ACEs questionnaire may not have captured all of the adversity and life stressors children were experiencing. This is especially relevant, because sensitive questions regarding maltreatment and neglect were removed from the questionnaire. However, because an association between the ACEs measure and PTSD symptoms was found, it is likely the ACEs measure is valid. It would be beneficial to test this measure of ACEs with parent-reported data to further solidify the questionnaire as a valid measure of adverse experiences. It is also important to remember the associations found do not imply causation (Stanovich, 2013). It is important to further examine the association found between ACEs and declarative memory functioning to determine specific mechanisms underlying this relationship, and to eliminate competing explanations of the relationships observed.

Further research involving the early effects of cumulative childhood stress is necessary. Findings from this study showing convergent validity of children’s self-reported ACEs should encourage researchers to continue to expand the literature on this topic. Considering memory impairment in adults who have experienced childhood trauma is prevalent in the literature, while observable childhood memory impairment is in question, it is important to determine when this deficit occurs in order to create effective interventions. A longitudinal study evaluating the impact of childhood stressors on declarative memory would be ideal to address this question.
References


Appendix A

Personal Reflection

Working in a research lab has been one of the most enriching and rewarding experiences in my undergraduate career. I have been working in the Karatekin lab for the previous four semesters. As I have continued to spend time as a member of the lab, I have developed as a researcher as well as increased my interest in research. I have received many benefits from spending time in a research lab, many of which have helped me to improve my resume and figure out what I would like to do after graduation.

Throughout my time working in the Karatekin lab, my role has continued to develop. When I began in the lab, I came to lab meetings and only modestly contributed. After the first semester, I began doing some reading on my own and developed a project examining the role of previous childhood stress on adult health in college students. This project allowed me to strengthen my skills in experimental design, data collection, data analysis, and finally writing up a lab report. Though I received a lot of assistance through each of these steps, I was able to better understand what it takes to conduct real research.

The following semester I began the project in which I have decided to use as my senior project. I consciously decided to take a more independent role in the design and execution of this project. My responsibilities included: filling out the form for IRB approval, designing the study, selecting the measures, finding research assistants to help with data collection, collecting the data, data entry and data analysis. Professor Karatekin was able to guide me through this process and help
along the way. This project took about eight months to complete in which I was able to gain further experience as a researcher.

Since I have begun this project, I have learned a lot about conducting research. I have learned that there are always unexpected “bumps” along the way. I have learned that it is probably wise to overestimate the amount of time data collection will take. I have learned that recruiting subjects, especially children, to participate in studies is not an easy task. Most importantly, however, I have learned that research, especially involving children, is absolutely intriguing to me. Once you discover your interests, becoming an expert is the easy part because learning is enjoyable. I have found this to be true with research. I am far from being an expert, but continuing to develop my skills and learn about my particular area of interest is not difficult, because I enjoy spending time reading and talking with others about the topic.

Since working in the lab, my interest in research has continued to grow immensely. My lab professor has not only been an incredible source for information, but she has become a mentor of mine. I believe I have caught what some call “the research bug”. I find myself thinking about potential projects and continue to soak up information. After graduation I plan to pursue a degree in clinical psychology. I strive to become a professor one day at a large research institution. Without my experiences working in a lab, I would not have realized my passion for science.