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Publication metadata

Title: Real-time Assessment of Looking Time at Central Environmental Cues for Spontaneous Recall in 35-month-olds
Author(s): Tirill F. Hjuler, Trine Sonne, Osman S. Kingo, Dorthe Berntsen & Peter Krøjgaard
Journal: Cognitive Development
DOI/Link: https://doi.org/10.1016/j.cogdev.2020.100995
Document version: Accepted manuscript (post-print)
Real-time Assessment of Looking Time at Central Environmental Cues for Spontaneous Recall in 35-month-olds

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Acknowledgements
This research was supported by the VELUX FOUNDATION (VELUX 10386) and the Danish National Research Foundation (DNRF 89). We would like to thank Marie Nymand for recruiting and testing participants, as well as Louise Jensen, Anne Rytter, Sofie Aamand Beyer, Emilie Buur Kristensen and Sofie Dam Christiansen for coding the video material, and Yibin Zhang for editing the videos prior to coding. Also, we would like to thank the children who participated, and their parents for letting them participate. The data that support the findings of this study are available from the corresponding author upon reasonable request.
Abstract

Evidence supporting the assumption that spontaneous recall of previously experienced events is triggered by distinct, environmental cues has hitherto exclusively been based on post-hoc reasoning and not on direct, in vivo examination. Using a novel experimental paradigm, we present the first real-time analyses of 35-month-old’s looking time as spontaneous retrieval unfolds. Twenty-nine middle-to-higher SES children (out of 114 participating) spontaneously recalled having taken part in either a Teddy or a Game event (adjacently placed in two unique boxes) when returning to the lab one week later. Naïve coders registered looking time towards the two dissimilar looking boxes 10 seconds preceding spontaneous recall. The children having spontaneous recollections looked reliably longer at their Target box (relative to Foil), whereas this was not the case for a group of matched (by gender, event, and CDI) controls producing no spontaneous memories. The findings are important for understanding how visual attention facilitates spontaneous recall.

Keywords: spontaneous recall; cues; looking time; memory; development; young children
1. Introduction

Involuntary memories are defined as memories of previously experienced events that come to mind with no preceding conscious attempt at retrieval (Berntsen, 2009). Functional brain scanning studies have revealed that retrieval of such involuntary memories is mainly the result of simple associative processes, requiring little executive control (e.g., Hall et al., 2014). Furthermore, these associative processes are often triggered by distinct cues in the environment (Berntsen, 1996, 2012). For instance, when going for a run on a vacation in California, the sight of a beautiful waterfall immediately reminded the first author of another vacation in Costa Rica, where she passed by another outstanding waterfall while running. Because involuntary retrieval of past events mainly involves simple associative mechanisms it may be present earlier in childhood than voluntary recall of personal events (Berntsen, 2012).

Until recently, involuntary memories have not been investigated systematically in young children. Methodological challenges may, at least in part, be responsible for this gap in the literature. When investigating involuntary memories in adults using a diary methodology, participants are typically asked to report involuntary memories after a careful instruction concerning how to distinguish between voluntary and involuntary retrieval. However, young children are not capable of making such metacognitive distinctions. In order to circumvent this methodical challenge, Krøjgaard, Kingo, Dahl, and Berntsen (2014) operationalized involuntary memories as spontaneous memories that are (i) verbally produced, (ii) socially unprompted, and often (iii) environmentally cued. When examining children, this operational definition of spontaneous memories has the advantage that evaluating whether a memory fulfills the criteria (or not) can be done from an observer perspective (i.e., a coder) and does not depend on first-person reports (i.e., from the child). Thus, conceptually, spontaneous memory is basically the same as involuntary
memory, but is assessed from a third-person perspective and therefore, as operationalized here, will have to be expressed verbally at the moment of recall.

That environmental cues can serve a crucial role in memory retrieval is well-established in research with adults, and not new in the developmental literature either. A prominent line of memory research with infants and young children is based on the elicited/deferred imitation paradigm. In this paradigm, an adult models an action, or a series of actions, and after a delay the infant is offered the opportunity to reproduce the to-be-remembered action or action sequence (e.g., Barr, Dowden, & Hayne, 1996 [6-24-month-olds]; Collie & Hayne, 1999 [6- and 9-month-olds]; Bauer & Lukowski, 2010 [16- and 20-month-olds]; Bauer, Wenner, Dropik, & Wewerka, 2000 [13-, 16-, and 20-month-olds]; Meltzoff 1985 [14- and 24-month-olds], 1988a [9-month-olds], 1988b [14-month-olds]; Sonne, Kingo, & Krojgaard, 2016 [20-month-olds]). The majority of studies using the elicited/deferred imitation paradigm relies on environmental cues in the form of props used. However, in part due to the somewhat younger participants, this line of research differs from the present operationalization of spontaneous recall by using motor (and not verbal) indices of memory. That said, a handful of studies using the elicited imitation paradigm have indeed—in addition to motor re-enactments—also examined 13- to 20-month-old infant’s verbal recollections of to-be-remembered events when returning to the lab at the age of three years (Bauer, Kroupina, Schwade, Dropik, & Wewerka, 1998; Bauer et al., 2004; Bauer, Wenner, & Kroupina, 2002). In these studies, two slightly different procedures were used to test possible verbal recollections of the to-be-remembered events at the age of three. In one procedure, children’s possible verbal responses were elicited by placing the props visible, yet out of reach, while the experimenter provided explicit prompts by means of labeling the event and asking “What is this one called? What can we do with this?” (Bauer et al., 2004; Bauer et al., 1998; Bauer et al., 2002). In the other procedure involving two-year olds, the children were allowed to manipulate the props when returning to the lab, and
then the experimenter prompted the children by providing the label of the event and subsequently stated “You can make/do X with that stuff” (Bauer et al., 2002; delayed-recall test 1). The results revealed that three-year-olds, but not two year olds, were able to recall the to-be-remembered events verbally after delays (Bauer et al., 2004, Bauer et al., 1998; Bauer et al., 2002).

The procedures used by Bauer and colleagues in these three studies share the features of spontaneous recollections of being verbally produced, and by being, at least to some extent, environmentally cued, as the props were present. However, both procedures used by Bauer et al. differ from spontaneous recall by being socially prompted in the form of offering explicit verbal prompts and thus encouraging the child to strategically search for a memory. Hence, these studies do not measure spontaneous recollections as operationalized by Krøjgaard et al. (2014).

Although many parents have experienced their young children having spontaneous recollections, and although such anecdotal evidence at times have been found in diary studies (e.g., Nelson & Ross, 1980; Todd & Perlmutter, 1980), very little systematic research on spontaneous recollections have been conducted until recently. For instance, a large number of studies have examined children’s verbal recollections of various kinds of staged events (e.g., Dahl, Kingo, & Krøjgaard, 2015; Jones & Pipe, 2002; Kingo, Staugaard, & Krøjgaard, 2014; Morris & Baker-Ward, 2007; Priestley, Roberts, & Pipe, 1999; Simcock & Hayne, 2002). Whereas such studies rely on mnemonic material that is both verbally reported and typically environmentally cued, the children were always socially prompted, if not directly asked, about the to-be-remembered material. Therefore, these studies do not address spontaneous memories as defined here. In order to present the rationale behind the present study, we first outline the sparse literature on spontaneous recall in young children and the role of contextual cues.

1.1 Previous findings on spontaneous recall and the role of contextual cues
A number of studies has suggested the critical importance of environmental cues for eliciting spontaneous recall (e.g., Krøjgaard, Kingo, Jensen, & Berntsen, 2017; Reese, 1999; Sonne, Kingo, Berntsen, & Krøjgaard, 2019). However, the core assumption that spontaneous retrieval is typically environmentally cued has primarily been based on retrospective assessments in research with children. For instance, we were able to identify just one published diary study that directly examined spontaneous memories (Reese, 1999). In this study, mothers recorded spontaneous talk about past events of their 25- and 32-month-old children. Parents retrospectively registered the type of cues triggering the memory, and the cues were subsequently divided into three broad categories (1) physical (i.e., an object or setting in the environment), (2) verbal (i.e., a memory cued by an utterance), or (3) internal (i.e., a memory not cued by any sight nor sound). Overall, the results revealed that the type of cues predominantly triggering spontaneous talk in both age groups were environmental, physical cues.

The importance of environmental cues as elicitors of spontaneous memories agrees with studies involving adults (e.g., Berntsen, 2009) and was also recently demonstrated in a series of experiments in which Krøjgaard and colleagues induced spontaneous recall in 35- and 46-month-old children (Krøjgaard et al., 2017; Sonne et al., 2019; Sonne, Kingo, Berntsen, & Krøjgaard, 2020, in press). At the first visit, the children experienced a highly memorable event (either a Teddy or a Game event) hidden in one of two distinct, but dissimilar, boxes. At the second visit, one week later, the children’s verbal utterances were recorded while waiting with their parent in front of the distinct boxes containing the props from the events. The reasoning behind the design was that waiting in front of the setup with the two unique, but dissimilar, boxes (of which the children at their return knew the contents of only one of them) would serve as a distinct cue for remembering the event experienced one week earlier. The results from the first of these studies using this experimental design (Krøjgaard et al., 2017) showed that spontaneous memories of the previous
experienced event was triggered in 42% of the 35-month-olds and 66% of the 46-month-olds (based on the Word List measure, see below).

Follow-up studies have shown that children’s spontaneous recall of these events is quite robust. In fact, a substantial number of children had spontaneous memories despite (a) returning to a different, but similarly furnished room (Sonne et al., 2019) and regardless (b) of changing the experimenter between the first and second visit (Sonne et al., in press). The fact that the children—despite changing prominent environmental cues (i.e., the room, or the experimenter)—persist in showing spontaneous recall, strongly suggests that other prominent environmental cues than the room or the experimenter, viewed in isolation, are responsible for the spontaneous recollections in this design.

For a number of reasons, we assume that a highly central environmental cue would be the distinct box containing props for the event witnessed one-week earlier—what we in the following refer to as the Target box: (1) The Target box is spatially related by being very close to the key components of the Target event (i.e., the box contains the props used for the Target event, thus holding strong spatial contiguity). (2) The features (shape, size, color, and texture) of the Target box are highly distinct. (3) The Target box is functionally related to the Target event because it has to be opened before the Target event is presented. (4) The Target box is temporally related by being the object encountered just before the Target event is demonstrated (temporal contiguity). (5) Last, but not least, the configuration with the two boxes remained a fixed and stable part of the design across all the previous studies in which spontaneous recall had been documented in a lab setting. All these factors render it highly probable that the child would be reminded of the event when encountering the Target box.

As already outlined, evidence from experimental studies (with adults: Berntsen, Staugaard, & Sørensen, 2013; with children: Krøjgaard et al., 2017; Sonne et al., 2019, in press) as
well as diary studies (for a review on adults, see Berntsen, 2009; children: Reese, 1999) have suggested that environmental cues are powerful elicitors of involuntary/spontaneous retrieval for both adults and children. These findings suggest a complex interaction between ongoing visual and overt attention (understood as looking directly at distinct cues) and stored information, facilitating spontaneous recall. The goal of the present study was to provide the first real-time analysis of attentional processes preceding spontaneous recall in young children. The study extends previous work by systematically examining, in real-time, how the spontaneous retrieval unfolds, that is, whether subjects actually look at the assumed central cue prior to producing a spontaneous memory. Whereas real-time examinations would not be possible in diary studies, the experimental design by Krøjgaard et al. (2017) allows us to objectively assess the children’s looking time preceding spontaneous retrieval as it occurs in real-time, and importantly, to do so without changing the basic design.

Real-time assessment of the looking time preceding verbally producing spontaneous recollections would provide important insights in several respects. Attention and memory retrieval are usually studied separately. However, in real life, attention and memory are not separate processes but will often presuppose one another. Attention is often guided by remembered information (e.g., Neisser, 1976), and visual attention to specific features of the environment may trigger spontaneous memory processes in children (e.g., Reese, 1999). Here we focus exclusively on the latter part. Attaining a deeper understanding of how visual attention affects memory retrieval is important in order to understand spontaneous memory processes and how they unfold in young children. Furthermore, insights regarding the conditions under which children’s attention towards environmental cues may facilitate spontaneous recall may be beneficial for applied domains like pedagogical and forensic psychology.
1.2 The present study

In the present study, we investigated children’s looking time preceding a spontaneous recollection. We took a departure point in the procedure developed by Krøjgaard et al. (2017) in which spontaneous memories were induced in young children. Only one age-group of 35-month-olds was tested, as the study by Krøjgaard et al. (2017) has shown that spontaneous memories can be induced at this age. Using the same age group would allow us to generalize to previous studies using the same overall design. At the first visit, the children were presented with a highly engaging, memorable event, the props for which were hidden in one of two boxes, when not being demonstrated. The design was counter-balanced so that, for half of the children, the memorable event-props (for the Teddy event) were hidden in a red metal box, whereas for the other half of the children, the memorable event-props (for the Game event) were locked away in a grey plastic box. When returning to the lab one week later, we examined to what extent each child looked at the Target box (i.e., the box containing props for the event the child was shown at the first visit) relative to the Foil box (i.e., the box for which the content was unknown to the child) preceding a spontaneous memory (if they produced any). In the looking time analyses, we focused exclusively at the boxes as cues, (a) because these were the only salient objects present in the lab, serving as distinct cues of each of the two events, and (b) because the results from previous studies indicated that the setup with the two distinct boxes may be a crucial cue-configuration (cf., the arguments presented above). In order to investigate the children’s looking time in an objective manner, a hidden camera was installed in the wall exactly between the two boxes, allowing for offline coding (see Fig. 1, Panel A). Based on recordings from this camera position and by means of a movie analysis software (see below), naïve coders (i.e., coders did not know which of the boxes was the
Target) could objectively assess the duration of time in seconds that the children looked at each of the two boxes, respectively.

Fig. 1

Panel A

Panel B

Panel C

Eye tracking technology was considered for this purpose, but rejected for two reasons: First, employing eye tracking would require changes to the original set-up used in Krøjgaard et al. (2017). It would interfere with the original procedure by, as a minimum, involving the inclusion of
either a table mounted eye tracker or eye tracking glasses, which all things equal potentially could add noise and thus degrade the comparability to the original design. Second, in the present design, the two boxes serving as areas of interest (AOIs) for the looking time analyses were so relatively large and separated that high resolution eye tracking was not deemed necessary.

Based on the results from previous studies using the exact same design, we expected that 30-50% of the children would have spontaneous recollections during the second visit (Krøjgaard et al., 2017; Sonne et al., 2019). For the sake of simplicity, we refer to this part of the study as the Spontaneous Recall Test. The main hypothesis regarding the looking time pattern preceding a spontaneous memory was only tested on the subset of children who actually had spontaneous memories when returning to the lab. We refer to this part of the study as the Looking Time Analyses. Based on the assumption that distinct environmental cues are assumed to be crucial for spontaneous recall, we expected that the children who produced spontaneous recollections, would look more at the Target box (the box containing props for the event the child saw at the first visit) relative to the Foil box (the box for which the child did not see the content at the first visit) during the 10 seconds preceding the occurrence of a spontaneous memory at the second visit, that is, 10 seconds preceding the exact moment when an utterance indicating a spontaneous recollection was initiated.

The choice of 10 seconds as time-frame for the Looking Time Analyses was based on the following reasoning: As the total waiting time in front of the two boxes at test was 2 minutes, we had to choose a more restricted time-period. Ten seconds were chosen as an adequate compromise, allowing the cue to work for the children, while at the same time maintaining a somewhat restricted time-period. The decision of a 10 second window was also motivated by research with adults, showing that spontaneous recollections on average emerge around 5 seconds
after the onset of a cue (e.g., Schlagman & Kvavilashvili, 2008). Thus, 10 seconds should provide enough time for observing attentional processes preceding recollection, even in young children.

To assess whether the possible looking time pattern obtained among the children producing spontaneous recollections was uniquely related to having spontaneous memories, the Looking Time Analyses were also administered to a matched control group of children who did not produce spontaneous recollections when returning to the lab for direct comparison. For the children in the matched control group, we did not expect them to look preferentially at their Target box.

2. Method

2.1. Participants

A total of one-hundred-and-fourteen 35-month-old children (55 girls, $M_{age} = 35.24$ months, $SD = .62$, range: 33.40-37.30) participated in the Spontaneous Recall Test. The children were randomly assigned to participate in either the Teddy event ($N = 59$) or the Game event ($N = 55$). The participants were all healthy and full-term children primarily recruited from the National Board of Health, and a minority were recruited via online advertisement. They were predominantly Scandinavian Caucasian living in families with middle to higher SES. All children received a small gift for participating. An additional 25 children were tested but excluded from the analysis due to: fussiness ($N = 2$), experimental error ($N = 5$), speaking a foreign language ($N = 1$), and an unsystematic technical error ($N = 17$) resulting in substantial noise on the recordings making it impossible to code the audio track on the video.

Since the main focus of the present study was to examine the children’s looking time with respect to the Target and the Foil box preceding the occurrence of a spontaneous memory, the Looking Time Analyses primarily focused on those children who actually had spontaneous recollections when returning to the lab. This subsample of children eligible for the Looking Time Analyses (henceforth: the Recall Group) consisted of twenty-nine 35-month-olds (14 girls, $M_{age} =$
35.19 months, $SD = .64$, range: 33.8-36.7). An additional five children also had spontaneous memories at the second visit, but were excluded from the Looking Time Analyses because: (1) The spontaneous utterance occurred at 0.0 seconds (that is, at the precise moment when the recording was started), which resulted in no prior looking time to code for ($N= 2$); (2) A small group of children did not look at any of the boxes during the 10 seconds coding ($N=3$). Whereas the initial large sample ($N = 114$) was randomized, the children in the Recall Group ($N = 29$) were not, as we could not know in advance which of the children eventually would have spontaneous memories. It turned out as follows: Teddy event = 21; Game event = 8).

As a control sample for the Looking Time Analyses, we constructed a matched control group (henceforth, the Matched Controls). The participants for the Matched Controls were selected and carefully matched as follows: For each child in the Recall Group, amongst the children who did not produce spontaneous memories, we chose the child of same gender, and same condition, with a CDI-score (see below) numerically closest to the matching child in the Recall Group. Based on these selection criteria, the Matched Controls also consisted of twenty-nine 35-month-olds (14 girls, $M_{age} = 35.26$ months, $SD = 0.74$, range: 33.40-37.30).

Written and informed consent was obtained prior to participation. The study had been approved by the local ethics committee at the Center on Autobiographical Memory Research, Department of Psychology at Aarhus University.

2.2. Materials

The children were tested in a 16 m$^2$ room. Along one side, two locked boxes were placed next to each other: To the left a red metal box with two doors (containing the props for Teddy event) and to the right a grey plastic box with a top lid (containing the props for the Game event). The Teddy event consisted of two mechanical teddies: Elly, a blue and grey elephant, who could wiggle its ears while singing; and Alfred, a light-brown dog, who could wiggle its ears and
clap its paws while singing. The Game event consisted of two different games: a home-made throwing game, involving three different colored buckets and three balls, and a bowling game, involving two balls and ten pins. The child and parent were sitting on chairs in front of a table placed along the opposite wall of the room allowing the child to have a clear view of both boxes (see Fig. 1, panel A). A GoPro camera was hidden inside the wall right between the two boxes to record the sessions for offline coding. From this camera, it was possible to see the child and the parent, but not the two boxes used for the event specific materials (see Fig. 1, panel B).

2.3. Design and procedure

Following the original design by Krøjgaard et al. (2017), all children visited the lab twice with a one-week retention interval ($M = 6.98$ days, $SD = .40$, range = 6-8). Two experimenters recruited the participants and conducted all of the experiments following the same manualized protocol. Prior to participation, the parents had been carefully instructed by mail and by phone not to let the children know the study was about memory. Nor should they initiate conversations with the children when verbal utterances and looking time were recorded. If the children asked questions, the parents were instructed to reply briefly with a neutral response. Both lab visits were video recorded for offline coding.

2.3.1. First visit: Encoding

At the first visit ($T_1$), the procedure involved two steps: (1) a two-minute waiting period serving as a baseline measure, and (2) an encoding session involving the specific event. When picked up in the waiting room, the parent was handed a written note as a reminder not to initiate conversations nor to follow up on the child’s comments. In the lab, the experimenter left the room immediately after obtaining the written consent, saying that she had to take care of something and would be right back. The child and the parent were thus left alone in the lab in front of the two
locked boxes for exactly two minutes. After the two-minute waiting period, the experimenter returned and presented the child with either the Teddy event or the Game event (see Krøjgaard et al., 2017 for an elaborated description of the events).

After the visit, the parents received an email with a link to an electronic version of the Danish MacArthur-Bates Communicative Development Inventory: Words and Sentences (CDI), which have Danish norms for children up to 36 months of age (Bleses, Faber, Madsen, Vach, & Wehberg, 2007). They were asked to complete the questionnaire before returning for the second visit.

2.3.2. Second visit: Test of spontaneous recall

The procedure for the test at the second visit (T2) was completely identical to the two-minute baseline procedure from the first visit: The child and the parent were again left alone in the lab in front of the two locked boxes for exactly two minutes. The only, but crucial, difference was that this time, the child knew the contents of one, but only one, of the boxes, potentially serving as a cue for spontaneous recall. After the two-minute test, the child was handed a small gift.

2.4. Coding

Two kinds of data were obtained: (i) verbal utterances produced at both the T1-baseline and the T2-test during the two-minute waiting period, (ii) looking time data from the Recall Group (N = 29) who produced spontaneous memories during T2, as well as from the group of Matched Controls (N = 29).

2.4.1. Coding of spontaneous verbal utterances

Prior to coding the two-minute sessions, two videos from each participant were created: One from the two-minute waiting period at T1 and one from the two-minute waiting period
at T₂. This made it possible to ensure the coders were blinded to whether the video was from T₁ or from T₂, as well as to which event the child had been shown at T₁. Two coders coded the material, one primary coder coded all children, and a secondary coder who re-coded 20% of the same data. Interrater agreement was high: 98.7%, range 88.7-100%. As for the previous studies using this design (Krøjgaard et al., 2017; Sonne et al., 2019, in press), the spontaneous utterances were coded by two measures: a Word List and a Coding Scheme.

2.4.2. Word List Coding

A predefined Word List (see Table 1) was used to code the video clips from both the first and the second visit. The Word List consisted of event specific words (from the Teddy or the Game event) and an additional list of unspecific words, indicating that the child had visited the lab before, but without referring to one of the specific events (e.g., “Why is she leaving the room again?”; see Krøjgaard et al., 2017 for further details). A sum score was calculated for each child.

Table 1.
Word List for each of the two events as well as an Unspecific list of words indicating that the child had visited the lab before, but without being specific about which event.

<table>
<thead>
<tr>
<th>Teddy Event</th>
<th>Game Event</th>
<th>Unspecific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfred</td>
<td>Ball</td>
<td>“Again”</td>
</tr>
<tr>
<td>Animal</td>
<td>Blue</td>
<td>“Always”</td>
</tr>
<tr>
<td>Bring/Take out (teddies)</td>
<td>Bowling</td>
<td>“Has been”</td>
</tr>
<tr>
<td>Clap</td>
<td>Bucket</td>
<td>“Last time”</td>
</tr>
<tr>
<td>Dog</td>
<td>Game</td>
<td></td>
</tr>
<tr>
<td>Elephant</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Elly</td>
<td>Hit</td>
<td></td>
</tr>
<tr>
<td>Get (teddies)</td>
<td>Knock down/Turn over</td>
<td></td>
</tr>
<tr>
<td>Hug</td>
<td>Medal</td>
<td></td>
</tr>
<tr>
<td>Knob</td>
<td>Pin</td>
<td></td>
</tr>
<tr>
<td>Live/Stay</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td>Prize</td>
<td></td>
</tr>
<tr>
<td>Push</td>
<td>Red (pin or bucket)</td>
<td></td>
</tr>
<tr>
<td>Sing</td>
<td>Roll</td>
<td></td>
</tr>
<tr>
<td>Teddy</td>
<td>Throw</td>
<td></td>
</tr>
<tr>
<td>Turn on</td>
<td>Win</td>
<td></td>
</tr>
<tr>
<td>Wiggle</td>
<td>Yellow</td>
<td></td>
</tr>
</tbody>
</table>
2.4.3. Coding Scheme Coding

Following Krøjgaard et al. (2017) possible utterances were also coded by a Coding Scheme in order to identify possible verbal utterances indicative of memory from the first visit, not captured by the fixed Word List. The development of the Coding Scheme was inspired by the coding of ‘internal details’ developed by Levine, Svoboda, Hay, Winocur, and Moscovitch (2002), which is used to distinguish between episodic and semantic components of memories of episodes. Relative to the seven dimensions used in the Krøjgaard et al. (2017) study, we here decided to reduce the number of dimensions to five dimensions in order to simplify the coding and still obtain sufficiently reliable codings. Every two-minute video clip was divided into twelve 10 seconds time-slots, for which the coders answered five specific questions related to the following different dimensions:

1) **Language**: “Does the child by means of language refer to knowledge that originates from a previous visit?”

2) **Gesture**: “Does the child by means of gestures refer to knowledge that originates from a previous visit?”

3) **Reliving**: “Does the child’s verbal and/or non-verbal behavior indicate that the child mentally relives parts of a previous visit?”

4) **Action details**: “Does the child refer to specific action details from a previous visit?”

5) **Spatial details**: “Does the child by means of specific spatial details refer to knowledge that originates from a previous visit?”

Thus, although spontaneous recall as defined here is verbal in nature, scores from the coding scheme may provide additional information about the children’s spontaneous recollection that the Word List does not grasp (e.g., pointing to one of the boxes, or referring to a spatial location). This Coding Scheme measure may elaborate and qualify the word list coding, by also
capturing indicators of the child’s engagement and conscious reliving of the event. For each question, each time-slot could give either a single [1] or no [0] score. To exemplify, one child said: “I know there are some animals. There are some animals hidden in the box [pointing to the box]!” This statement resulted in scores on all five dimensions. Another child said: “I can’t see the teddies.” This statement resulted in scores on dimension 1 and 3, but not on the dimensions 2, 4, or 5. A sum score was calculated based on the results from the twelve ten second time-slots for each dimension. Thus, for each child there were five sum scores. In addition, by adding the sum scores from the five dimensions, a grand sum score was calculated.

2.4.4. Coding of looking time

All the children having spontaneous memories at T2, as identified by one or more ‘hits’ (i.e., positive scores indicating spontaneous recollections) on either the Word List and/or one or more hits from the Coding Scheme codings, were selected for further coding for the Looking Time Analyses (the Recall Group, N = 29). In addition a group of Matched Controls of same size (N = 29), were also included in the Looking Time Analyses. Here we describe first the procedure for the looking time coding for the Recall Group. Afterwards follows the procedure for looking time coding for the Matched Controls.

Only looking time preceding the first spontaneous recollection from each child in the Recall Group was coded. The reasoning behind this decision was that potential additional recollections were considered much more likely to be driven by internal self-cueing and therefore less valid for the Looking Time Analyses. Thus, the exact starting time of the children’s first spontaneous memories was noted on the Coding Scheme. The looking time during the 10 seconds leading up to the first spontaneous memory was coded (see Fig. 1, panel C) with respect to two different areas of interest (AOI): (a) left AOI [i.e., the position of the grey box (Game event)], (b) right AOI [i.e., the position of the red box (Teddy event)]. Note that, for 44.8% of the children the
spontaneous recollection occurred earlier than 10 seconds after the two minute-waiting periods were initiated. In these cases, the Looking Time Analyses were based on the available time segment from the beginning of the waiting period until the spontaneous memories were produced (i.e., 0 < x < 10 seconds). On average the first spontaneous memories appeared after 27.4 seconds (SD = 31.2; range: 1.1-113.8 seconds).

An instruction video, in which the AOIs were specified by a person looking at the different areas, was made prior to coding and used for training and instructing the coders. It should be noted that the boxes were not visible for the coders (cf. Fig. 1, panel B). The looking time codings were conducted using Vegas Movie Studio, Version 14.0 that allowed for high resolution frame-by-frame codings. Via the software, the coders marked whenever the children looked at AOI 1 (equivalent to the Teddy box), AOI 2 (equivalent to the Game box), or elsewhere within the available time segment, and accumulated looking time for each of these AOIs could be counted.

The coding of looking time for the Matched Controls was identical to the procedure described above except that the specific time segment used for a given child in the Matched Control group obviously could not be based these children’s first spontaneous recollection, as these children had none. Instead, the time segment used for each child in the Matched Control group was selected from the matching child in the Recall Group. For example, if a given child in the Recall Group produced the first spontaneous recollection after 9.276 seconds, and accordingly had his or her Looking Time Analysis based on the first 9.276 seconds of the two-minute waiting period at T2, then the Looking Time Analysis of the matching child in the Matched Control group was also based on exactly the first 9.276 seconds of his or her two-minute waiting period at T2.

One primary coder coded all of the material, and a secondary coder re-coded 20% of the material. Interrater agreement across all AOIs was high: Recall Group: 95.0% (range: 89.9-100%); Matched Controls: 99.0% (range: 98.0-100%).
3. Results

The plan for the statistical analyses was the following: First by means of the data from the Word List and the Coding Scheme measures, we analyzed whether the children produced spontaneous recollections when returning to the lab at T_2. Given that no hits for these specific measures were obtained at T_1 (and hence no variance), these analyses were conducted by means of one-sample t-tests on the measures obtained at T_2. Subsequently we conducted the Looking Time Analysis based exclusively on the sub-group of the children who actually produced spontaneous recollections, The Recall Group (N = 29) as well as for the children in the Matched Controls (N = 29) who did not display any spontaneous recollections. For the Looking Time Analyses, both parametric (proportional looking) and non-parametric (binomial) analyses were employed (see below). Consistently an α-level = .05 was used.

3.1. Preliminary analyses – the Spontaneous Recall Test

Preliminary analysis were conducted to ensure that the children’s vocabulary was the same across the Teddy and the Game event (note, that because we failed to obtain CDI data from four participants, these analyses were based on N = 110). An independent t-test revealed that the children’s vocabulary scores (CDI) did not differ between the Teddy (M = 549.9, SD = 113.2) and the Game (M = 554.4, SD = 109.2) events, t(108) = -0.210, p = 0.834, Cohen’s d = 0.02.

3.2. Analyses from the Spontaneous Recall Test – Word List and Coding Scheme

A congruent spontaneous utterance was defined as referring specifically to the event (Teddy or Game) the child experienced at T_1, whereas an incongruent utterance referred to the event that the child did not experience at T_1. Overall, there were no hits regarding neither congruent nor incongruent utterances at T_1 indicating that none of the children talked about the events at the
first visit (that is, before having seen them), and no hits in relation to incongruent utterances from the T2-test, meaning that none of the children talked about the event they had not experienced when returning to the lab. Therefore, in the following analyses we could safely disregard both T1 codings as well as incongruent T2 codings, as there were none. Because the two events (Teddy and Game) were counter-balanced across the children, they were collapsed in the following analyses (following Krøjgaard et al., 2017; Sonne et al., 2019).

Both the Word List codings and the Coding Scheme codings were analyzed based on the congruent hits (event specific as well as unspecific) obtained at the T2-test by simple one-sample \( t \)-tests (two-tailed) tested against the test value of “0” (i.e., “no hits”).

Table 2 shows the descriptive statistics as well as the results from these \( t \)-tests. As can be seen from the table, the children produced a significant number of spontaneous recollections of the events they had experienced at the first visit. The results were clear and systematic, and generally replicated previous findings (Krøjgaard et al., 2017; Sonne et al., 2019), as the children clearly had spontaneous recollections of the experienced events both when determined by the Word List measures and by the Coding Scheme measures, with all dimensions being significantly different from zero.
Table 2.
Descriptive statistics for T<sub>1</sub> and T<sub>2</sub> and one sample t-tests based on the mean Congruent Word List sum score measures and the mean Congruent Coding Scheme sum score measures at T<sub>2</sub> (N = 114). The Grand Sum Coding Scheme score consists of the sums of all five Coding Scheme dimensions.

<table>
<thead>
<tr>
<th>Measure</th>
<th>T&lt;sub&gt;1&lt;/sub&gt; M</th>
<th>T&lt;sub&gt;1&lt;/sub&gt; SD</th>
<th>T&lt;sub&gt;2&lt;/sub&gt; M</th>
<th>T&lt;sub&gt;2&lt;/sub&gt; SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word List</td>
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<td>0.54</td>
<td>1.07</td>
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<td>113</td>
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<td>0.50</td>
</tr>
<tr>
<td>Coding Scheme</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>0.46</td>
<td>0.83</td>
<td>0.46</td>
<td>0.83</td>
<td>5.96</td>
<td>113</td>
<td>&lt; 0.001</td>
<td>0.55</td>
</tr>
<tr>
<td>Gesture</td>
<td>0.25</td>
<td>0.53</td>
<td>0.25</td>
<td>0.53</td>
<td>5.00</td>
<td>113</td>
<td>&lt; 0.001</td>
<td>0.47</td>
</tr>
<tr>
<td>Reliving</td>
<td>0.46</td>
<td>0.83</td>
<td>0.46</td>
<td>0.83</td>
<td>5.96</td>
<td>113</td>
<td>&lt; 0.001</td>
<td>0.55</td>
</tr>
<tr>
<td>Action</td>
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<td>0.37</td>
<td>0.14</td>
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<td>4.01</td>
<td>113</td>
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<td>0.25</td>
<td>0.51</td>
<td>5.17</td>
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<td>0.49</td>
</tr>
<tr>
<td>Grand Sum Coding Scheme</td>
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<td>1.56</td>
<td>2.79</td>
<td>5.98</td>
<td>113</td>
<td>&lt; 0.001</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Note: The Congruent hits are based on the event specific hits (e.g., “teddy”, “ball”) as well as unspecific hits (e.g., “again”, “last time”). Because there were no hits at T<sub>1</sub>, and hence no variance at T<sub>1</sub>, all tests could be conducted as simple one-sample t-tests (two-tailed) tested against “0”.

Consistent with previous studies (Krøjgaard et al., 2017; Sonne et al., 2019) we ran an item analysis of the dimensions from the Coding Scheme. The reliability analysis revealed that the five items had a Cronbach’s α = 0.919, indicating that the Coding Scheme dimensions showed acceptable internal consistency allowing us to base the following analyses on the grand sum scores from the Coding Scheme. Consistent with previous studies, a one-sample t-test based on the grand sum Coding Scheme scores and tested against zero once again showed that children in the T<sub>2</sub>-test spontaneously and reliably recalled the event they had experienced at the first visit (see Table 2).
We also examined whether the children who produced spontaneous memories (N = 34, called Spon) \(^1\) differed from all the children who did not produce spontaneous recollections (N = 76; here referred to as Non-Spon) with regard to CDI. (The Non-Spon group is not to be confused with the smaller group \([n = 29]\) of matched controls). An ANOVA with Spontaneous recollections (yes vs. no) as between-subjects variable and the CDI score as the dependent variable revealed that the two groups did not differ with respect to vocabulary, \(F(1, 108) = 0.46, p = .831, M_{\text{Spon}} = 548.61, SD = 90.16; M_{\text{Non-Spon}} = 553.57, SD = 119.02.\)

### 3.3. Looking Time Analyses – the Recall Group

For the Recall Group, we investigated looking time at the two boxes preceding (max 10 seconds) the occurrence of a spontaneous memory. We were especially interested in examining whether the Target box, compared to the Foil box, was devoted more visual attention preceding recall. The analyses were based on the subsample of children who showed evidence of having spontaneous memories (\(N = 29\)). In looking time paradigms, proportional looking time is typically applied in the analyses, which results in a number between 0 and 1 (e.g., Richmond, Colombo, & Hayne, 2007). Thus, we calculated the proportional looking time at the Target box operationalized as the looking time at the Target box divided by the sum of looking time at the Target box and the looking time at the Foil box (i.e., Target/[Target + Foil]).

A one-sample \(t\)-test tested against 0.5 (two-tailed), showed a significant result, \(t(28) = 8.81, p < 0.001, \text{Cohen’s } d = 1.64,\) with a mean proportional looking at Target box = 0.84 (see Fig. 2a). Thus, the children in the Recall Group were clearly inclined to look more at the Target box than at the Foil box in the 10 seconds preceding a spontaneous recollection. However, the number of children having spontaneous recollections were somewhat skewed across events (Teddy: \(N = 21,\)

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\(^1\) In addition to the 29 children in the Recall Group, for this specific analysis, we also included the additional five children who also had spontaneous recollections, but were excluded from the Looking Time Analysis due to lack of looking time data (cf. section 2.1). Hence, for this test: \(N = 34.\)
Game: N = 8). In order to examine whether the skewed distribution affected the results, we ran a one-way ANOVA with Condition (Teddy vs. Game) as between-subjects factor and with proportional looking to Target as the dependent variable. The results revealed that Condition did not affect the results, F(1, 27) = 0.20, p = .657, ηp² = .007. In addition, the pattern of results regarding proportional looking to Target replicated when looking at the two events separately (see Fig. 2b): Teddy event t(20) = 6.87, p < 0.001, Cohen’s d = 1.50 with the children looking longer at the Target box (Msec = 2.8, SD = 2.4) compared to the Foil box (Msec = 0.7, SD = 1.1); Game event t(7) = 5.67, p = 0.001, Cohen’s d = 2.00, with the children looking longer at the Target box (Msec = 2.9, SD = 2.5) compared to the Foil box (Msec = 0.4, SD = 0.5).

Fig. 2a

![Fig. 2a](image)

Fig. 2a: A graphic representation of the proportional looking time at Target box relative to total looking time at the two boxes for both the Recall Group and the Matched Controls. Bars for the Teddy and the Game...
event combined as well as for the Teddy and the Game event separately are displayed. The dotted line represents chance level (0.5). **p < .001, *p = .001.

**Fig. 2b**

![Fig. 2b](image.png)

Fig. 2b: A graphic representation of the mean looking time in seconds at the Target and Foil boxes for both the Recall Group and the Matched Controls. Bars for the Teddy and the Game event combined as well as for the Teddy and the Game event separately are displayed.

The results from the parametric analysis were further underscored by additional binomial tests analyzing whether the number of children looking more at the Target box relative to the Foil box during the 10 seconds preceding the occurrence of spontaneous recollections differed from chance. The binomial test (N = 29) revealed that the proportion of children looking more at the Target box (N = 27) relative to the Foil box (N = 2) was .93, which is significantly higher than chance (0.50), \( p < .001 \), Odds Ratio = 13.5 : 1. Again these results replicated when looking at the
events separately: In the Teddy event the binomial test ($N = 21$) showed that the proportion of children looking more at the Target box ($N = 19$) relative to the Foil box ($N = 2$) was $0.90$, $p < .001$, Odds Ratio = $9.5 : 1$. Note, that the two children who displayed a preference for the Foil box, looked only briefly at any of the boxes (Child #1: looking time Target = $0.7$ s, looking time Foil = $0.8$ s; Child #2: looking time Target = $1.8$ s, looking time Foil = $2.5$ s). The same overall pattern was found for the binomial test in the Game event ($N = 8$), which showed that the proportion of children looking more at the Target box ($N = 8$), relative to the Foil box ($N = 0$) was $1.0$, $p = .008$.

Overall, the results from the Looking Time Analyses supported the assumption that the Target box containing props for the known event received substantially more visual attention preceding retrieval and thereby likely served as a distinct cue triggering spontaneous memory recollections from the first visit in the lab—importantly, this was the case no matter which event the child originally had witnessed.

### 3.4 Looking Time Analyses – the Matched Controls

As a preliminary manipulation check, we first examined whether the Matched Control group, actually was comparable to the Recall Group with regard to CDI. An ANOVA with Spontaneous recall (Recall Groups vs. Matched Controls) as between-subjects factor and with CDI as the dependent variable, revealed that the matching of the two groups with respect to CDI had succeeded, $F(1, 56) = 0$, $p = .993$, $M_{\text{Recall Group-CDI}} = 541.10$, $SD = 92.75$, $M_{\text{Matched Controls-CDI}} = 540.86$, $SD = 106.90$.

In order to establish whether the pattern of results associated with looking time was uniquely related to the children who had produced spontaneous memories, we conducted the same analyses for an equally sized control group ($N = 29$) matched on gender, condition, and the numerically closest CDI score. For the Matched Controls we expected no looking time preference for the Target box. The following analyses for each child in the Matched Control Group were based
on the exact equivalent time segment derived from the matching child in the Recall Group (cf. section 2.4.4).

As expected, a one-sample $t$-test against 0.5 (two-tailed) testing the proportional looking to Target for the children in the Matched Control group, revealed no looking time preference for the Target box (see Fig. 2a and 2b), $t(20) = 0.38, p = 0.708$, Cohen’s $d = 0.17$, with a mean proportional looking at the Target box = 0.54, (the degrees of freedom were reduced because eight of the matched controls did not look at any of the two boxes within the available time segment). Following the strategy of analyses from the Recall Group, we also examined whether the skewed distribution of the events leading to spontaneous retrieval in the Recall Group, affected the results. Thus, for the Matched Control group we ran a one-way ANOVA with Condition (Teddy vs. Game) as between-subjects factor and with proportional looking to Target as the dependent variable. The results revealed that Condition had no effect on looking time, $F(1, 19) = 0.39, p = .538, \eta_p^2 = .020$ (see Fig. 2).

The negative results from the parametric analysis of the Matched Controls were further underscored by additional binomial tests analyzing the number of children looking more at the Target box relative to the Foil box during the available time segments ($0 < x < 10$ sec). Of the 29 children in the Matched Control group, 10 children looked more at the Target, 11 children looked more at the Foil, and eight children did not look at any of the boxes. Thus, the children in the Matched Control group, who actually looked at any of the two boxes ($N = 21$), did not show a preference for any of the two boxes.

Finally, we by means of a one-way ANOVA with Spontaneous retrieval (Recall Group vs. Matched Controls) as between-subjects variable, and with proportional looking to Target as the dependent variable, contrasted the Recall Group directly with the Matched Controls. This analysis revealed an effect of Spontaneous retrieval, $F(1, 48) = 9.325, p = .004, \eta_p^2 = .163,$
indicating that the children who had spontaneous recollections (the Recall Group) had reliably higher proportional looking to Target ($M = 0.84$, $SD = 0.21$), than their Matched Controls ($M = 0.54$, $SD = 0.47$).

To summarize, the children in the Recall Group reliably and systematically looked more at their Target box relative to their Foil box during the 10 second time segment preceding the occurrence of a spontaneous memory when returning to the lab. Importantly, this pattern of results was exclusively found for the children in the Recall Group. It was absent in the Matched Controls, who displayed no preference for any of the boxes.

4. **Discussion**

We present the first systematic and objective, real-time examination of young children’s looking time towards central cues preceding spontaneous recollections. First, the results replicate the findings from previous studies (Krøjgaard et al., 2017; Sonne et al., 2019, in press) using the same basic design showing that spontaneous recollections can be induced in an experimental setting across a one-week retention interval in children with an average age below 3 years. This lends further credibility to the basic design employed. Second, and crucially, the results from the Looking Time Analyses were clear and unequivocal: During the 10 seconds preceding the occurrence of a spontaneous memory of the unique event experienced one-week earlier, the children in the Recall Group looked reliably longer at the Target box containing props from the event they had experienced before relative to the Foil box containing props from the event they did not experience at the first visit. Third, this looking time pattern was exclusively related to the children who had shown evidence of spontaneous recall when returning to the lab. It was absent in a Matched Control group of children, who did not produce spontaneous memories at test. We first discuss the validity of the results. We next consider the present findings in relation to the broader literature on memory in early childhood.
Regarding the validity of the present findings, a possible concern might be whether the results from the Looking Time Analyses of the Recall Group simply could reflect the differences in appearance of the two boxes. The skewed distribution of the events involving spontaneous recollections in the Recall Group (Teddy event: \(N = 21\); Game event: \(N = 8\)) may support this interpretation. We acknowledge that we cannot rule out that the red box might have been a stronger cue than the grey box. We also cannot rule out that the Teddy event may have been more interesting to the children than the Game event. However, due to the counter-balanced design ensuring that the Target box and the Foil box differed across subjects, neither differences in appearance of the boxes, nor differences in the saliency of the to-be-remembered events can explain the results. Furthermore, additional analyses showed that Teddy versus Game Condition had no impact on the results in the Recall Group. In fact, the results from both the parametric and the non-parametric analyses showed similar patterns regardless of whether the red or the grey box was the Target. These effects replicated when analyzing each of the events (Teddy and Game) separately, despite the fact that the cell size for the Game event was small (\(N = 8\)). This suggests large and robust effects. In contrast, the Looking Time Analysis of the children in the Matched Control group, who did not produce spontaneous recollections when returning to the lab, were markedly different. For these children, there was no indication that they preferred looking at any of the boxes.

Although the results from the children in the Recall Group concerning looking time were clear and systematic and supported the idea that spontaneous recollections are facilitated by the Target box as cue, a few children producing spontaneous recollections did not comply to the general pattern of results described above. While we do not believe that these few exceptions challenge the results, a closer look at the data from these children seem to suggest other mechanisms at play that deserve attention as well. First, three of the children who had spontaneous recollections at the second visit did not look at any of the boxes during the 10 seconds leading up to
spontaneous retrieval, and these children were therefore excluded from the Looking Time Analyses. Second, two children produced spontaneous recollections exactly when the monitored looking time period began (that is, at 0.0 s, right at the time when the recording was started), leaving no prior time for looking time assessment. Finally, two of the 29 children in the Recall Group looked longer at the Foil box. How should the spontaneous recollections of these seven children be interpreted? One possibility is that some of these seven children were cued by contextual cues early in the process—for instance when arriving at the Campus, when entering the waiting room before being brought back to the lab (during debriefing a few parents spontaneously mentioned examples of such incidents), or by the sight of the experimenter. Evidence from even younger children lends indirect support to these possibilities. Cuevas, Rovee-Collier, and Learmonth (2006) showed that 6-month-old infants were able to form associations between memory representations of stimuli, even though the stimuli were absent at the time of retrieval (see also Barr, Vieira, & Rovee-Collier, 2001, 2002). Applied to the present context, this suggests the possibility that the children’s memory may have been cued by stimuli outside the lab (e.g., when arriving at campus or when entering the waiting room). Alternatively, some of these children may have been cued by the Target box immediately when entering the room or while the experimenter welcomed the participant, that is, after entering the test room, but before the experimenter left the room and the two-minute waiting period began. When entering a strange room only encountered once before, it seems quite natural immediately to look around, and when doing so in the sparsely furnished test room, the two boxes were highly prominent.

A second possibility is that some of these seven children may have cued themselves by ‘internal cueing’ (i.e., by their own thoughts). This interpretation would agree with the results from Reese’s (1999) diary study. Although the children’s spontaneous talk about past events in Reese’s (1999) diary study was identified as predominantly environmentally cued, some of the
spontaneous recollections were identified as internally cued. However, the paradigm applied in the present study only allows us to capture what the child states verbally (and only during the two-minute waiting periods), and we have no way of assessing whether internal cuing was responsible or not for spontaneous recall in these few cases. Taken together, these considerations suggest that while the Target box clearly seems to be a highly prominent cue for spontaneous recall in the present design, it is at the same time unlikely to be the only effective cue leading to spontaneous recollections.

The current definition of spontaneous recall provides a rather conservative measure of this construct by capturing only what is verbally produced by the children. Thus, we cannot rule out the possibility that some of the children, who did not produce verbal indicators of spontaneous recall (N = 80), in fact spontaneously recalled the event they experienced one week earlier, but just did not voice their recollections.

The present study contributes to the literature on event memory in children by demonstrating how spontaneous memory retrieval is preceded by the allocation of visual attention to a relevant and distinct memory cue. The obtained results support the assumption that environmental cues may indeed be a core mechanism by which spontaneous memories come to mind. Such cuing does not seem to be related to vocabulary as the children who produced spontaneous memories did not differ from the children who did not produce spontaneous recollections, with regard to CDI. Obviously, the reverse causality, that a recollection would draw attention to the target box, is also a possibility. One way to examine this in the future might be to show the child reminders of the event (e.g., pictures of the toys) and next examine if this would elicit preferential looking at the target box.

The results obtained here would be beyond reach in most diary studies, as access to objective measures of the children’s looking time as spontaneous recall unfolds in real-time,
probably warrants an experimental design. Modifying well-established designs with a novel aim in mind often involves the risk of adding noise to the original design. However, this was not the case in the present study because the implementation of looking time measures was administered in a non-intervening way. Thus, from the children’s perspective, the design was identical to the design that the present study attempted to extend (i.e., Krøjgaard et al., 2017). Consequently, the results obtained in the present study can safely be generalized to previous studies using the same design for inducing spontaneous memories in young children (Krøjgaard et al., 2017; Sonne et al., 2019, in press). With the extension of the results from the present study, findings from the spontaneous memory paradigm show that (a) spontaneous memories reliably can be induced in young children in a controlled lab setting through basic associative principles, and (b) the children producing spontaneous memories are inclined to look preferentially at the Target box right before having spontaneous recollections in the present design, whereas this looking time preference is absent in children who do not produce spontaneous memories, and that (c) identifiable attentional processes directed at relevant and distinct environmental cues precede spontaneous recollection of past events in almost all cases.

An interesting question concerns whether motor-based indices of memory also could occur spontaneously, such as spontaneously imitating the clapping teddy? We consider this likely and tried to capture such motor-based memory indices by parts of the coding scheme, albeit in a rudimentary and simple form. Addressing this question more systematically is methodologically challenging by requiring ways of assessing motor-based indices of spontaneous recollections that comply with the criteria of the memory not being socially prompted. Although pure motor re-enactments displayed by means of deferred imitation may reflect declarative memory (Bauer, 2007; Collie & Hayne, 1999; Meltzoff, 1995), it is difficult to rule out that infants participating in deferred imitation are not subject to at least some elements of social prompting, such that their memory
would be more intentionally retrieved than what we aim to capture by the conception of spontaneous memory. Even in strict versions of the deferred imitation procedure in which (a) no ‘rehearsal’ is granted the infant before test, and in which (b) no verbal prompts are offered (e.g., Herbert & Hayne, 2000; Meltzoff, 1988), some social prompting may still be present: First, warm-up sessions are typically administered. Second, the experimenter is always present during test, and third, the props are (obviously) always visible. All three aspects may contribute to implicitly informing the infant, that “we are gonna play” and thereby provide at least some social prompting.

In the present paradigm, these three potential sources of social prompts are ruled out. No warm-up sessions are given; the experimenter is always absent during the 2-minutes test, and the props are not visible but locked away. Because lack of social prompting is a crucial feature of spontaneous recall by our definition, future paradigms aimed at examining spontaneous recall by motor-based indices should take these considerations into account. These possibilities are currently being explored in our lab by using a modified version of the present paradigm involving only the teddy condition and with the task presented in ways that invite the child to imitate the movements of the teddy. This modified version makes it possible for younger children (<24 month of age) to potentially report spontaneous memories by both verbal means and motor-actions at the test session at T2.

To conclude, we have demonstrated that distinct, environmental cues seem to trigger spontaneous memory retrieval of a previously experienced event in young children. The results revealed that the great majority of children looked at the Target cue preceding the occurrence of a spontaneous memory. The present design offers a simple and novel experimental approach for future research disentangling the interaction between visual attention and spontaneous memory processes.
References


