The Plymouth Student Scientist - Volume 08 - 2015 The Plymouth Student Scientist - Volume 8, No. 2 - 2015

2015

Are children's false memories driven by conceptual or perceptual factors?

Hodgson, A.

Evans, J. (2015) 'Are children's false memories driven by conceptual or perceptual factors?'.
The Plymouth Student Scientist, 8(2), p. 149-163.
http://hdl.handle.net/10026.1/14101

The Plymouth Student Scientist
University of Plymouth

Are children's false memories driven by conceptual or perceptual factors?

Alexandra Hodgson

Project Advisors: *Marina Wimmer and Fayme Yeates School of Psychology, Faculty of Health & Human Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA*

Abstract

Using the Deese/Roediger-McDermott (DRM) paradigm we examined the effects of perceptual (distinctiveness) and conceptual (backward associative strength) factors on the generation of false memories in 5 and 7-year-old children. Participants were randomly assigned to either the perceptually similar (just black or white pictures) or dissimilar condition (alternating black and white with colour pictures). For both conditions, these pictures were also high or low in backward associative strength. We hypothesised that false memories would be influenced by age, perceptual similarity and conceptual factors interacting. Results showed that true memories increased with age. False memories in 5 year olds not only extended to categories outside of the DRM paradigm but also appeared to be influenced by perceptual factors. In controlling for a yes-bias this false memory effect was no longer significant. There were no significant main effects or interactions found for false memories in 7 year olds. Potential limitations including list lengths and associative strength of items were considered and implications for future research were discussed.

Introduction

The topic of false memories in both children and adults has interested researchers for many years and has become a particular focus due to the implications in the legal system (Brainerd, Reyna & Forrest, 2002). One method of generating false memories which has been suggested to be a robust measure in both children and adults (Wimmer & Howe, 2010) has been termed the Deese/Roediger-Mcdermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995). In the DRM paradigm participants are shown a list of words, examples of which include: physician, stethoscope, nurse, medicine, patient. In this case, all are associated with the non-presented item or “critical lure” of “doctor”. When the DRM paradigm for verbal information has been implemented, participants have been shown to not only remember the presented items (true memories) but also the critical lures (which indicate false memories) associated with these items. This has been replicated by multiple researchers (e.g. Seamon et al., 2002; Toglia, Neuschatz & Goodwin, 1999). Ghetti, Qin and Goodman (2002) suggested that by using the DRM paradigm, researchers can be fairly positive that participants are experiencing false memories rather than being influenced by social pressures, as has been seen in other false memory paradigms. It remains unclear from the research exactly which mechanisms drive false memories in children; this research was particularly interested in the interaction between age, perceptual and conceptual factors.

How age affects false memories

Research has suggested that with the DRM paradigm there is a developmental reverse, (McGeown, Gray, Robinson & Dewhurst, 2014) in that false memories have been seen to increase with age. As an indication of this, Brainerd et al., (2002) found that false memories in younger children were nearly at the lowest level in comparison to older children and adults. This developmental reverse has further been supported by many researchers (Brainerd, Forrest, Karibian & Reyna, 2006; Dewhurst, Pursglove & Lewis, 2007; Howe, 2006; Howe, Wimmer, Gagnon & Plumpton, 2009). In considering the DRM paradigm, one problem with the research is that the words used are typically adult-association normed (Nelson, McEvoy, & Schreiber, 1999; Nelson, McEvoy & Schreiber, 2004) and therefore false memories in children tend to reduce (Wimmer & Howe, 2009). However, main effects have still been found with children in these studies. In research using child-normed associative lists, this false memory developmental reverse has still been seen (Anastasi & Rhodes, 2008; Carneiro, Albuquerque, Fernandez, & Esteves, 2007) suggesting that DRM lists for that are adult and child-normed do influence false memories in children.

There have been two main explanations for why the DRM paradigm has shown this developmental reverse; fuzzy trace theory (FTT) (Brainerd, Reyna & Ceci, 2008) and associative activation theory (AAT) (Howe, 2005; Howe et al., 2009). According to FTT at encoding, representations of events are stored in memory using two separate traces; verbatim and gist traces (Hedwige, Larøi, Van der Lindon, 2011). Verbatim traces encode the surface features of items such as phonological structures of words; gist traces encode the overall meaning of items (Wimmer & Howe, 2009). Gist traces are thought to be responsible for false memories as children’s ability to extract the gist of the information presented to them tends to increase with age. The other theory thought to explain this age effect is AAT, which suggests that memory for critical lures occurs due to it being activated many times because of its association with the presented items. Wimmer and Howe (2009), suggested that this theory considers an idea of activation spreading within a mental lexicon, which was also considered in the activation monitoring theory (AMT)(Roediger, Watson, McDermott & Gallo, 2001). AMT suggests that when a list of words from the DRM paradigm is presented, it can activate nodes in our mental lexicon which then spread throughout our semantic system and can activate items that are not related to those which have been presented (Anderson & Pirolli, 1984). This ability to create automatic associations has been said to increase with age (Kimball & Bjork, 2002). In considering how the DRM influences true memories, both FTT and AAT theories also predict that these should increase with age (Howe, 2008). In our research we would therefore expect to find higher levels of true memories for older rather than younger children.

To further understand the relationship of false memories, we wanted to see if these could be extended to items that were closely related in category (related items) to the presented items but were not directly associated (as with critical lures). Such words included "food" and "cure" which were related in category to the presented items but also to the critical lures of "bread" and "doctor".

Within the current research we also wanted to implement the DRM paradigm with 5 and 7 year olds whose ages were chosen due to the "five to seven year shift" (Sameroff & Haith, 1996). It was explained that there is a cognitive developmental shift between 5 and 7 year olds, from child-like thinking to more adult forms of thought (Davidson, 1998) or as described by Piaget, the shift from pre-operational to concrete operational thought (Azzi, 2002). Therefore, we would expect to see a difference in the generation of false memories between 5 and 7 year olds. We hypothesised that 7 year olds would have more false memories for the DRM lists than 5 year olds due to their developmental ability to automatically make associations with the presented items to un-presented items or 'critical lures'; we were also interested in whether this extended to the related distractors.

How perceptual factors affect false memories

In contrast to using the DRM paradigm for verbal information, experiments involving pictures resulted in false memories reducing across all age groups, due to the stimuli being more distinctive (Dodson & Hege, 2005). Different explanations have been proposed for why this occurs. One explanation was suggested by Schacter, Israel and Racine (1999) and was termed the "distinctiveness heuristic" where participants were aware that they had been provided with distinctive information and therefore included recollection of these distinctive details when encoding. In retrieval, the critical lure could be rejected due to the visual information of studied items being distinctive. Ghetti et al. (2002) however, suggested it would be unlikely that young children would be able to implement such a decision-based rule when encoding the visual information and therefore suggested that another mechanism may well be involved. Smith and Hunt (1998) argued that distinctive processing at encoding allows for the discrimination between presented (true memories) and un-presented items (false memories) at retrieval, due to the specific features being associated with presented items; therefore it makes it possible to discriminate these features from the un-presented item's features. In their experiment, Ghetti et al. (2002) tested how distinctiveness could influence false memories in children. In one condition words were studied alone, in the other, words were accompanied by pictures; the findings indicated that 5 year olds had more false memories in terms of false recall rates compared with older children and adults. They also found that distinctive information (words presented with pictures) reduced false memories for all age groups. They suggested that their finding of 5 year olds having more false memories compared with older children and adults was due to experimental design. In terms of true memories, distinctiveness did not influence recall for presented items. Distinctiveness as a factor in reducing false memories was measured by Howe (2008) who considered these effects in the production of false memories using photographs of objects from DRM lists. He tested this with 5, 7 & 11 year olds and found that the more distinctive condition reduced false memory effects in all the different age groups. In the experimental condition where the background for the pictures was not distinctive, older children had more false memories. There were no differences found for true recall across all age groups. This was consistent with Ghetti et al.'s (2002) findings on true memories.

The present research tested the effects of distinctiveness on false memories by assigning children to either the perceptually similar (just black and white pictures) or perceptually dissimilar condition (alternating colour and black and white pictures) in which the pictures were presented followed by an auditory presentation of the item. Schacter, Cendan, Dodson and Clifford, (2001) and Schacter et al. (1999) found that when this presentation of items, followed by the auditory information was presented false memories were reduced. Otgaar, Howe, Peters, Smeets and Moritz (2014) suggested that by using visual scenes such as pictures it may well be a more appropriate way of testing the impact of DRM lists on the activation of false memories as they are more related to 'real-life' than using word lists alone. We did not expect the distinctiveness to influence true memories, however we did expect false memories to be affected. We therefore hypothesised that the perceptually dissimilar condition would reduce false memories across all age groups due to the stimuli being more distinctive.

How conceptual factors affect false memories

We were interested in the conceptual factor of backward associative strength (BAS) and how this might influence false memories in children. BAS was described by Deese (1959), (as discussed by Roediger et al., 2001) as the average tendency for presented items to elicit the critical lure in a recognition task. Robinson and Roediger (1997), on the other hand, suggested that the false memory phenomenon was not predicted by the average associative strength but instead was due to the sum of the associative strength. In our research, we chose words based on the Roediger et al.'s (2001) research, which scored either high or low in both sum and average overall BAS. In Roediger et al.'s (2001) research, they found that those items highest in BAS which were more strongly associated to the critical lures, were more likely to elicit false memories. Increased false memories for high BAS lists has further been supported in research including that by Cann, McRae and Katz (2011), and Howe, Wimmer and Blease (2009), who found that false memories varied depending on differences in BAS, in that high BAS lists elicited more false memories than low BAS. In addition, Arndt (2012) examined the effects of forward associative strength (FAS) which he described as the associative strength of critical lures to presented items, as opposed to associative strength of presented items to critical lures (as is seen in BAS). He suggested this to be a potential confounding variable for results in which BAS has been shown to affect false memory rates. In controlling for the effects of

FAS, he still supported previous research and found high BAS lists created more false memories. In also considering true memories alongside false memories, Knott, Dewhurst and Howe (2012) found that both false memories and true recognition rates were higher for high BAS lists. Hicks and Hancock (2002) also found that lists higher in association increased true memories.

In our present research, we would predict that those lists higher in associative strength would have higher true memory rates than low BAS lists. We would also hypothesise that words in the high BAS lists would elicit more false memories than low BAS lists.

Rationale

As previous research has shown, false memories can be influenced by age, conceptual and perceptual factors and we have hypothesised how we thought they would individually impact false memories. To our knowledge, these factors have not been considered in terms of how they might interact and influence false memories and whether these are driven more by conceptual or perceptual factors or perhaps neither. Dewhurst and Robinson (2004) suggested that younger children's false memories are less likely to be driven by conceptual than perceptual factors, which was also supported by Howe's (2008) research into the effects of distinctiveness on false memories. This would suggest that in our research we would expect to see false memories being driven more by perceptual factors than conceptual factors, particularly in the 5 year olds. However, previous research has also claimed that when participants study a large number of items that are either perceptually or conceptually related, then false memory rates are said to increase (e.g. Hintzman, 1988; Koustaal & Schacter, 1997) this suggests that conceptual factors must also play in a role in false memory rates. With previous research in mind, our main hypothesis was that false memories would be influenced by the factors of age, perceptual similarity and conceptual factors interacting.

Method

Participants

A total of 178 children, (94 females, 84 males), participated in this experiment: 91, 5 year olds, (mean age = 5.7 Years, SD= 5 months) and 87, 7 year olds (mean age = 7. 6 Years, SD= 5 Months). All children were tested following head teacher and parental consent and their own assent on the day of testing.

Design

A 2 (Perceptual Similarity: High Vs Low) x 2 (Backward Associative Strength (BAS): High Vs Low) x 2 (Age: 5 vs 7 year olds) repeated measures analysis of variance (ANOVA) was used to measure the proportion of yes responses for true presented items and un-presented critical lures and related distractors. BAS was manipulated within-subjects and perceptual similarity and age were manipulated between-subjects.

Materials and Procedure

Participants were tested in a quiet room and conditions were standardised throughout, with all viewing the experiment on a laptop. The participants were randomly assigned to either the perceptually similar (all pictures black and white) or dissimilar condition (pictures alternating between colour and black and white). Within the perceptually dissimilar condition, participants were further randomly allocated to complete one of two versions, which either presented a black and white picture followed by a coloured image first, or vice versa. This was conducted in order to counterbalance the effects of colour pictures followed by black and white pictures. To measure the within-subjects factor of BAS, it was split into two levels which included high BAS, with the words being strongly associated to bread (M=.27), doctor (M=.33) and lion (M=.18) and low BAS with the words being less strongly associated to butterfly (M=.06), pen (M=.13) and cup (M=.15) (Roediger et al. 2001) (for further BAS values of all items presented, See Appendix A). Children were told that they would be shown some pictures and that they should try and remember as much as they could. The children were then visually presented with six lists of eleven words (selected from DRM lists), accompanied by the sound of each word. The colour of the pictures was manipulated by the experimental condition each child was allocated to. Following a list of six words, a filler picture of a yellow star would be presented for 3 seconds before the next set of six words was presented. Once the study phase was over, a 3-minute distractor task of playing “Where’s Wally?” was used.

Following the distractor task, in the recognition phase children were shown 36 pictures presented in a random order, again the pictures were followed by the sound of the words (for examples of pictures presented, see Appendix B). The colour of the pictures they were presented with corresponded to the study phase condition they had been allocated to. The experimenter asked, “Did we have that one before?” and participants would then follow this with a “yes” or “no” response. The pictures presented in the recognition phase included 18 previously presented items, six critical lures, six related distractors and six unrelated distractors. (For a full list of pictures presented, see Appendix A).

Results

To test the main hypotheses defined in this research, a 2 (Perceptual Similarity: High Vs Low) x 2 (Backward Associative Strength (BAS): High Vs Low) x 2 (Age: 5 vs 7 year olds) repeated measures analysis of variance (ANOVA) was used to measure the dependent variable of the proportion of yes responses for true presented items and un-presented critical lures and distractor items.

Un-Corrected Scores

Table 1 presents the mean proportion of yes responses for high and low BAS items in 5 and 7 year olds for presented items, critical lures, related and un-related distractors.

As can be seen in Table 1, 5 year olds had higher mean proportions of yes responses to low BAS presented items, critical lures, related and un-related distractors. 7 year olds had higher mean proportions for presented items in terms of high BAS lists. These were subjected to analysis. The variability within the data differed for the different items, with presented items having the lowest variability across both age groups.

Table 1: Mean proportions of yes responses for Presented Items, Critical lures, Related and Un-related distractors.

Age In Years	Backward Associative Strength	Presented	Critical Lure	Related	Un-Related
5	High BAS	.82 (.20)	.37 (.38)	.23 (.34)	.27(.40)
	Low BAS	.85 (.16)	.36 (.44)	.29 (.40)	.24(.38)
7	High BAS	.85 (.16)	.29 (.32)	.11 (.24)	.15(.33)
	Low BAS	.84 (.12)	.26 (.38)	.19 (.34)	.15(.32)

Note. Standard Deviations are in Parenthesis.

True memories. For true memories the analysis revealed that there were no main effects found for age, perceptual similarity, or BAS on the proportion of yes responses for presented Items ($F(1,174) = .53$, $p = .47$, $F(1,174) = .60$, $p = .44$, $F(1,174) = .93$, $p = .34$., respectively). There was a BAS x Age interaction found $F(1,174) = 4.53$, $p = .04$, and a t-test analysis revealed an approaching significance $t(90) = -1.85$, $p = .07$ for 5 year olds, with low BAS ($M= .85$) lists resulting in more true memories than high BAS lists ($M= .82$). For 7 year olds there was no statistical significance of BAS, $t(86)= .64$, $p = .52$ (see Figure 1). There were no other interactions found (all ps > .05).

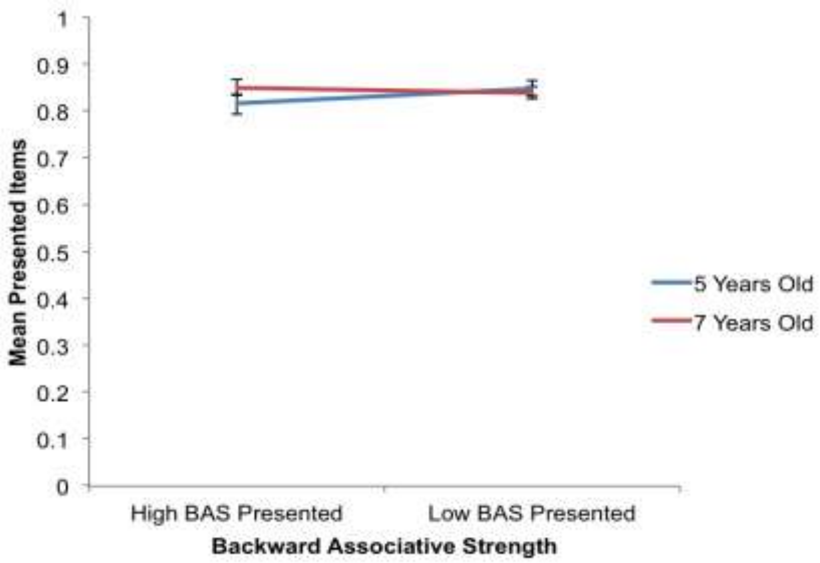

Figure 1: The means of the Age x BAS approaching significance interaction for 5 and 7 year olds for presented items. Error bars represent standard error.

False Memories. False memories were measured by the proportion of yes responses to critical lures and related distractors; for the critical lures, there was a main effect found for age $F(1,174) = 4.19$, $p = .04$. With more proportions of yes responses for 5 year olds ($M= .38$) than 7 year olds ($M=.27$). No main effects were found for perceptual similarity $F(1,174) = .87$, $p = .35$ or for BAS $F(1,174)= .67$, $p = .41$. An Age x Perceptual Similarity interaction was approaching significance $F(1,174)= 3.70$, $p = .06$, as confirmed by a post hoc analysis $F(1,174)= 4.20$, $p = .04$, which revealed that this interaction occurred because 5 year olds had more false memories in the perceptually similar condition (M=.46) than perceptually dissimilar condition (M=.30).There was no significance found between the two conditions of perceptual similarity vs perceptual dissimilarity for 7 Year olds, $F(1,174) = .48$, $p = .49$ (see Figure 2). No other interactions were found for the critical lures (all *ps* > .05).

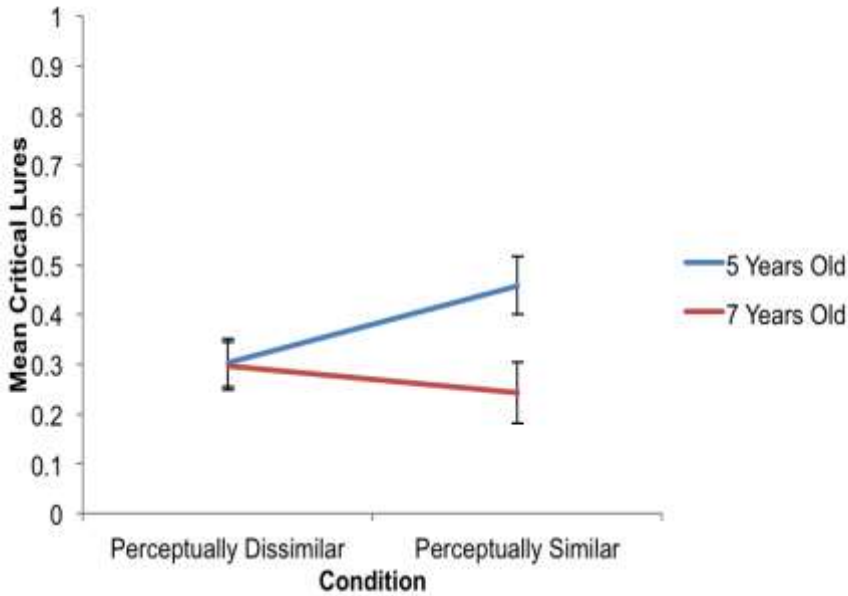

Figure 2: The means of the Age x Condition Interaction for 5 and 7 year olds in the perceptually similar vs dissimilar condition for critical lures. Error bars represent standard error.

For the related distractors a main effect was found for age $F(1,174)= 6.24$, $p = .01$, with 5 year olds having more false memories (M=.27) than 7 year olds (M= .15). A main effect for BAS was also found $F(1,174) = 19.71$, $p < .001$, with the low BAS condition creating more false memories ($M = .24$) than the high BAS condition ($M = .18$). There was no main effect found for perceptual similarity $F(1,174)= .89$, $p = .35$ and there were no interactions found (all *ps* >.05).

Corrected Scores

In order to control for a yes bias within the results, the unrelated distractor proportion of yes responses were deducted from each of the proportion of yes responses for the presented items, critical lures and related distractors (Snodgrass & Corwin, 1988). Again a 2 (Perceptual Similarity: High Vs Low) x 2 (Backward Associative Strength (BAS): High Vs Low) x 2 (Age: 5 vs 7 year olds) repeated measures ANOVA was used to measure the proportion of yes responses for true presented items and un-presented items of critical lures and distractors.

Table 2 presents the mean proportion of yes responses for high and low BAS items in 5 and 7 year olds once the proportion of yes-responses to unrelated distractors was deducted from the presented items, critical lures and related distractors.

Table 2 Mean proportions of yes responses for Corrected Presented Items, Corrected Critical Lures and Corrected Related Distractors.

Age In Years	Backward Associative Strength	Corrected Presented	Corrected Critical Lure	Corrected Related
5	High BAS	.54 (.49)	.10 (.29)	.02 (.19)
	Low BAS	.61 (.39)	.11 (.22)	.05 (.19)
7	High BAS	.70 (.42)	.14 (.24)	.004 (.13)
	Low BAS	.69 (.36)	.11 (.22)	.03 (.19)

Note. Standard Deviations are in parenthesis.

As can be seen in Table 2, 5 year olds had higher mean proportion of yes responses to corrected related distractors. 7 year olds had higher mean proportions for corrected presented and corrected critical lures. These were subjected to analysis. The variability within the data varied for the different items, with corrected presented items for both age groups having the largest variability and corrected related items having the smallest.

True memories. For the corrected true memories, there was a main effect of age on the proportion of yes responses for presented items, $F(1,174)= 4.89$, $p = .03$, with 7 year olds remembering more ($M= .69$) than 5 year olds ($M= .56$). There were no main effects found for perceptual similarity $F(1,174)= 1.45$, $p =.23$ or BAS $F(1,174)= 2.16$, $p =. 14$. There was a BAS x Age interaction found $F(1,174)= 5.52$, $p =.02$, this was confirmed by a t-test analysis $t(90)=-2.44$, $p =.02$ which revealed that this interaction occurred due to 5 year olds having more true memories for low BAS items ($M=.61$) than high BAS ($M= .54$). There was no significance found for 7 year olds $t(86)=.44$, $p =.66$ (see Figure 3). There were no interactions found (all *ps* >.05).

False memories. For false memories in terms of corrected critical lures there were no main effects found for the age, perceptual similarity, or BAS ($F(1,174)=.09$, $p = .76$, $F(1,174)=.05$, $p =.82$, $F(1,174)=.01$, $p = .94$., respectively). There were also no interactions found (all ps >.05).

For false memories in terms of corrected related distractors there was a main effect of BAS found $F(1,174) = 7.10$, $p = .01$, with the low BAS corrected related distractors creating more false memories ($M= .04$) than the high BAS corrected condition ($M = .01$). There were no main effects found for perceptual similarity $F(1,174)=.003$, $p =.96$ or age $F(1,174)= .003$, $p =.96$. There were no interactions found (all ps >.05).

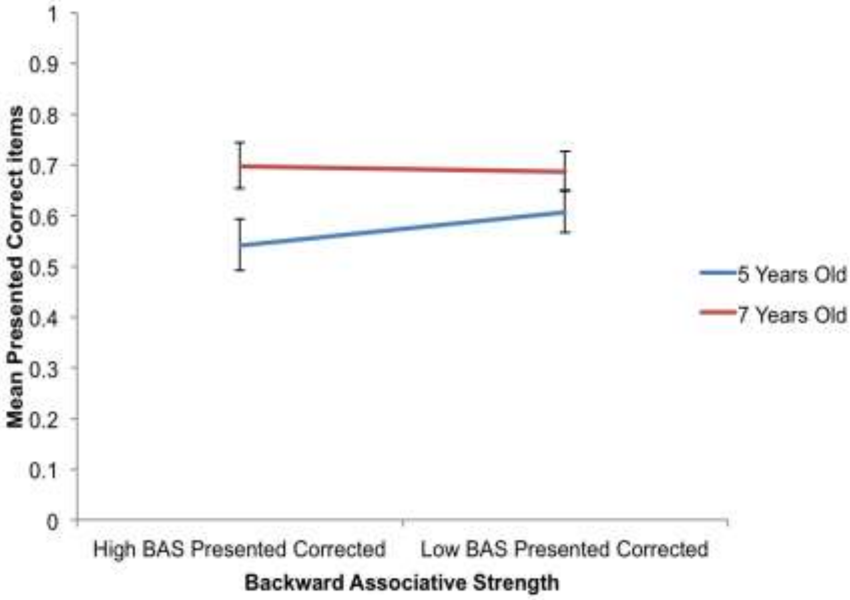

Figure 3: The means of the BAS x Age Group Interaction for 5 and 7 year olds for presented corrected items. Error bars represent standard error.

Discussion

True memory findings were consistent with previous developmental research, FTT and AAT theories in that true recall increased with age; 7 year olds had more true memories than 5 year olds. This was found once the yes-bias had been controlled for (Snodgrass & Corwin, 1988) and the scores had been corrected. The findings were also consistent with our predictions. A BAS x Age interaction revealed that 5 year olds had more true memories for low BAS items, which was found before and after the scores were corrected, but not found for 7 year olds. These results were inconsistent with previous research, which found that high BAS lists not only increase false memories but also true memories (Knott et al., 2012; Hicks & Hancock, 2002) but also inconsistent with our predictions. Howe et al. (2009) have suggested that true memories are less influenced by associative links between presented items and critical lures, and are affected differently by the associations. This could be an explanation as to why low BAS items elicited more true memories than high BAS lists, as associative strength was playing less of a role in the production of true memories. In further support of this, Howe (2009) suggested that true memories are not influenced by association but instead by categories, therefore it could have been the particular categories of the low BAS items which lead to more true memories. This interaction was not found for 7 year olds.

In considering whether perceptual similarity would have an effect on true memories, we did not expect to find any interactions or main effects. Consistent with previous research (Ghetti et al. 2002; Howe, 2008) and in line with our predictions, there was no significant difference between the perceptually similar and dissimilar conditions on the proportion of yes responses to presented items.

In relation to false memories we were also interested in the proportion of yes responses for critical lures; we found that 5 year olds had more false memories than 7 year olds and that an interaction revealed this was for perceptually similar items.

This finding was consistent with previous research by Ghetti et al. (2002) who reported that younger children had more false memories than older children and that the less distinctive condition created more false memories. With this in mind, it could be suggested that in this case, perceptual factors were driving false memories for the younger children and distinctiveness was reducing false memories. This is consistent with the "distinctiveness heuristic" proposed by Schacter et al. (1999) which suggested that participants were aware of the distinctive information and could use this in the recognition task realising that they had been provided with distinctive information. However, as already mentioned Ghetti et al. (2002) suggested that it would be unlikely that young children would be able to implement this heuristic, since our finding was for 5 year olds it could be suggested that perhaps it was not the ideas of "distinctiveness heuristic" driving false memory rates. By contrast, Smith and Hunt (1998) argued that distinctiveness at encoding allows for successful discrimination at retrieval of presented and un-presented items and perhaps it was this that lead to the perceptually similar condition creating more false memories. Although interesting, once the scores had been corrected this interaction disappeared, suggesting that the yes-bias was influencing the generation of false memories for critical lures in 5 year olds.

In considering false memories we were also interested in whether these could be extended to other items aside from the critical lures. To this end we included related distractors which were close in category to the critical lure but less directly associated. There was a main effect of BAS found, in that low BAS items generated more false memories than high BAS items. The same was true for the corrected scores suggesting that false memories can be extended to categories further than the associated critical lures. This is however an unexpected finding, as previous research has been consistent with the idea that high BAS items normally elicit more false memories (Ardnt, 2014; Hicks & Hancock, 2002; Howe et al., 2009; Knott et al., 2012; Roediger et al., 2001). In considering the data and potential explanations for why this unexpected finding occurred, one potential criticism is that there were some items in the low BAS lists that had higher associative strength to the critical lure than some items in the high BAS lists. Examples included Quill, Saucer & Cocoon, as opposed to other in high BAS lists (slice, sick, pride for example). Although the average and total overall associative strength was lower for low BAS lists, it may have been these higher associative strength items within these lists contributing to the false memories. More in-depth analysis of the data would be required to see if these items were confounding the results. Roediger et al. (2001) included items in their low BAS lists that we did not include in our data. These had lower associative strengths to the critical lure and for future research it could be considered that all the items within the low BAS lists should have lower associative strength than those in the high BAS lists.

A main effect of age was also found for the related distractors with 5 year olds having more false memories than 7 year olds, this may have been due to the fact that the related distractors did not have a direct association to the critical lure, but were instead related by category. Howe et al. (2009) suggested that category lists should have higher false recall rates than DRM lists for younger children because they contain fewer gists. According to FTT, it is the gist traces which encode the overall meaning of an item and this ability increases with age. Therefore, if there are fewer gists this could explain our finding. Once the scores were corrected however, this main effect disappeared, which again suggests that the yes-bias was influencing the results.

Across the board, there were no main effects or interactions found for 7 year olds. This is inconsistent with previous research into the DRM paradigm, which using AAT and FTT would predict that 7 year olds would have more false memories than 5 year olds (Brainerd, et al., 2006; Dewhurst et al, 2007; Howe, 2006; Howe et al., 2009). This was also inconsistent with our predictions. One potential limitation which might explain why this occurred was considered by Ghetti et al. (2002). They suggested that participants should have enough time to be able to encode and retrieve the material they see. There should be limited time for items to be encoded and false memories to be elicited, but they cannot exceed the abilities of the young children. There was only 3 seconds between each presented list, which may not have been enough time for the information to have been encoded by the children. However, in research conducted by Howe (2008), Howe et al. (2009) which used similar timings, they still found the developmental reverse, which suggests that perhaps it was not the encoding time playing a role in our unexpected results. Another limitation which could have influenced our findings was the DRM lists that we used were adult-normed, as Roediger et al.'s (2001) word lists were all derived from research conducted with undergraduates (e.g. Nelson et al., 1999; Stadler, Roediger & McDermott, 1999). Although DRM lists that were child-normed have still seen this developmental reverse, (Anastasi & Rhodes, 2008; Carneiro et al., 2007) these adult-normed lists may still have reduced false memories in the children (Wimmer & Howe, 2009). Anastasi & Rhodes (2008) examined the effects of using adult-word norms on children and found that both true and false recall was reduced. Therefore, our results may have been affected by using adult-normed lists. For future research, our study could be replicated using child-normed lists, to see if this influences our results.

Our main effects for 5 year olds were confounded by the yes-bias. One potential reason for this occurrence could be explained by Brainerd et al.'s (2002) research into list lengths. They suggested that list lengths need to be long enough for gists to be extracted and false memories to be elicited, but not too long as to make the task too difficult. Their research found that the list-lengths of 12 items were too cognitively demanding for 5 year olds. They arrived at this conclusion due to low levels of true recall and recognition found in their results for 5 year olds. We had six lists of eleven words and as this was close to the threshold of 12 items it could be suggested that perhaps the 5-year olds found the task too difficult; which lead to more of the yes-bias within our results.

To conclude, if the yes-bias was not taken into consideration, it would appear that perceptual factors were driving the false memories more than conceptual factors. This was due to the fact that 5 year olds had more false memories than 7 year olds, and that distinctiveness reduced false memories. In terms of conceptual factors, the fact that low BAS items elicited more false memories would not suggest that this was a factor as consistent research has found high BAS lists elicit more false memories. However, taking the yes-bias into consideration, these main effects and interactions were not significant; therefore we cannot conclude that perceptual factors drove false memories more than conceptual factors. Potential limitations to our methods have been considered and in light of future research could be altered accordingly. In addition, this study has highlighted some of the ways in which false memories can be influenced and these could have implications within the criminal justice system.

References

Anastasi, J. S., & Rhodes, M. G. (2008). Examining differences in the levels of false memories in children and adults using child-normed lists. *Developmental Psychology, 44,* 889-894.

Anderson, J. R., & Pirolli, P. L. (1984). Spread of activation. *Journal of Experimental Psychology: Learning, Memory & Cognition, 10,* 791-798.

Arndt, J. (2012). The influence of forward and backward associative strength on false recognition. Journal of Experimental Psychology: *Learning, Memory, and Cognition, 38,* 747–756.

Arndt, J. (2014). The influence of forward and backward associative strength on false memories for encoding context. *Memory*. Retrieved 25/2/15 from http://www-tandfonline-com.plymouth.idm.oclc.org/doi/full10.1080/09658211.2014.959527 #abstract

Azzi, L. G. (2002). Play behaviour and peer status of five to seven year old children as a function of cognitive development. Retrieved 24/Feb/15 from http://search.proquest.com/docview/619962479?accountid=14711

Brainerd. C. J., Forrest, T. J., Karibian, D., & Reyna, V. F. (2006). Development of the false memory illusion. *Developmental Psychology, 42,* 962-979.

Brainerd, C. J., Reyna, V. F., & Ceci, S. J. (2008). Developmental reversals in false memory. *Developmental Psychology, 42,* 962-979.

Brainerd, C. J., Reyna, V. F., & Forrest, T. J. (2002). Are Young Children Susceptible to the False-Memory Illusion? *Child Development, 73,* 1363-1377.

Cann, D, R., McRae, K., & Katz, A, N. (2011). False recall in the Deese-Roediger-McDermott paradigm: the roles of gist and associative strength. *The Quarterly Journal of Experimental Psychology, 64,* 1515- 1542.

Carneiro, P., Albuquerque, P., Fernandez, A., & Esteves, F. (2007). Analyzing false memories in children with associative lists specific for their age. *Child Development, 78,* 1171-1185.

Davidson, D. (1998). The 5- to 7- year shift: Does it still exist? *The American Journal of Psychology, 111,* 305-312.

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology, 58,* 17-22.

Dewhurst, S. A., Pursglove, R. C., & Lewis, C. (2007). Story contexts increase susceptibility to the DRM illusion in 5-year-olds. *Developmental Science, 10,* 374-378.

Dewhurst, S. A., & Robinson, C. A. (2004). False memories in Children: Evidence for a shift from phonological to semantic associations*. Psychological Science, 15,* 782-786.

Dodson, C. S., & Hege, A. C. G. (2005). Speeded retrieval abolishes the false-memory suppression effect: Evidence for the distinctiveness heuristic. *Psychonomic Bulletin & Review, 12,* 726-731.

Ghetti, S., Qin, J., & Goodman, G. (2002). False memories in Children and Adults: Age, Distinctiveness, And Subjective Experience. *Developmental Psychology, 38,* 705-718.

Hedwige, D., Laroi, F., & Van der Lindon, M. (2011). The influence of encoding style on the production of false memories in the DRM paradigm: New insights on individual differences in false memory susceptibility. *Personality and individual differences, 50,* 583-587.

Hicks, J. L., & Hancock, T. W. (2002). Backward Associative Strength determines source attributions given to false memories. *Psychonomic Bulletin & Review, 9,* 807-815.

Hintzman, D. L. (1988). Judgements of frequency and recognition memory in a multiple-trace memory model. *Psychological Review, 95,* 528-551.

Howe, M. L. (2005). Children (but not adults) can inhibit false memories. *Psychological Science, 16,* 927-931.

Howe, M. L. (2006). Developmentally invariant dissociations in children's true and false memories: Not all relatedness is created equal. *Child Development, 77*, 1112.

Howe, M. L. (2008). Visual Distinctiveness and the development of children's false memories. *Child Development, 79,* 65-79.

Howe, M. L. (2009). An associative-activation theory of children's and adult's memory illusions. *Journal of Memory and Language, 60,* 229-251.

Howe, M. L., Wimmer, M. C., Blease, K. (2009). The role of associative strength in children's false memory illusions. *Memory, 17,* 8-16.

Howe, M.L., Wimmer, M. C., Gagnon, N., & Plumpton, S. (2009). An associative-activation theory of children's and adults' memory adult illusions. *Journal of Memory and Language, 60,* 229-251.

Kimball, D. R., & Bjork, R. A. (2002). Influences of intentional and unintentional forgetting on false memories. *Journal of Experimental Psychology: General, 131,* 116-130.

Koustaal, W., & Schacter, D. L. (1997). Gist-based false recognition of pictures in older and younger adults. *Journal of Memory & Language, 37,* 555-583.

Knott, L. M., Dewhurst, S. A. Howe, M. L. (2012). What factors underlie associative and categorical memory illusions? The role of Backward Associative Strength and interim connectivity*. Journal of Experimental Psychology: Learning, Memory & Cognition, 38,* 229-239.

McGeown, S. P., Gray, E. A., Robinson, J. L., & Dewhurst, S. A. (2014). What factors underline children's susceptibility to semantic and phonological false memories? Investigating the roles of language skills and auditory short-term memory. *Cognition, 131,* 323-329.

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1999). The university of South Florida word association, rhyme and word fragment norms. Retrieved 25/2/15 from http://w3.usf.edu/FreeAssociation.

Nelson, D. L., McEvoy, C. L., & Schreiber, T.A. (2004). The university of South Florida word association, rhyme and word fragment norms. *Behaviour Research Methods, Instruments & Computers, 36,* 402-407.

Otgaar, H., Howe, M. L., Peters, M., Smeets, T., & Moritz, S. (2014). The production of spontaneous false memories across childhood. *Journal of Experimental Child Psychology, 121,* 28-41.

Robinson, K. J., & Roediger, H. L. III. (1997). Associative Processes in false recall and false recognition. *Psychological Science, 8,* 231-237.

Roediger, H. L. III., & McDermott, K, B. (1995). Creating false memories: Remembering words not presented on lists. *Journal of Experimental Psychology: Learning, Memory & Cognition, 21,* 803-814.

Roediger, H. L. III., Watson, J. M., McDermott, K, B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis*. Psychonomic Bulletin & Review, 8,* 385-407.

Sameroff, A. J., & Haith, M. M., (Eds.) (1996). *The five to seven year shift: The age of reason and responsibility.* Chicago: University of Chicago Press.

Schacter, D. L., Cendan, D. L., Dodson, C. S., Clifford, E. R., (2001). Retrieval conditions and false recognition: Testing the distinctiveness heuristic. *Psychonomic Bulletin & Review, 8,* 827-833.

Schacter, D. L., Israel, L., & Racine, C. (1999). Suppressing false recognition in younger and older adults: The distinctiveness heuristic. *Journal of Memory and Language, 40,* 1-24.

Seamon, J. H., Luo, C. R., Schwartz, M. A., Jones, K. J., Lee, D. M., & Jones, S. J. (2002). Repetition can have similar and different effects on accurate and false recognition. *Journal of Memory and Language, 46,* 323-340.

Smith, R. E., & Hunt, R. R. (1998). Presentation modality affects false memory. *Psychonomic Bulletin & Review, 5,* 710-715.

Snodgrass, J. G., & Corwin, J. (1988). Perceptual Identification thresholds for 150 fragmented pictures from the Snodgrass and Vanderwart picture set. *Perceptual and Motor Skills, 67,* 3-36.

Stadler, M. A., Roediger, H. L., III, & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition, 27,* 494-500.

Toglia, M. P., Neuschatz, J. S., & Goodwin, K. A. (1999). Recall accuracy and illusory memories: When more is less. *Memory, 7,* 233-256.

Wimmer, M. C., & Howe, M. L. (2009). The development of automatic associative processes and children's false memories. *Journal of Experimental Child Psychology, 104,* 447-465.

Wimmer, M. C., & Howe, M. L. (2010). Are children's memory illusions created differently from those of adults? Evidence from levels-of-processing and divided attention paradigms. *Journal of Experimental Child Psychology, 107,* 31-49.

Appendices for this work can be retrieved within the Supplementary Files folder which is located in the Reading Tools menu adjacent to this PDF window.