Child Abuse & Neglect xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Child Abuse & Neglect

Research article

Does developmental timing of exposure to child maltreatment predict memory performance in adulthood? Results from a large, population-based sample☆

Erin C. Dunn[a,b,c,*], Daniel S. Busso[d], Miriam R. Raffeld[a], Jordan W. Smoller[a,b,c,e], Charles A. Nelson[d,e,f], Alysa E. Doyle[a,b,c], Gigi Luk[d]

[a] Center for Human Genetic Research, Massachusetts General Hospital, USA
[b] Department of Psychiatry, Harvard Medical School, USA
[c] Stanley Center for Psychiatric Research, The Broad Institute of Harvard and MIT, USA
[d] Harvard Graduate School of Education, Cambridge, MA, USA
[e] Boston Children's Hospital, Boston, MA, USA
[f] Center on the Developing Child, Harvard University, USA

ARTICLE INFO

Article history:
Received 17 July 2015
Received in revised form 13 October 2015
Accepted 15 October 2015
Available online xxx

Keywords:
Epidemiology
Memory
Cognition
Sensitive periods
Etiology
Maltreatment

ABSTRACT

Although maltreatment is a known risk factor for multiple adverse outcomes across the lifespan, its effects on cognitive development, especially memory, are poorly understood. Using data from a large, nationally representative sample of young adults (Add Health), we examined the effects of physical and sexual abuse on working and short-term memory in adulthood. We examined the association between exposure to maltreatment as well as its timing of first onset after adjusting for covariates. Of our sample, 16.50% of respondents were exposed to physical abuse and 4.36% to sexual abuse by age 17. An analysis comparing unexposed respondents to those exposed to physical or sexual abuse did not yield any significant differences in adult memory performance. However, two developmental time periods emerged as important for shaping memory following exposure to sexual abuse, but in opposite ways. Relative to non-exposed respondents, those exposed to sexual abuse during early childhood (ages 3–5), had better number recall and those first exposed during adolescence (ages 14–17) had worse number recall. However, other variables, including socioeconomic status, played a larger role (than maltreatment) on working and short-term memory. We conclude that a simple examination of "exposed" versus "unexposed" respondents may obscure potentially important within-group differences that are revealed by examining the effects of age at onset to maltreatment.

☆ This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (http://www.cpc.unc.edu/addhealth). No direct support was received from grant P01-HD31921 for this analysis. Visit Add Health at: https://www.cpc.unc.edu/projects/addhealth. Research reported in this publication was supported, in part, by the Harvard University Center on the Developing Child (Drs. Smoller, Dunn, Nelson, and Luk) and the National Institute of Mental Health (NIMH) under award number (K01 MH102403 Dunn and K24 MH094614 Smoller).

* Corresponding author at: Psychiatric and Neurodevelopmental Genetics Unit, Center for Human Genetic Research, Massachusetts General Hospital, 185 Cambridge Street, Simches Research Building 6th Floor (Room 6.252), Boston, MA, USA.

http://dx.doi.org/10.1016/j.chiabu.2015.10.014
0145-2134/

Child maltreatment, like other childhood adversities, has been linked in both youth and adults to numerous immediate and long-term consequences, spanning multiple domains of health (McLaughlin et al., 2010, 2012), premature mortality, suicidality, and risky behavior (Felitti et al., 1998), adverse education and employment outcomes (Cicchetti & Toth, 2005; Gilbert et al., 2009), and both structural and functional changes in the brain (De Bellis et al., 1999; De Bellis, Woolley, & Hooper, 2013; Porter, Lawson, & Bigler, 2005; Teicher et al., 2003). These findings are concerning given current epidemiological estimates suggesting that 4.1% of youth have experienced some type of sexual maltreatment and as many as one in 10 youth have experienced physical abuse (Finkelhor, Turner, Shattuck, & Hamby, 2013; McLaughlin et al., 2012).

Relatively little is known, however, about the effects of child maltreatment on cognitive functioning, especially working memory (i.e., the temporary storage, manipulation and retrieval of limited amount of information) and short-term memory (i.e., the temporary storage for limited amount of information; see Cowan, 2008 for a review). The lack of research on this association is problematic, as the ability to retain, manipulate and retrieve information is essential to everyday functions, such as multitasking and adaptation to changing task demands (Morgan et al., 2013) and may be one of the many adverse consequences of exposure to maltreatment. Indeed, many have hypothesized that child maltreatment is a negative contributor to memory performance, as higher-order cognition, such as executive function and memory, is subserved primarily by the prefrontal cortex and hippocampus, both of which are stress-sensitive brain regions (Gunnar & Quevedo, 2007). However, to date, empirical findings have been mixed. Some studies, including those from convenience samples of children (DePrince, Weinzierl, & Combs, 2009), studies of maltreated children identified by Child Protective Services (Augusti & Melinder, 2013), clinical studies of adult survivors of abuse (Bremner et al., 1995; Stein, Hanna, Vaerum, & Koverola, 1999), and population-based samples of adults (Majer, Nater, Lin, Capuron, & Reeves, 2010) have found deficits in aspects of working memory and short-term memory, including spatial recognition, verbal learning and memory, visual memory, and spatial and pattern recognition memory, among those exposed to maltreatment. In some studies, sexual abuse exerts a stronger effect (De Bellis et al., 2013; Gould et al., 2012) on working or short-term memory relative to physical abuse or neglect.

However, other studies using convenience samples of adult women (Navalta, Polcari, Webster, Boghossian, & Teicher, 2006; Pederson et al., 2004) or samples of adults with documented cases of maltreatment have found no differences or even *enhanced* working or short-term memory when assessing memory among those exposed to maltreatment (Nolin & Ethier, 2007; Porter et al., 2005), especially sexual abuse. For example, one population-based study of older adults found child sexual abuse was associated with *better* immediate recall of emotionally neutral words (Feeney, Kamiya, Robertson, & Kenny, 2013). These findings parallel research in other aspects of memory, including autobiographical memory and recall of negative memories or emotionally-valenced words, which have also observed memory deficits among some maltreated children and enhanced memory among others (Goodman, Quas, & Ogle, 2010; Howe, Cicchetti, & Toth, 2006; Pollak, Cicchetti, & Klorman, 1998).

We speculate that there are three possible explanations for the mixed results among prior studies. First, prior studies have used a variety of measures to assess working memory, making it difficult to discern whether mixed results are an artifact of differential measurement. Second, prior studies have not consistently adjusted for co-occurring mental health symptoms, leaving open the possibility that observed memory deficits are secondary to a psychiatric condition, rather than being a consequence of maltreatment itself (Hart & Rubia, 2012). Third, and more importantly, there has been a lack of attention to age-related differences in the effect of exposure to specific types of maltreatment – or the possibility of "sensitive periods" in development. Sensitive periods are windows of time when the developing brain is highly "plastic" and therefore especially malleable to environmental influence (Bailey, Bruer, Symons, & Lichtman, 2001; Knudsen, 2004). While the existence of sensitive periods has been established for the visual (Hensch, 2004), and auditory systems (McMahon, Wintermark, & Lahav, 2012), knowledge about sensitive periods for cognition is more limited and mixed (Lupien, McEwen, Gunnar, & Heim, 2009). Although some previous studies suggest a sensitive period for cognitive development occurs before age 2 (Nelson et al., 2007), others find the time of greatest plasticity for some aspects of cognition may be during adolescence (Blakemore & Choudhury, 2006; Somerville & Casey, 2010). For instance, Andersen and Teicher found that greater levels of sexual abuse starting at 3–5 or 11–13 were associated with lower hippocampal volume in adult women and that greater levels of abuse starting at ages 14–16 was associated with lower frontal gray matter volume (Andersen et al., 2008). These findings underscore the possibility that there may be multiple sensitive periods corresponding to different brain regions and associated cognitive functions throughout the lifespan.

In the current study, we sought to overcome these gaps in knowledge by using data from a large, nationally representative epidemiological sample of young adults to examine the association between exposure to physical and sexual abuse with memory. Our use of a population-based study is a major strength, as few population-based studies of cognition have been conducted; see for example (Anda et al., 2006; Majer et al., 2010; Mills et al., 2011). The lack of data on the relationship between maltreatment and lifespan cognition in epidemiological studies is an important gap, as children in referred samples (who are identified in administrative records, including CPS), represent only a fraction of all children with maltreatment experiences, perhaps as few as 5–8% of physically or sexually abused children, respectively (MacMillan, Jamieson, & Walsh, 2003). Our primary aim was to disentangle the effect of type and timing of exposure to child maltreatment on working memory. In so doing, we aimed to better understand how the features of maltreatment predict memory, which could be used to guide the investment of resources to public health interventions that can reduce the consequences of exposure to maltreatment.

Please cite this article in press as: Dunn, E. C., et al. Does developmental timing of exposure to child maltreatment predict memory performance in adulthood? Results from a large, population-based sample. *Child Abuse & Neglect* (2015), http://dx.doi.org/10.1016/j.chiabu.2015.10.014