Maltreated and non-maltreated children's true and false memories of neutral and emotional word lists in the DRM task

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Abstract

Maltreated (n = 26) and non-maltreated (n = 31) 7- to 12-year-old children were tested on the Deese/Roediger-McDermot (DRM) false memory task using emotional and neutral word lists. True recall was significantly better for non-maltreated than maltreated children regardless of list valence. The proportion of false recall for neutral lists was comparable regardless of maltreatment status. However, maltreated children showed a significantly higher false recall rate for the emotional lists than non-maltreated children. Together, these results provide new evidence that maltreated children could be more prone to false memory illusions for negatively-valenced information than their non-maltreated counterparts.

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Child testimony is often the key evidence in forensic contexts and courts must decide on the reliability of a child's memory report. That is, does the child recount the events accurately or is the memory report contaminated by internal (spontaneous false memories) or external (suggested misinformation) influences. Because of these concerns research on child witnesses has focused on children's memory errors as well as their susceptibility to false memory illusions. On the one hand, this research has shown that children's spontaneous memory reports using free recall are frequently very accurate even when they are reporting about stressful events (e.g., Alexander, Goodman, & Schaaf, 2002; Baugerud, Magnussen, & Melinder, 2014). On the other hand, it has also been shown that children are more susceptible to external coercion (suggestion, misinformation) than adults (Ceci & Bruck, 1995; Goswami, 2008).

Many of the children involved in legal proceedings have been victims of physical or psychological maltreatment. Being exposed to chronic stress during childhood may put children at risk for a wide range of behavioral and cognitive problems, including impaired memory function. For instance, stress related cortisol elevations have been shown to have a negative effect on declarative memory (Elzinga & Bremner, 2002). Studies examining traumatized individuals (Moradi, Doost, Taghavi, Yule, & Dagleish, 1999), including those with early abuse experiences and who have been diagnosed with stress-related mental disorders (Bremner et al., 2003; Elzinga & Bremner, 2002; Kuyken & Brewin, 1995), have found maltreatment to be associated with a wide variety of cognitive difficulties such as reduced working memory performance (Matthias, Nater, Lin, Capuron & Reeves, 2010), difficulties in reporting autobiographical facts from childhood (Hunter & Andrews, 2002;

Valentino, Toth, & Cicchetti, 2009; but see Greenhoot, Bunnell, Curtis, & Beyer, 2008), and increased memory errors in facial recognition tasks (Pollak, Cicchetti, Hornung, & Reed, 2000). This suggests that there may be some aspects of maltreated children's memory that may be more vulnerable than non-maltreated children's memory to influences that distort what is being remembered (see also Beers & De Bellis, 2002; Carrion, Haas, Garrett, Song, & Reiss, 2010; Cicchetti, Rogosch, Howe, & Toth, 2010; Kirk-Smith, Henry, & Messer, 2014).

However, there are also findings suggesting no differences between maltreated and non-maltreated children's basic memory processes (Cichetti et al., 2010; Eisen, Goodman, Qin, Davis, & Crayton, 2007). For example, studies using the Deese/Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995) have found few differences between maltreated and non-maltreated children's true and false memory rates (e.g., Howe, Cicchetti, Toth, & Cerrito, 2004). In the DRM task, participants are presented with word lists (e.g., *needle, nurse, medicine, hospital, sick, ambulance)* and later, when given either a free recall or recognition memory test, they often falsely remember highly associated critical lures (e.g., *doctor)* that, although consistent with the thematic structure of the list, were not among the studied items (e.g., Ghetti, Qin, & Goodman, 2002; Howe, 2008; Howe, Wimmer, Gagnon, & Plumpton, 2009; Metzger, Warren, Price, Shelton, Reed, & Williams, 2008; Schacter, Norman, & Koustal, 1998).

In terms of the effects of the emotional nature of the stimuli on false remembering, a number of studies have found that when adults are presented word lists containing negative emotional items, the number of false memories increases over those found for neutral lists (e.g., Brainerd, Stein Silveira, Rohenkohl, & Reyna, 2008). Studies examining children's false memories for emotional lists have found that they exhibit higher levels of false recall for neutral as compared to negative lists, but that false recognition is higher for negative emotional information compared to neutral information (Howe, 2007; Howe, Candel, Otgaar,

Malone, & Wimmer, 2010). Brainerd, Holliday, Reyna, Yang, and Toglia (2010) likewise found that children's false recognition was higher for negatively valenced, high-arousal items compared to positively valenced, low-arousal items.

These latter studies were all conducted with non-maltreated children as participants. Howe and collaborators (2004) compared the performance of maltreated and non-maltreated children using standard (neutral) DRM lists and failed to find significant differences between the groups with respect to true or false recall. In a subsequent study, memory for emotional and neutral DRM lists were compared, but again no significant differences between maltreated and non-maltreated children appeared, although both groups did show low false recall for the emotional word lists (Howe, Toth, & Cicchetti, 2011). However, in a DRM study of adolescents and adults with and without documented histories of child sexual abuse (CSA) in which trauma-related and non-trauma-related lists were used, participants with histories of CSA evinced higher levels of false memories particularly for the negatively valenced DRM lists (Goodman, Ogle, Block, Harris et al., 2011).

The failure to observe differences between maltreated and non-maltreated children in the first study by Howe et al. (2004) could be due to the fact that the children were only tested with neutral DRM lists. The absence of differences in the second study by Howe et al. (2011), which did include emotional DRM lists, might be due to the fact that maltreated and non-maltreated children had similar socioeconomic backgrounds or because the severity and chronicity of CSA was not controlled. Because this factor is related to changes in long-term memory functioning, particularly memory accuracy (e.g., Goodman et al., 2003), better documentation of participants' CSA histories is needed before generalizations about maltreated children's true and false memory propensity can be made.

In the present study, we examined maltreated children's susceptibility to spontaneous false memory illusions using emotional word lists in a DRM task. The design of the present

study is similar to that of Howe et al. (2011), but the maltreatment experienced by our child participants was better documented and can be considered to be more chronic than in the Howe et al. (2004, 2011) studies. That is, in the Howe et al. (2004, 2011) studies, participants were recruited via the DHS and some of the children may not have been removed from the home of their biological parent(s) In the current study, all children in the maltreated group had been subjected to serious care deficiencies or subjected to other serious abuses in the home situation which could not be alleviated through the application of voluntary assistance measures. These transgressions were so serious that the children had to be removed from their biological families by court order with the assistance of child protective services (CPS) and frequently with the aid of the police. Thus, these children represent the most severe maltreatment cases handled by the CPS and the professional judgment was that under no circumstances should they remain with their biological family. Because dimensions of maltreatment severity impact on the developmental outcomes in maltreated children (Litrownik et al., 2005), it is important to extend Howe et al.'s (2011) study to those children exposed to the maximum severity of maltreatment.

Worth noting is that there are small regional differences in family income in Norway compared to most countries (SSB, 2014) and indicators of both material and non-material welfare are at high levels and among the highest in the world (OECD, 2014). For example, 90.2% of all children between the ages of 1-5 attend kindergarten and 90% of the employees have an approved pre-school education (SSB, 2014). This gives the children valuable out-of-home relationships that are particularly important for the maltreated children, as these may serve as important means of supporting stability and quality as well as cognitive stimulation, regardless of their family's income and the children's developmental needs. Research has shown that stimulation of children's cognitive skills in pre-school age have a significant

impact on children's development (Shonkoff & Phillips, 2000). In the present study both the non-maltreated and the maltreated children had attended kindergarten.

Method

Participants

The participants were 31 8- to 12-year-old (M = 10.16, SD = 1.65) (38% girls) non-maltreated children and 26 7- to 12-year-old (M = 10.34, SD = 1.77) (40.4% girls) maltreated children. The community sample of non-maltreated children was mainly middle-class Caucasian children (90%) recruited through primary schools and parents provided informed consent to participate and child assent was obtained on the day of testing. The sample of maltreated children was mainly Caucasian (62.5%), with an additional 21% of Asian background, 8% of Eastern-European background, and 8.5% of African background. Maltreated children were recruited from the same geographic area as the non-maltreated children. The non-maltreated as well as the maltreated children were mainly recruited from middle-class areas, with regional average family incomes between $46222 and $52016. The samples were matched for age range and vocabulary scores (see below).

Maltreated children had been exposed to parental shortcomings including physical, emotional, or sexual abuse and neglect severe enough to trigger the CPS to intervene and remove the children with force from their biological parents. Such a court order is implemented only if the child's situation is serious and a decision for a care order is made because the child is subjected to serious care deficiencies, is being mistreated, or is being subjected to other serious abuses in the home (Ministry of Equality, Family and Social Inclusion, 2014). All of the maltreated children were recruited through the CPS. Parental consent was obtained at the start of the removal where possible. In some of the removals, researchers obtained parental consent after the removal; if parents then declined participation

the data were destroyed. Of the cases included, both the children and their parents agreed to participate in the study (also see Baugerud & Melinder, 2012; Melinder, Baugerud, Ovenstad, & Goodman, 2013).

Materials and Procedure

Approximately one year after the removal from their biological family the maltreated children were given the DRM test. They were tested either in their foster home or if they had left the foster home and moved back to their biological parents' home, they were tested there. The adult norms of the DRM material were carefully modified and adjusted to be appropriate for 8- to 12-year-old children. This was accomplished by taking 150 words that were selected on the basis of age-normed words in the Norwegian language (Department of Linguistics and Scandinavian Studies). Then, 40 8- to 9-year-old children and 46 11- to 12–year-old children from a second community sample were instructed to write down the first word that came to mind when each of the 150 words were read out loud to them. From here, different word associations were selected as follows: (1) study lists were composed of the critical words with the greatest number of associations and (2) each critical word that was selected formed a single list that contained its most frequently associated words, placed in decreasing order of associative frequency. Due to developmental differences in the memory span of young children (Dempster, 1981), we made shorter versions of the adults' lists in accordance with a procedure used in previous studies (Carneiro, Fernandez, Albuquerque, & Esteves, 2007; Ghetti et al., 2002). As a result, 15 word lists were created with 10 words in each list. There were 9 lists with neutral words and 6 lists with negative emotional words.

The 15 lists were randomized and divided into 3 groups of 5 lists each. These three groups were then conjoined to create three different 10-list block combinations. Each child then listened to one block of 10 lists where 6 lists were neutral and 4 were negative emotional.

The critical lures for the emotional lists were *violence, bullying*, *dead*, *war, scared,* and *angry*, and those for the neutral lists were *man, bed, girl, jewel, doctor, light*, *flower*, *foot,* and *cold.* The emotional words were not equated on arousal although they were all of negative valence. The children were tested individually and were randomly assigned to one of the three word-list blocks. Word lists were digitally recorded at a presentation rate of 3 seconds per word. After presentation of each list, a simple 15-second distractor task was given to prevent maintenance rehearsal, and then the children attempted to recall all the words from that list. The three 10-list blocks were equally distributed across the two groups of children so that list difficulty was controlled across the maltreated and non-maltreated samples.

Additional test. In addition to the DRM test, participants were given the Wechsler Abbreviated Scale of Intelligence (WASI) (Psychological Corporation, 1999) or the Wechsler Preschool and Primary Scale of Intelligence–Revised (WPPSI–R) (Wechsler, 1990). The children completed the Vocabulary subtest in order to obtain an assessment of word knowledge and verbal concept formation. The Vocabulary subtest correlates very highly with verbal IQ scores and the full-scale IQ score (Lezak, Howieson, & Loring 2004) and thus may give an indication of children's intelligence. The test was individually administered.

Results

The results were calculated in terms of the proportion of emotional and neutral studied words correctly recalled as well as the proportion of critical lures falsely recalled. Because preliminary analyses showed that there were no significant effects of gender on any of the memory variables [F's $(4, 52) \leq 1.70$, p's $\geq .20$] the results for male and female participants were collapsed. Further, an ANOVA showed no significant differences between the maltreated and non-maltreated children in relation to age [$F\,(1, 42) = 2.29$, $p = .13$, $\eta^2 = .05$] so this variable was no longer considered in subsequent analyses. Finally, an independent *t*-

test showed no significant differences in vocabulary score among the maltreated and non-maltreated children, t (45) = -.05, p = .96.

Turning to our main question as to whether maltreatment status had an effect on true and false recall, we used two separate (one for true recall and one for false recall) 2(Sample: maltreated vs. non-maltreated) x 2(Valence: neutral vs. emotional) mixed design analyses of covariance (ANCOVAs) where the first factor was between-participants, the second factor was within-participant, and vocabulary scores served as the covariate. This analysis showed that there was no significant effect of the covariate on either true [F(1,39) = 1.85, p = .10, η^2 = .05] or false [F(1,39) 1.55, p = .23, η^2 =.04] recall.

For true recall, the analysis revealed no significant main effect of valence but there was a significant effect of sample [F(1,52) = 54.18, p = .0001, η^2 = .50], with the non-maltreated children reporting more true items than the maltreated children. Figure 1a shows the proportion of correctly remembered items for the maltreated and non-maltreated children as a function of list type (neutral vs. emotional). There was no interaction, confirming that non-maltreated children performed better than the maltreated children on both list types ($p < .001$). In order to insure that these differences in true recall were due to maltreatment per se and not to the fact that maltreated children did not persist on the task for all 10 trials/lists, we conducted a 2(Sample: maltreated, non-maltreated) x 2(Sequence: first 5 lists, last 5 lists) ANOVA. Like the main findings, there was a main effect for sample, F(1, 33) = 12.10, p=.001, η^2 = .27, where non-maltreated children had higher true recall than maltreated children. There was no effect of sequence and, critically, no Sample x Sequence interaction. Thus, differences in true recall are due to the effects of maltreatment and not to failures in maltreated children's task persistence.

For false recall (see Figure 1b), there were no significant main effects but there was a significant Sample x Valence interaction [$F(1,54) = 5.26$, $p = .03$, $\eta^2 = .09$]. Post hoc tests did not detect a significant difference between nonmaltreated and maltreated children's false memories for neutral lists, ($p = .13$), but maltreated children had two and a half times more false memories for emotional items than the non-maltreated children. The effect size for the follow-up test was $\eta^2 = .08$. Interestingly, looking at Figure 1b there is some qualitative evidence that this interaction might have been a full crossover where non-maltreated children not only produced fewer emotional false memories than maltreated children but also more neutral false memories than maltreated children. However, this latter effect was not reliable.

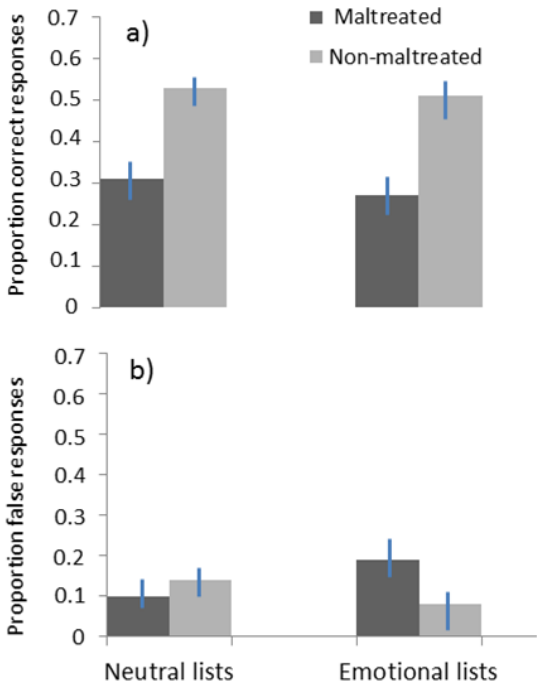

Figure 1. (a) Mean proportion of true recall and (b) mean proportion of false recall for emotional and neutral lists for both maltreated and non-maltreated children. Error bars indicate ± 1 SEM.

Discussion

The results of the present study show that maltreated children perform more poorly than non-maltreated children when attempting to recall words from DRM lists regardless of whether those lists were emotionally neutral or negative. This may not seem surprising as previous research has found decreased memory accuracy as a function of abuse severity (Goodman et al., 2003) as well as cognitive developmental delays and decreased academic performance (Crozier, & Barth, 2005; Goodman et al., 2009). One explanation may be that deficits in maltreated children's memory performance may be due to problems in executive function. There is evidence that maltreated children are at risk of impaired executive function and even if the precise mechanism(s) underlying this impairment are not known, there are reasons to believe that there are interactions with environmental as well as genetic factors (Kirke-Smith, Henry, & Messer, 2014). However, because the vocabulary scores of our two samples were comparable, there seems to be more similarities than differences in the two groups' IQs, something that would lead us to expect that performance on our verbal memory task should have been more similar than it was. Of course, we cannot rule out the possibility that the observed differences associated with maltreated children's memory performance may not have been mediated by maltreatment per se but by correlated deficits in executive function.

Importantly, differences in memory performance cannot be attributed to variation in SES because our children were of comparable SES. Previously, when SES status was equated, there were no differences between maltreated and non-maltreated children's memory performance (Howe et al., 2011). However, in that study, children were all of very low SES whereas in this study children were of middle SES. Thus, it would appear that the differences in memory performance between the groups observed in the present study are somehow related to differences in maltreatment status (also see, Goodman et al., 2003).

For false recall, maltreated and non-maltreated children were comparable on neutral lists but maltreated children had higher false recall rates for emotional lists than non-maltreated children. This result contrasts with previous DRM studies investigating valence effects on maltreated and non-maltreated children (Howe et al., 2011) in which there were no significant differences between the samples. However, in addition to the SES differences mentioned earlier, it is possible that the life histories of the maltreated children in the present study contain stronger and more prolonged stress factors than those of the previous studies. Such chronicity may have consequences both for the general memory performance of these children (De Bellis, Woolley, & Hooper, 2013) and for the children's alertness to emotional stimuli. Children removed by force from their biological family represent the most severe maltreatment cases and are probably the children most seriously harmed by severe parental shortcomings. So it may be that changes at the behavioral level in maltreated children's episodic memory are restricted to those children at the more severe end of the maltreatment spectrum.

Interestingly, we did not find more false memories for neutral than emotional lists, an effect typically associated with non-maltreated children (Howe, 2007; Howe et al., 2010). In fact, we observed the opposite effect for the maltreated children. The different patterns of false recall between the groups may be due to maltreatment status. Several researchers have emphasized that the activation of false memories depends on arousal (Gallo, Foster, & Johnson, 2009; Porter, Spencer, & Birt, 2003) and there are indications of increased arousal in maltreated children as compared with non-maltreated children (Pollak, Vardi, Bechner, & Curtin, 2005; Wismer Fris, Shirtcliff, & Pollak, 2008). It is possible that these maltreated children, due to their negative life experiences, are more sensitized to negative information and when tested with emotionally negative words become more aroused than non-maltreated children. This increased arousal, in turn, affects maltreated children's ability to store and

retrieve emotional information. Increased stress and potentially higher levels of vigilance for negative information may contribute to an increased failure to monitor retrieval, something that results in an inability to distinguish between true and false memories during output (Payne, Nadel, Allen, Thomas, & Jacobs, 2002). Perhaps less likely, but still possible, is that the negative emotional words are more familiar for the maltreated children due to their adverse life experiences, thus enhancing their false memory rates. For example, both Brainerd et al. (2008) and Howe et al. (2010) pointed out that meaning-based processing is particularly important when it comes to false memories for negative emotional information. Moreover, Brainerd, Yang, Reyna, Howe, and Mills (2008) found that familiarity and meaningfulness were among the strongest predictors of false memory rates in the DRM paradigm. Thus, the possible higher familiarity with negative words and the increased arousal levels in the maltreated sample may have led to enhanced false recollection of emotional memories.

To conclude, maltreated children's recall of studied information was poorer than that of non-maltreated children regardless of the emotional nature of the studied materials. Maltreatment status does not influence children's susceptibility to spontaneous false memory illusions except when those illusions have to do with negative information. Indeed, our findings showed that severely maltreated children's susceptibility to false memories for negative information was over twice as great as that for non-maltreated children. Together, these findings (poorer correct recall and elevated false recall for negative information) raise questions about severely maltreated children's ability to provide accurate memory evidence when remembering stressful events. Even if memories from word lists are very different from remembering a personally relevant negative event, these findings may be important as they indicate a possible negative impact of severe maltreatment on children's emotional memory. Importantly, however, our findings are consistent with those obtained by Goodman et al. (2011) who found higher false recall for trauma-related words in maltreated adolescents. Of

course, caution needs to be exercised here because such results are only suggestive and further research (perhaps examining false recall of autobiographical events) is needed to firmly establish whether maltreated children exposed to severe and chronic maltreatment are more susceptible to generating false memories with emotional material than are non-maltreated samples. It would be important as well to establish the extent to which such memory errors reflect mistakes about specific details of an otherwise correctly remembered experience or the creation of entirely false events.

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