



By-passing strategic retrieval: Experimentally induced spontaneous episodic memories in 35- and 46-month-old children



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ABSTRACT

Most parents have experienced their preschool child having spontaneous episodic memories, that is, verbally reported memories of past events that come to the child almost out of the blue. Until recently such memories had only been observed outside the lab. By means of a new paradigm we report experimentally induced spontaneous memories of a unique event experienced one week earlier in 35- and 46-month-old children ($N = 110$). At the first visit, half of the children experienced a Teddy event and the other half experienced a Game event. At the second visit the children's spontaneous utterances were recorded while waiting. The results revealed that the children talked spontaneously about the unique event experienced previously. Age showed no systematic effect on spontaneous episodic recollection, but there was a clear effect of age on subsequent control questions requiring strategic retrieval. The results support the idea of involuntary episodic remembering being a developmentally early achievement.

1. Introduction

The predominant method used when examining verbally reported memories in children is to simply ask the children about their previous experiences (Hayne, Scarf, & Imuta, 2015). When asked directly about previously experienced events, young children often have a hard time retrieving and talking about specific episodes from their past (e.g., Dahl, Kingo, & Krøjgaard, 2015; Simcock & Hayne, 2002). In order to respond to such questions, children will have to engage in a deliberate and strategic retrieval process. Deliberate and strategic retrieval requires executive control and involves the use of frontal lobes, which matures relatively late in the ontogenesis (e.g., Johnson, 2005). Thus, for young children, the process involved and required when responding to direct questions about past events, is by itself a cognitively demanding achievement which, all things equal, may have detrimental effects on the children's memory performance.

However, strategic recall is not the only way in which memories of past events come to mind. Evidence from healthy adults has shown that memories frequently come to mind involuntarily, or spontaneously, that is, without any deliberate attempts to recall the episode, but often in response to concrete environmental cues (Berntsen, 1996, 2009). Involuntary episodic memories differ from voluntary episodic memories by not involving neural activity in prefrontal areas associated with retrieval effort (Hall et al., 2014) and by involving shorter retrieval time (e.g., Berntsen, Staugaard, & Sørensen, 2013; Schlagman & Kvavilashvili, 2008), both consistent with the idea of relatively effortless retrieval. At the same time, such involuntary memories appear to be highly cue dependent (Berntsen, 1996, 2009). In addition involuntary memories are more frequently about specific episodes and have been found to have more emotional impact, and some studies find them to be more vivid than voluntary memories (for a review, see Berntsen, 2010). The

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notion of spontaneous memories as used here is adopted from the research on involuntary memories in adults.

We define spontaneous memories as (i) verbally produced, (ii) socially unprompted, and (iii) environmentally cued (Krøjgaard, Kingo, Dahl, & Berntsen, 2014). ‘Socially unprompted’ means that the memories do not occur as a result of prompts of any kind, as for instance explicit or implicit questions or demand characteristics directed at the child. Because spontaneous retrieval is based primarily on associative mechanisms and hence less dependent on executive functions and mature frontal lobes, (a) spontaneous retrieval is assumed to be less cognitively demanding than strategic retrieval, and, following the same logic, (b) spontaneous memories may be more prevalent in children than in adults, and (c) is likely to be developmentally earlier than strategic remembering (Berntsen, 2009, 2012). In the following we briefly present the existing evidence on spontaneous memories in children (for a more detailed review, see Krøjgaard et al., 2014).

1.1. Spontaneous memories in children

We recently reported experimental evidence of spontaneous recollections of a repeated, non-specific event in 46 months old children (Krøjgaard et al., 2014). However, no systematic research has been conducted on children’s spontaneous recollections of unique episodes in their past. The literature is also lacking systematic examination of the effects of age on spontaneous versus strategic episodic memories.

Although previous work is scarce, at times spontaneous memories as defined here have appeared in studies examining children’s memory in general. Spontaneous memories have for instance been observed in a number of studies using unstructured or semi-structured methodologies, usually diary studies (Ashmead & Perlmutter, 1980; Hudson, 1990; Nelson, 1989; Nelson & Ross, 1980; Reese, 1999; Todd & Perlmutter, 1980). As an illustrative example of a spontaneous memory, Todd and Perlmutter (1980, p. 82) reported the following:

[...] the parents of one of the three-year-olds reported that while watching a commercial that displayed a bottle of honey, the child said she had liked the chocolate stuff her mother used to give her but not the yellow. The mother felt this could only refer to the chocolate syrup and honey she used to put in the child’s bottle when she was a baby.

A number of experimentally based studies have collected children’s ‘spontaneous’ verbal references to their previous visits to a lab, while their non-verbal memories were tested by means of the elicited imitation paradigm (Bauer, Kroupina, Schwade, Dropik, & Wewerka, 1998; Bauer, van Abbema, Wiebe, Cary, Phill, & Burch, 2004; Bauer, Wenner, & Kroupina, 2002; Bauer & Wewerka, 1995). To illustrate, in some of the studies by Bauer and colleagues the children ‘spontaneously’ reported task-relevant material from the previous lab visits during the first of two delayed tests (Bauer, Kroupina, Schade, Dropnik, & Wewerka, 1998; Bauer & Wewerka, 1995; Bauer et al., 2002, 2004). However, because the setting involved encouragements to remember the previous task, as the children were explicitly asked to recall the motor actions of the events (i.e., “You can make a windmill with this stuff. Show me how to make a windmill”), these verbal productions were prompted and would therefore not fulfill the criteria used here for spontaneous memories.

Krøjgaard et al. (2014) presented evidence of experimentally induced spontaneous memories of a repeated event. Forty-six-month-old children were brought back to the lab where they had previously experienced memorable events, and while waiting in front of the props for the experimenter to return from a “phone call”, their possible spontaneous utterances were recorded. The rationale behind being able to induce spontaneous memories from specifically these previous encounters in the lab (and not any other experiences) was based on two assumptions: First, by bringing the children back to the exact same lab, with the same props, the same experimenter etc., there was a substantial overlap between the recall situation and the to-be-remembered episode which is known to facilitate memory (Hayne, 2004; Newcombe, Lloyd, & Ratliff, 2007). Second, the cues involved were not only overlapping; they were highly distinct. This strategy was consistent with the notion of cue overload stating that “The probability of recalling an item declines with the number of items subsumed by its functional retrieval cue” (Watkins & Watkins, 1975, p. 442). Thus, the likelihood of a cue providing access to a given target memory depends on the extent to which this cue is uniquely associated with the target. Its strength declines to the extent it is associated with other memories as well. This principle has shown its relevance in relation to involuntary episodic memories in adults (e.g., Berntsen et al., 2013) and in non-human primates (Martin-Ordas, Berntsen, & Call, 2013). Based on this principle, the most important factor is not the number or range of overlapping features between a present context and a remembered event, but rather whether the available cues referred *specifically* to the to-be-remembered episode, and not to other episodes. The recordings from the waiting period revealed that the 46-month-olds spontaneously produced significantly more mnemonic material relative to an age-matched control group (Krøjgaard et al., 2014).

Whereas the study by Krøjgaard et al. (2014) demonstrated that spontaneous memories could be induced experimentally, the study had a number of limitations: First, only 46-month-olds were examined; hence we do not know whether spontaneous memories could be induced in even younger children. Second, the props were fully visible during the test, whereby online reasoning could be a confounder. Third, because the children in the experimental group had visited the lab three times before, the to-be-remembered event was not unique and therefore did not fulfill a commonly used criterion for episodic memory. In addition, the multiple previous visits may have made the children in the experimental group more comfortable during the test relative to controls that had never been in the lab before. Fourth, the previous visits concerned memory tasks. Thus, the possibility remains that although the children were never asked or prompted while waiting in front of the props, some of the children in the experimental group may have guessed that this study was about memory too.

In order to pursue the investigation of experimentally induced spontaneous recall further, we here tested the children’s memories for a single distinct event, contrasted age groups and improved the experimental procedure used by Krøjgaard et al. (2014).

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