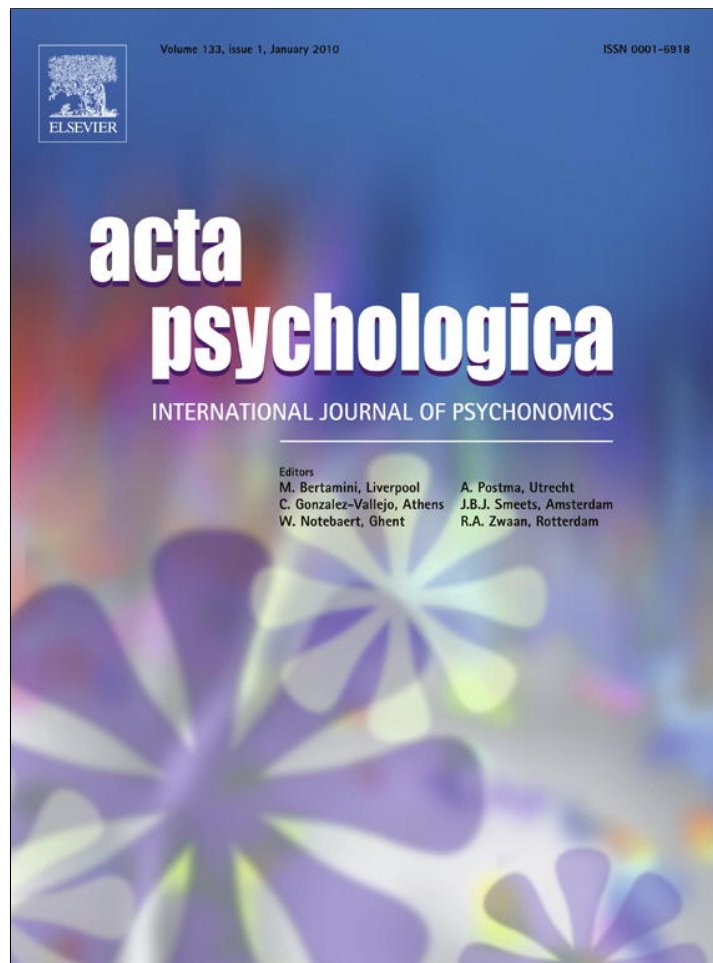


Provided for non-commercial research and education use.  
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: [www.elsevier.com/locate/actpsy](http://www.elsevier.com/locate/actpsy)

## Script knowledge enhances the development of children's false memories

Henry Otgaar<sup>a,\*</sup>, Ingrid Candel<sup>a</sup>, Alan Scoboria<sup>b</sup>, Harald Merckelbach<sup>a</sup>

<sup>a</sup> Faculty of Psychology, Maastricht University, P.O. Box 616, 6200 MD, Maastricht, The Netherlands

<sup>b</sup> University of Windsor, Canada

### ARTICLE INFO

#### Article history:

Received 19 May 2009

Received in revised form 25 September 2009

Accepted 28 September 2009

Available online 23 October 2009

#### PsycINFO classification:

2343

#### Keywords:

Children

False memories

Script knowledge

### ABSTRACT

We examined whether script knowledge contributes to the development of children's false memories. Sixty 7-year-old and 60 11-year-old children listened to false narratives describing either a high-knowledge event (i.e., fingers being caught in a mousetrap) or a low-knowledge event (i.e., receiving a rectal enema) that were similar in terms of plausibility and pleasantness. Moreover, half of the children in each condition received additional suggestive details about the false events. Across two interviews, children had to report everything they remembered about the events. Script knowledge affected children's false memories in that both younger and older children developed more false memories for the high-knowledge event than for the low-knowledge event. Moreover, at the first interview, additional suggestive details inhibited the development of children's images into false memories.

© 2009 Elsevier B.V. All rights reserved.

### 1. Introduction

Children are able to give detailed descriptions of events they experience in daily life (see Fivush, 1997, 1998). Although these descriptions will be often accurate, studies have shown that children can “remember” entire events that did not happen to them (e.g., Ceci & Bruck, 1993; Otgaar, Candel, & Merckelbach, 2008). A common procedure in these studies is to present children with false narratives or doctored photographs suggesting that an event happened to them while in fact it did not (i.e., implantation paradigm: e.g., Otgaar, Candel, Merckelbach, & Wade, 2009; Pezdek & Hodge, 1999; Strange, Sutherland, & Garry, 2006). Subsequently, they are encouraged to report everything they remember about the fictitious event. With this procedure, many children can be brought to falsely remember a plethora of events ranging from plausible (i.e., lost in a shopping mall; Pezdek & Hodge, 1999) to implausible events (i.e., abducted by a UFO; Otgaar et al., 2009). The aim of the present study was to examine whether schematic or script knowledge (i.e., knowledge structures specifying sequences of actions; Fivush, 1997) is a critical precursor of children's implanted false memories.

So far, the few studies that explored the role of script knowledge focused on how it affects adults' beliefs (Hart & Schooler, 2006; Scoboria, Mazzoni, Kirsch, & Jimenez, 2006). Overall, these

studies found that in adults, script knowledge is *not* a necessary prerequisite for false beliefs and memories to develop. Whether script knowledge contributes to the development of *children's* false memories, however, is largely unknown.

One of the few studies that addressed this issue in children is that of Pezdek and Hodge (1999). These authors reported that children more readily developed false memories for having been lost in a shopping mall than for having received a rectal enema. However, event plausibility and script knowledge were confounded in this study. That is to say, relative to the rectal enema event, children might possess more background knowledge about being lost in a shopping mall *and* find it a more plausible event. Although one might expect that the concepts of plausibility and script knowledge are highly correlated, the one study that examined this in adult participants found no relationship between them (Scoboria, Mazzoni, Kirsch, & Relyea, 2004).

Examining whether script knowledge boosts children's false memories for entire events has theoretical significance. Although beliefs and memories are interrelated constructs, they are certainly not equivalent (Scoboria et al., 2004; Smeets, Merckelbach, Horselenberg, & Jelicic, 2005). When people have a memory of an event, they have a clear recollection of the event whereas people can believe in the occurrence of an event with or without recollection (Scoboria et al., 2004; Smeets et al., 2005). Although former studies focusing on the role of script knowledge concentrated mainly on (false) belief ratings of adults (e.g., Hart & Schooler, 2006; Scoboria et al., 2006), no study thus far has focused on the effect of script

\* Corresponding author. Tel.: +31 43 3884340; fax: +31 43 3884196.  
E-mail address: [Henry.Otgaar@maastrichtuniversity.nl](mailto:Henry.Otgaar@maastrichtuniversity.nl) (H. Otgaar).

knowledge upon children's false memory formation. Thus, it is relevant to examine whether in children existing script knowledge has an impact that goes beyond false beliefs and promotes genuine false memories. As well, it is unknown whether adding suggested details (i.e., background information) would further promote such memories. The Mazzoni and Kirsch (2002) metacognitive model of false belief and memory formation predicts that lack of knowledge about an event may be used to reject an unremembered event as not having occurred (see Ghetti (2008) for a similar argument). However, research on children's metamemory abilities indicates that younger children may be less able to use their knowledge effectively to determine whether or not events did occur (see Ghetti & Alexander, 2004; Koriat, Goldsmith, Schneider, & Nakash-Dura, 2001). Thus, it may well be the case that children form false memories even when they have no knowledge about a fictitious event.

While it is true that recent research suggests that event plausibility is not a critical antecedent of young children's false memories (Otgaar et al., 2009; Strange et al., 2006), plausibility of events has not been well controlled in the preceding work on script knowledge. Indeed, previous studies did not specifically establish to what extent their target false events were regarded as plausible by children (e.g., Pezdek & Hodge, 1999). Recent work by Ghetti and Alexander (2004) demonstrated that before the age of 7, children tend not to use plausibility when evaluating unremembered events. In contrast from the age 9 onwards, children employ plausibility in a way that is similar to adults to reject false events. Hence, what is needed are studies that examine the impact of script knowledge upon children's false memory formation while controlling for the plausibility of events.

Another parameter that has not been systematically varied in past research is the degree to which fictitious events are judged as unpleasant. Studies which have contrasted events such as receiving a non-invasive medical procedure (e.g., an X-ray) or moderate unpleasant events (e.g., lost in a shopping mall; Pezdek & Hodge, 1999) with receiving an enema have the additional confound that the enema event is typically viewed as invasive and uncomfortable, and therefore may be less likely to be endorsed.

To date, no study has examined whether script knowledge enhances children's implanted false memories while holding plausibility and pleasantness constant. Hence, the aim of the present study was to investigate whether script knowledge promotes the development of children's false memories. Using a false memory implantation procedure (see below), 7-year-old and 11-year-old children listened to fabricated narratives about a moderately plausible, low-knowledge event or a moderately plausible, high-knowledge event (see Appendix A). Half of the children received additional suggestive details about their target event. Across two interviews, children had to indicate everything they remembered about the event.

Following Pezdek, Blandon-Gitlin, Lam, Hart, and Schooler (2006) who argued that script-relevant information must be retrieved from memory to facilitate the construction of an image of a false event, we hypothesized that the high-knowledge event would evoke more false memories than the low-knowledge event. Germane to this is also recent research showing that having semantic knowledge increases the development of false memories (Brainerd, Reyna, & Ceci, 2008). As to the effect of additional suggestive details, two outcomes are possible. On the one hand, additional suggestive details might deepen script-relevant information about the target events, thereby boosting false memory rates for the events. On the other hand, additional suggestive details may suppress false memory creation. The idea here is that additional suggestive details could restrict imagination and/or inhibit recall fluency, because extra information includes specific details, people, and locations thereby lowering the chances for the construction of

false memories (Garry and Wade (2005); see also Tesser and Leone (1977)).

With respect to age, we hypothesized that younger children would be more likely to develop implanted false memories than older children. This hypothesis was derived from developmental false memory research (see Bruck & Ceci, 1999; Otgaar et al., 2009; Strange et al., 2006) showing that younger children assent more readily to suggestive manipulations than older children and adults. Furthermore, recent research shows that younger children are less effective in using metacognitive strategies (e.g., event memorability) to judge whether or not a false event has occurred. This implies that younger children are less likely able to reject false events and thus develop more false memories than older children (Ghetti & Alexander, 2004). Also, based upon Ghetti's (2008) work, we anticipated that if younger children are less effective at using a lack of script knowledge to reject the occurrence of fictitious events, then they should show more false memories for the low-knowledge event than older children. To test this, we included two age groups: 7-year-olds and 11-year-olds (e.g., see also Bruck & Ceci, 1999; Ceci, Ross, & Togli, 1987). So, young children's deficits in using metacognitive strategies could be particularly pronounced when they are presented with false events of which their knowledge is extremely limited (e.g., low-knowledge event; Ghetti, 2008).

## 2. Method

### 2.1. Participants

The participants were 120 primary school children (51 girls) from two different age groups ( $n = 60$ , 7-year-old,  $M = 7.37$ ,  $SD = 0.52$ , range 7–8;  $n = 60$ , 11-year-old,  $M = 11.33$ ,  $SD = 0.47$ , range 11–12). Children received a small present for their participation upon completion. Informed consent was provided by the school and the children's parents. The study was approved by the standing ethical committee of the Faculty of Psychology, Maastricht University.

### 2.2. Materials

#### 2.2.1. True narratives

To obtain for each child two true events that happened to him/her at the age of 4, questionnaires were sent to the parents. Specifically, they were instructed to describe two moderately significant experienced events (e.g., birthday party and family trip), including what the event was, where it took place, when it took place, and who was present. These details formed the basis for the true narratives, which were approximately five sentences in length. An example of a true narrative (translated from Dutch) was

"Your mother told me that when you were 4 years old, you went to Euro Disney in France. This was for your birthday. Your parents and grandparents also joined you. You came there by bus. Your mother told me you really loved the fairy forest."

#### 2.2.2. False narratives

False events were selected from a pilot study in which 103 children ( $M = 8.48$  years,  $SD = 1.67$ , range 6–13) rated the plausibility and pleasantness of 48 events on 7-point Smiley scales (anchors: ☹ = implausible/negative, ☺ = plausible/positive), with bigger Smiley faces indicating more plausible/more positive events. Specifically, children indicated how likely it was that the events happened to them (e.g., "How likely is it that you personally could have received a rectal enema?"; i.e., personal plausibility; Scoboria et al., 2004) and how pleasant the events were for them (e.g., "How pleasant

do you think it will be to receive a rectal enema?”). To make sure that they understood the procedure, two practice items were added. The majority of the pilot events was taken from the literature on false memories (e.g., taking a hot air balloon ride; Wade, Garry, Read, & Lindsay, 2002). A randomly selected subsample of the pilot group ( $n = 55$ ,  $M = 8$  years,  $SD = 1.18$ , range 6–11) was asked to provide script knowledge for each of these events. This subsample was instructed to report what typically happens when such events occur. The number of idea units was our measure of script knowledge (Scoboria et al., 2004). For example, if a child reported that an enema occurs at the hospital, then this was counted as 1 idea unit. Based on children's ratings, two critical events were selected: an event for which children had relatively poor script knowledge (low-knowledge event; “receiving a rectal enema”;  $M_{\text{script}} = .18$ ,  $SD = .66$ , range 0–3) and an event for which they had relatively more script knowledge (high-knowledge event; “fingers being caught in a mousetrap”;  $M_{\text{script}} = 1.00$ ,  $SD = 1.12$ , range 0–4),  $t(53) = 3.40$ ,  $p < .01$ ,  $d = 0.87$ . Both events were similar in terms of pleasantness ( $M_{\text{mousetrap}} = 1.55$ ,  $SD = 1.63$ ,  $M_{\text{rectal enema}} = 1.09$ ,  $SD = .45$ ),  $t(100) < 1$ , n.s. (1 missing value) and plausibility ( $M_{\text{mousetrap}} = 4.86$ ,  $SD = 2.69$ ,  $M_{\text{rectal enema}} = 4.60$ ,  $SD = .248$ ),  $t(100) < 1$ , n.s. (1 missing value).<sup>1</sup> Also, we found no significant correlations (range  $r = -0.17$  to  $0.31$ ; mean  $r = 0.13$ ) between plausibility and script knowledge ratings of the events indicating that these ratings tap different conceptual domains. Parents of the children participating in the current study confirmed that their children had not experienced the target events.

### 2.2.3. Additional suggestive details

For the false events, additional suggestive details were incorporated in the description of the narratives. More precisely, the procedures that were involved in these events were added (for examples of the narratives with/without additional suggestive details, see Appendix A). These procedures were based on studies of Ceci, Huffman, Smith, and Loftus (1994) and Pezdek et al. (1999). As a manipulation check, a pilot group of 18 children ( $M = 9$ -years,  $SD = 2.12$ , range 7–13) was asked about script knowledge of the target events before and after the presentation of additional suggestive details. Children reported more script knowledge about the target events after the presentation of additional suggestive details ( $M_{\text{mousetrap}} = 5.55$ ,  $SD = 2.50$ ,  $M_{\text{rectal enema}} = 4.33$ ,  $SD = 1.71$ ) than before ( $M_{\text{mousetrap}} = 2.67$ ,  $SD = 1.24$ ,  $M_{\text{rectal enema}} = 0.61$ ,  $SD = 0.98$ ,  $t_{\text{mousetrap}}(17) = -4.91$ ,  $p = .001$ ,  $d = 1.04$ ,  $t_{\text{rectal enema}}(17) = -8.58$ ,  $p < .001$ ,  $d = 2.25$ ).

### 2.3. Design and procedure

This study relied on a 2 (Age: younger children vs. older children)  $\times$  2 (Event type: low-knowledge vs. high-knowledge)  $\times$  2 (Additional suggestive details: yes vs. no) between-subjects design. The children were randomly assigned to event type and to additional suggestive details.

Interviews were administered individually, twice over a seven-day period. A digital voice device recorded all interviews. The children were subjected to the implantation paradigm: a paradigm specifically developed to induce false memories for entire events (e.g., Garry & Wade, 2005; Loftus & Pickrell, 1995). The procedure of the interviews was adopted from Wade et al. (2002). During each interview, the children listened to two true narratives and one false narrative. The false narrative was always located in the third position. Before Interview 1, the interviewer told each child that we were interested in their memories for events that occurred

when they were 4 years old and that they had to report everything they could remember about these events. Children who were unable to say anything about the events were told that “many people can't recall certain events because they haven't thought about them for such a long time. Please concentrate and try again.” If they still did not come up with any details, context reinstatement and guided imagery techniques were applied to bring the children mentally back to the scene of the event. Thus, children were told to close their eyes and were instructed to think about their feelings, who was with them, and about the time of the year. Next, children were asked once more to recall any details about the events. If they were still unable to come up with any additional information, the next event narrative was presented.

After the first interview, children were told that they had to think about these events every day and they were encouraged to come up with more details during the second interview. Moreover, they were instructed not to talk with others about the events. Likewise, children's parents were asked not to discuss the events with their children. Interview 2 was identical to Interview 1. Debriefing occurred at the end of the second interview and was constructed according to ethical guidelines for false memory research with children (Goodman, Quas, & Redlich, 1998).

### 2.4. Scoring

True memories were classified as either remembered or not remembered. A memory was classified as remembered if a child correctly reported at least two of the three correct details (i.e., where, when, with whom) provided by the parents. Using criteria adopted from Lindsay, Hagen, Read, Wade, and Garry (2004), children's responses to the false events were coded as no false memory, images but not memories or false memory. The images category was included to examine what other researchers (e.g., Hyman & Billings, 1998; Lindsay et al., 2004; Porter, Yuille, & Lehman, 1999) have coined “partial false memories”. Thus, a child that tried to recall, but did not have any memory of the event and did not report any details related to the event, was said to have no false memory. Images included children's speculations about the event and image descriptions related to the event. A report was scored as a false memory only when a child indicated that it remembered the false event and reported details not mentioned by the experimenter, but related to the false event. If a child merely indicated that the event could have happened and/or thought the event happened, then this was not classified as a false memory. To counteract the effect of demand characteristics, direct positive responses (e.g., “yes”) to interviewer prompts were not categorized as a false memory. Two raters who were blind to the conditions and hypotheses of the study scored transcripts; inter-rater agreement ( $\kappa$ ) was high: .91 and .95 for Interview 1 and Interview 2, respectively.

## 3. Results

### 3.1. True events

A maximum of 240 true events could be reported, with children remembering 214 (88%) events at Interview 1 and 229 (95%) events at Interview 2, an increase that was significant,  $\chi^2(1) = 6.59$ ,  $p < .01$ , Cramer's  $V = .12$ . At neither interview were there significant age differences in remembering true events (all  $ps > .05$ ).

### 3.2. False events

Twenty-two percent ( $n = 26$ ) of the children reported an image of the false event at Interview 1, while at Interview 2, this percent-

<sup>1</sup> Younger (6–7-year old) and older (11–12-year old) children's plausibility, pleasantness, and script knowledge ratings did not statistically differ for the two target events (all  $ps > .05$ ).

age was 23% ( $n = 27$ ;  $\chi^2(1) = .02$ , n.s.). Also, 50% ( $n = 13$ ) of the children who had an image of the false events at Interview 1 also reported an image at Interview 2. This 11-year-old child's report is an example of an image of receiving a rectal enema:

"I think they did something with my stomach, something with a small tube. And that had to be at the hospital or at the doctor."

Furthermore, 22% ( $n = 26$ ) of the children had a false memory at Interview 1, with 42% ( $n = 11$ ) of them reporting it instantly, without the cues provided by the guided imagery and context reinstatement techniques. At Interview 2, this pattern remained rather similar, with 21% ( $n = 25$ ) of the children describing a false event ( $\chi^2(1) = .03$ , n.s.). This time, 76% ( $n = 19$ ) of them immediately reported a false memory. Furthermore, 62% ( $n = 16$ ) of the children who developed a false memory at the first interviews also had a false memory at the second interview. Although one might expect that children who had images at the first interview would be more likely to develop a false memory at the second interview, only 8% ( $n = 2$ ) of the children who reported an image at the first interview developed a false memory at Interview 2. Appendix B gives examples of false memories for both events.

### 3.3. Age and high-knowledge vs. low-knowledge event

To examine the effect of age, event type, and additional suggestive details, logistic regression analyses were conducted with false memory (0 = no false memory/images, 1 = false memory) as the dependent variable and event type, age, additional suggestive details, and corresponding two-way and three-way interactions as predictor variables. For neither interview, significant interactions were detected (all  $ps > .05$ ). Therefore, logistic regression analyses were computed with only event type, age, and additional suggestive details as predictor variables. As expected, a significant age effect was present at Interview 2 ( $B = 1.06$ ,  $SE = .50$ ,  $Wald = 4.51$ , adjusted  $OR = 2.89$ ,  $p < .05$ ) with 28% ( $n = 17$ ) of the younger children concurring to the false events compared to 13% ( $n = 8$ ) of older children developing a false memory.

However, we did not find a significant interaction between age and event type ( $p > .05$ ). Also, a significant main effect for event type was found at both interviews. Children who were provided with the mousetrap event (high-knowledge event; Interview 1: 32%,  $n = 19$ ; Interview 2: 32%,  $n = 19$ ) were more likely to create a false memory than children who received the enema event (low-knowledge event; Interview 1: 12%,  $n = 7$ ; Interview 2: 10%,  $n = 6$ ; Interview 1:  $B = -1.37$ ,  $SE = .50$ ,  $Wald = 7.51$ , adjusted  $OR = .25$ ,  $p < .01$ ; Interview 2:  $B = -1.57$ ,  $SE = .53$ ,  $Wald = 8.82$ , adjusted  $OR = .21$ ,  $p < .01$ ). Twenty-three percent of the 7-year-olds ( $n = 7$ ) at Interview 1 and 19% of this subgroup ( $n = 6$ ) at Interview 2 falsely remembered the rectal enema event (see Table 1). Meanwhile, their memory reports were limited. Specifically, an independent samples t-test with number of words used for describing the false events as dependent variable showed a significant main effect of event type (i.e., mousetrap event vs. rectal enema event;  $t(29) = -2.24$ ,  $p < .05$ ,  $d = 0.84$ ) with 7-year-old children using

more words to describe the mousetrap event ( $M = 35.89$ ,  $SD = 26.61$ ) than the rectal enema event ( $M = 17.85$ ,  $SD = 13.54$ ). However, although the number of words for describing the rectal enema event was limited, these reports fulfilled the false memory criteria.

### 3.4. Additional suggestive details

With regard to the effect of additional suggestive details, at neither interview did additional suggestive details contribute to false memory creation (Interview 1:  $B = .68$ ,  $SE = .48$ ,  $Wald = 2.05$ , adjusted  $OR = 1.97$ , n.s.; Interview 2:  $B = .38$ ,  $SE = .48$ ,  $Wald = .62$ , adjusted  $OR = 1.46$ , n.s.). We conducted exploratory analyses of the effects of age, event type, and additional suggestive details upon the relative rates of development of images vs. memories (see Table 1). Logistic regression analyses contrasting the images and memory categories for Interview 1 revealed a main effect for age ( $B = 1.73$ ,  $SE = .79$ ,  $Wald = 4.82$ , adjusted  $OR = 5.64$ ,  $p < .05$ ), with younger children being more likely than older children to be categorized as having a false memory than just an image. Furthermore, the mousetrap event was more likely to be recalled as false memory, while the rectal enema event was more likely to be endorsed as an image ( $B = -2.70$ ,  $SE = .85$ ,  $Wald = 10.15$ , adjusted  $OR = .07$ ,  $p < .01$ ). Interestingly, additional suggestive details were associated with greater frequency of images, whereas no suggested details were associated with more false memories. Thus, the addition of suggested details inhibited the formation of false memories at the time it was presented ( $B = 2.04$ ,  $SE = .78$ ,  $Wald = 6.89$ , adjusted  $OR = 7.71$ ,  $p < .01$ ).

At Interview 2, a significant main effect emerged for event type ( $B = -1.87$ ,  $SE = .66$ ,  $Wald = 7.93$ , adjusted  $OR = .16$ ,  $p < .01$ ), while the main effect for age was borderline significant ( $B = 1.25$ ,  $SE = .68$ ,  $Wald = 3.34$ , adjusted  $OR = 3.48$ ,  $p < .07$ ). The effect for additional suggestive details was no longer significant ( $B = .51$ ,  $SE = .62$ ,  $Wald = .63$ , adjusted  $OR = 1.67$ , n.s.).

## 4. Discussion

The present study examined whether script knowledge enhances the formation of children's false memories. Our study is the first one showing that children more easily develop false memories for events of which they have knowledge (i.e., fingers being caught in a mousetrap) than for events of which their knowledge is limited (i.e., receiving a rectal enema). Furthermore, we found that at the second interview, younger children developed more false memories than their older counterparts. A subsidiary aim of our study was to explore whether additional suggestive details would boost false memory development. We found no support for this. If anything, the opposite was true with additional suggestive details inhibiting the development of children's images to false memories during the first interview.

Our finding that the high-knowledge event (i.e., fingers being caught in a mousetrap) elicited more false memories than the

**Table 1**  
Percentage and number (between parentheses) of children who reported false memories (FMs) and images at Interviews 1 and 2.

		Interview 1				Interview 2			
		Mousetrap		Enema		Mousetrap		Enema	
		FMs	Images	FMs	Images	FMs	Images	FMs	Images
7-year-old	No additional script	36 (5)	0 (0)	31 (5)	13 (2)	43 (6)	7 (1)	13 (2)	25 (4)
	Additional script	27 (4)	20 (3)	13 (2)	33 (5)	33 (5)	27 (4)	27 (4)	27 (4)
11-year-old	No additional script	40 (6)	7 (1)	0 (0)	27 (4)	40 (6)	20 (3)	0 (0)	33 (5)
	Additional script	27 (4)	27 (4)	0 (0)	47 (7)	13 (2)	13 (2)	0 (0)	27 (4)

low-knowledge event (i.e., receiving a rectal enema) replicates and extends Porter, Yuille, and Lehman (1999). These authors found suggestive evidence that events are more likely to be implanted when they are plausible and when background knowledge exists in memory. In our study, events differed in script knowledge, while we held plausibility and pleasantness constant. Clearly, in our study, children possessed more script knowledge about the mousetrap event than about the enema event. Our finding that more false memories occurred for the mousetrap event than for the enema event fits nicely with “the lack of knowledge inference”. This inference was first described by Gentner and Collins (1981); see also Pezdek and Hodge (1999) and consists of meta-knowledge about events that people use when they have to evaluate whether an event has happened to them or not. In the context of our study, this meant that children will not know exactly what a rectal enema is and therefore will more readily conclude that they never received a rectal enema.

Our finding that children develop more false memories for the high-knowledge than the low-knowledge event is reminiscent of studies showing that children reject false events if they are perceived as highly memorable (Ghetti, 2008; Ghetti & Alexander, 2004). That is, when children believe that a false event is memorable, they interpret their lack of memory of the event as an indication that the event did not occur and therefore reject it (see also Mazzoni & Kirsch, 2002). In the current study, children will likely have evaluated the rectal enema event as extremely memorable resulting in more readily rejecting this event as something they have experienced than the mousetrap event. It may well be the case, therefore, that our effect is driven by metacognitive strategies (i.e., perceived memorability) that children use when they are presented with low-knowledge and high-knowledge events. One might argue, however, that the concepts of memorability and plausibility are overlapping. Indeed, Ghetti and Alexander (2004) suggested that memorability and plausibility are intimately related. These authors reasoned that implausible events are perceived as more memorable. Meanwhile, their study clearly demonstrated that event salience is more related to memorability than plausibility in that both children and adults experienced high-salience events as more memorable than low-salience events (Ghetti & Alexander, 2004). For plausibility, this is not the case: only older children and adults regard implausible events as more memorable.

Although our explanation about the use of the memorability-based strategy is speculative, there are indications that people may experience events as highly memorable even though they lack a specific episodic memory of those events (see Ghetti, 2008). Since our study was not optimally designed to examine to what extent our false events were highly memorable, future research should address this issue in a more systematic fashion.

With respect to age, we did not find that younger children were more likely to develop false memories for the low-knowledge event than older children. Yet, we did find that in the second interview, younger children were more likely to develop a false memory than the older children. Of course, this replicates other studies reporting developmental differences in false memory formation (e.g., Pezdek & Hodge, 1999; Strange et al., 2006). Younger children are more likely to concur to suggestive methods, such as fictitious narratives, than older children. This has to do with the fact that younger children do not yet possess optimal source-monitoring capabilities to distinguish between real and fictitious events (Lindsay, Johnson, and Kwon (1991); for an overview see Roberts and Blades (2000)). Alternatively, younger children might more readily agree with interviewer's demands and thus show more compliant behavior towards interviewers than older children (Gudjonsson, 1989, 1992; Richardson & Kelly, 2004). This would also result in younger children assenting more often to the false events than older children.

Brainerd, Reyna, and Ceci (2008), however, found that with certain paradigms, false memory rates increase with age because older children and adults possess more semantic knowledge than children. Younger and older children in our study had similar script knowledge ratings for the false events. Thus, in our study, having knowledge about an event did not account for age differences, but for general acceptance of some false events over others.

An exploratory enterprise in our study was to examine whether additional suggestive details would strengthen false memory effects. Overall, we found this not to be the case. It could well be that a single presentation of additional suggestive details is just not enough to establish a well-structured script of the event. Indeed, developmental research shows that only after repetitive experiences, children are able to construct well-organized scripts of events (see for an overview Farrar & Goodman, 1992; Hudson, Fivush, & Kuebli, 1992). Thus, it is possible that children need to be repeatedly exposed to additional suggestive details in order to find any effects on false memory rates. Another factor that might play a role in this context is that even for younger children, a single presentation of additional information might be easy to identify as an external source (e.g., presented by someone else), thereby lowering the chances for source misattributions.

Interestingly, at Interview 1, age, event type, and additional suggestive details affected whether children formed images or memories. Thus, older age was associated with more images and younger age with more memories; the low-knowledge (enema) event was associated with more images and the high-knowledge (mousetrap) event with more memories. Furthermore, adding suggested details was associated with more imagery and providing no additional suggestive details with more memories. This observation is particularly interesting as it suggests that the addition of suggested details may have inhibited the development of images into memories. This is in agreement with the idea that the provision of detailed information may in fact constrain memory search, thereby inhibiting the development of false memories (Garry & Wade, 2005). Furthermore, our finding is related to the discrepancy detection principle (Hall, Loftus, & Tournant, 1984).<sup>2</sup> According to this principle, the greater the distance is between already existing memories of an event and suggested information (e.g., additional suggestive details), the less likely it is that the suggestive information will be accepted. Thus, in our study, one could argue that, adding extra knowledge about an event might have increased the gap between existing memories about the event and suggested information such that false memories were inhibited. This effect was only apparent at Interview 1. It may well be the case that at Interview 2, children who received additional details about the false events did not regard it as unique anymore, because they had thought about the events between Interview 1 and 2. Hence, the passage of time could have decreased the distinctiveness of the false events such that extra knowledge did not inhibit false memory rates at Interview 2 (see also Ghetti, Qin, & Goodman, 2002; Hege & Dudson, 2004; Howe, 1998, 2008).

That the provision of additional suggestive details inhibits the development of images into false memories is in contrast with studies (e.g., Otgaar et al., 2009; Wade et al., 2002) showing that when suggestions are added and interviews are repeated, false memory rates increase. One possibility is that the extra suggested details in our study made the events less credible and less plausi-

<sup>2</sup> One might argue that false memory implantation techniques always create a gap between already existing memories of an event and suggested information, thereby implying that these techniques never work. However, the point is whether suggestive information *increases* or *decreases* the distance with existing memories. So, extra suggestions that decrease the gap will augment the likelihood that false events are implanted (e.g., Otgaar et al., 2009) while extra suggestions that increase the gap will make it less likely that the individual adopts the false events.

ble. This in turn could have made children more reluctant in stating that they experienced the false events.<sup>3</sup>

As already mentioned, we also found that older age and the low-knowledge event were associated with more images, while younger age and the high-knowledge event were more related to memories. This pattern has to do with age-related differences in false memory formation with younger children being more vulnerable to false memories than older children (see above; e.g., Strange et al., 2006). It also indicates that script knowledge enhances children's false memory formation.

A further striking result in our study was that a substantial number of the 7-year-old children (Interview 1:  $n = 7$ ; Interview 2:  $n = 6$ ; 23%) "remembered" receiving a rectal enema at age 4, while none of the 11-year-olds falsely remembered this event. Apparently, younger children are less able to reject false events when they have limited knowledge about them (Ghetti, 2008). This result stands in sharp contrast to Pezdek and colleagues' claim (1999) that only few children will adopt the enema event. We suspect that our finding has to do with the Dutch translation of "rectal enema" (i.e., *darmspoeling*), that includes more information than the English term. Not only is the Dutch equivalent a less medical term and therefore easier to understand for children, it also provides indirect information about what happens during a rectal enema. The root *darm* is translated as 'intestines' or 'gut' and *spoeling* as 'washing' or 'cleaning'. Accordingly, although 7-year-old Dutch children will not know exactly what a rectal enema is, they will be able to make some loose associations about the term. As an example, one child with a false memory reported that something went into his stomach and that he felt water going through his stomach. The words "stomach" and "water" could be the only associations that popped up into children's memory when they were presented with the rectal enema event. Since children have a more structured script of a mousetrap event, more associations can be created about this event, which in turn will have caused more detailed and elaborated false memory reports of the mousetrap event.

The results of the current study bear relevance to legal cases where children are suggestively interrogated about a non-experienced event and are sometimes given suggested details about that event. Well-known legal cases such as the "Wee Care Nursery School" and "McMartin Preschool" trials clearly demonstrate that children can develop full-blown false memories of traumatic events they did not experience (Ceci & Bruck, 1993; Garven, Wood, Malpass, & Shaw, 1998). Our results support the idea that having knowledge about an event facilitates the development of false memories of such an event, an idea that has received, up until now, little empirical attention (e.g., Loftus, 1993). Yet, providing children with additional information may constrain the development of false memories. Clearly, existing internal knowledge and adding extra information have different effects on false memory formation. Hence, future studies looking at the precise circumstances under which knowledge facilitates and/or suppresses false memory formation would be of great practical significance.

### Acknowledgement

This study was supported by a grant to Ingrid Candel from the Netherlands Organisation of Scientific Research (NWO), grant number 400-05-015.

<sup>3</sup> We thank an anonymous reviewer for providing us with this alternative explanation.

### Appendix A. Examples of the narratives with/without additional script knowledge

Rectal enema event with additional suggestive details:

"Your mother told me that when you were 4 years old, she let you eat too much. After a couple of days of junk food though, you started to feel really sick. You couldn't go to the bathroom. Your mother thought you should have a rectal enema. An enema is when you have some warm water put into your bottom to help you. Your mother remembered telling you that the enema wouldn't hurt and that it would make you feel better. You were scared anyway though, because when your mother took you into the bathroom, she remembered that you cried a lot."

Rectal enema event without suggested details:

"Your mother told me that when you were 4 years old, you received a rectal enema."

Mousetrap event with additional suggestive details:

"Your mother told me that when you were 4 years old, you were at the attic at someone's place. You did not know that there were all mousetraps. When you did not pay attention, your finger got caught in a mousetrap. Your mother remembered that you said it hurt and that you were crying. Then your mother brought you to the hospital to release the mousetrap from your finger. The doctor then putted a bandage on your finger".

Mousetrap event without additional suggestive details:

"Your mother told me that when you were 4 years old, you finger got caught in a mousetrap."

### Appendix B. Examples of false memories for the high-knowledge and script absent event

Mousetrap event

Child: "I fell and there was suddenly a mousetrap. Then I placed my hand in front of the mousetrap. Then the clicking mousetrap got caught in my index finger, right here."

Interviewer: "Where did this happen?"

Child: "This happened at my uncle and aunt's place. And then I cried. I cried a lot and then my mother came and brought me downstairs. Then we went outside and went to the city hospital by bike, because it had to be in plaster. And then we were at the emergency department or something like that, and then I received an injection. And then I fell asleep."

Rectal enema event:

Child: "I was four years old and then I had to go to the doctor. Then he had a look at my stomach and there was [inaudible word]. And then I had to lie down and there was something in my stomach, but I know what. It was a sort of little stone which was connected to my heart and little pipes. And then he got rid of it."

### References

- Brainerd, C. J., Reyna, V. F., & Ceci, S. J. (2008). Developmental reversals in false memory: A review of data and theory. *Psychological Bulletin*, 134, 343–382.
- Bruck, M., & Ceci, S. J. (1999). The suggestibility of children's memory. *Annual Review of Psychology*, 50, 419–439.
- Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin*, 113, 403–439.

- Ceci, S. J., Huffman, M. L. C., Smith, E., & Loftus, E. F. (1994). Repeatedly thinking about a non-event: Source misattributions among preschoolers. *Consciousness and Cognition*, 3, 388–407.
- Ceci, S. J., Ross, D. F., & Togliani, M. P. (1987). Suggestibility of children's memory: Psycholegal implications. *Journal of Experimental Psychology: General*, 116, 38–49.
- Farrar, M. J., & Goodman, G. S. (1992). Developmental changes in event memory. *Child Development*, 63, 173–187.
- Fivush, R. (1997). Event memory. In N. Cowan (Ed.), *The development of memory in childhood* (pp. 139–162). Psychology Press: Hove.
- Fivush, R. (1998). Children's recollections of traumatic and nontraumatic events. *Development and Psychopathology*, 10, 699–716.
- Garven, S., Wood, J., Malpass, R., & Shaw, J. III, (1998). More than suggestion: The effect of interviewing techniques from the McMartin Preschool case. *Journal of Applied Psychology*, 83, 347–359.
- Garry, M., & Wade, K. A. (2005). Actually, a picture is worth less than 45 words: Narratives produce more false memories than photographs do. *Psychonomic Bulletin and Review*, 12, 359–366.
- Gentner, D., & Collins, A. (1981). Studies of inference from lack of knowledge. *Memory and Cognition*, 9, 434–443.
- Ghetti, S. (2008). Rejection of false events in childhood. *Current Directions in Psychological Science*, 17, 16–20.
- Ghetti, S., & Alexander, K. W. (2004). "If it happened, I would remember it": Strategic use of event memorability in the rejection of false autobiographical events. *Child Development*, 75, 542–561.
- Ghetti, S., Qin, J., & Goodman, G. S. (2002). False memories in children and adults: Age, distinctiveness, and subjective experience. *Developmental Psychology*, 38, 705–718.
- Goodman, G. S., Quas, J. A., & Redlich, A. D. (1998). The ethics of conducting 'false memory' research with children: A reply to Hermann and Yodor. *Applied Cognitive Psychology*, 12, 207–217.
- Gudjonsson, G. H. (1989). Compliance in an interrogation situation: A new scale. *Personality and Individual Differences*, 10, 535–540.
- Gudjonsson, G. H. (1992). *The psychology of interrogations, confessions, and testimony*. Chichester: John Wiley & Sons.
- Hall, D. F., Loftus, E. F., & Tausignant, J. P. (1984). Postevent information and changes in recollection for a natural event. In G. L. Wells & E. F. Loftus (Eds.), *Eyewitness testimony: Psychological perspectives*. Cambridge: Cambridge University Press.
- Hart, R., & Schooler, J. (2006). Increasing belief in an invasive procedure that never happened: The role of plausibility and schematicity. *Applied Cognitive Psychology*, 20, 661–669.
- Hege, C. G., & Dudson, C. S. (2004). Why distinctive information reduces false memories: Evidence for both impoverished relational-encoding and distinctiveness heuristic accounts. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 30, 787–795.
- Howe, M. L. (1998). When distinctiveness fails, false memories prevail. *Journal of Experimental Child Psychology*, 71, 170–177.
- Howe, M. L. (2008). Visual distinctiveness and the development of children's false memories. *Child Development*, 79, 65–79.
- Hudson, J. A., Fivush, R., & Kuebli, J. (1992). Scripts and episodes: The development of event memory. *Applied Cognitive Psychology*, 6, 483–505.
- Hyman, I. E., & Billings, J. R. (1998). Individual differences and the creation of false childhood memories. *Memory*, 6, 1–20.
- Koriat, A., Goldsmith, M., Schneider, W., & Nakash-Dura, M. (2001). The credibility of children's testimony: Can children control the accuracy of their memory reports. *Journal of Experimental Child Psychology*, 79, 405–437.
- Lindsay, D. S., Hagen, L., Read, J. D., Wade, K., & Garry, M. (2004). True photographs and false memories. *Psychological Science*, 15, 149–154.
- Lindsay, D. S., Johnson, M. K., & Kwon, P. (1991). Developmental changes in memory source monitoring. *Journal of Experimental Child Psychology*, 52, 297–318.
- Loftus, E. F. (1993). The reality of repressed memories. *American Psychologist*, 48, 518–537.
- Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals*, 25, 720–725.
- Mazzoni, G., & Kirsch, I. (2002). Autobiographical memories and beliefs: A preliminary metacognitive model. In T. Perfect & B. Schwartz (Eds.), *Applied Metacognition* (pp. 121–145). Cambridge, UK: Cambridge University Press.
- Otgaar, H., Candel, I., & Merckelbach, H. (2008). Children's false memories: Easier to elicit for a negative than for a neutral event. *Acta Psychologica*, 128, 350–354.
- Otgaar, H., Candel, I., Merckelbach, H., & Wade, K. A. (2009). Abducted by a UFO: Prevalence information affects young children's false memories for an implausible event. *Applied Cognitive Psychology*, 23, 115–125.
- Pezdek, K., Blandon-Gitlin, I., Lam, S., Hart, R. E., & Schooler, J. W. (2006). Is knowing believing? The role of event plausibility and background knowledge in planting false beliefs about the personal past. *Memory and Cognition*, 34, 1628–1635.
- Pezdek, K., & Hodge, D. (1999). Planting false childhood memories in children: The role of event plausibility. *Child Development*, 70, 887–895.
- Porter, S., Yuille, J. C., & Lehman, D. R. (1999). The nature of real, implanted and fabricated memories for emotional childhood events: Implications for the false memory debate. *Law and Human Behavior*, 23, 517–838.
- Richardson, G., & Kelly, T. P. (2004). A study in the relationship between interrogative suggestibility, compliance and social desirability in institutionalized adolescents. *Personality and Individual Differences*, 36, 485–494.
- Roberts, K., & Blades, M. (2000). *Children's source monitoring*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Scoboria, A., Mazzoni, G., Kirsch, I., & Jimenez, S. (2006). The effects of prevalence and script information on plausibility, belief, and memory of autobiographical events. *Applied Cognitive Psychology*, 20, 1049–1064.
- Scoboria, A., Mazzoni, G., Kirsch, I., & Relyea, M. (2004). Plausibility and belief in autobiographical memory. *Applied Cognitive Psychology*, 18, 791–807.
- Smeets, T., Merckelbach, H., Horselenberg, R., & Jelicic, M. (2005). Trying to recollect past events: Confidence, beliefs, and memories. *Clinical Psychology Review*, 25, 917–934.
- Strange, D., Sutherland, R., & Garry, M. (2006). Event plausibility does not determine children's false memories. *Memory*, 14, 937–951.
- Tesser, A., & Leone, C. (1977). Cognitive schemas and thought as determinants of attitude change. *Journal of Experimental Social Psychology*, 13, 340–356.
- Wade, K. A., Garry, M., Read, J. D., & Lindsay, S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin and Review*, 9, 597–603.