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Three-year-olds' memory for a person met only once at the age of 12 months: Very long-term memory revealed by a late-manifesting novelty preference

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ABSTRACT

This study examined three-year-olds' verbal and non-verbal memory for a person met only once after a 28 month interval. Children in the Test group ($N = 50$) had participated in an earlier experiment at our lab at the age of 12 months where they met one of two possible experimenters. At this past event half of the children were tested by one, the other half by the other experimenter. At the follow-up, run by a naïve experimenter, the children were shown two videos from the original experiment in a visual paired comparison task: One with the specific experimenter testing them at the original visit (the Target) and one of the other experimenter (the Foil), with whom they had no experience. When explicitly asked, the children's responses did not differ from chance. However, eye-tracking data revealed a late-manifesting novelty preference for the "Foil" person indicating memory for the "Target" person met once before.

1. Introduction

One of the greatest memory enigmas is that if we ask adults about their earliest memories, most people will not be able to report memories for any event that happened before the age of 3–4 years – the phenomenon called *infantile* or *childhood amnesia* (Bauer, 2007; Goswami, 2008; Jack & Hayne, 2010; Pillemer & White, 1989). Intriguingly, we also know beyond doubt that children learn a lot, and at an impressive pace, from birth throughout childhood (e.g. Berk, 2012). This knowledge naturally leads us to questions about children's capacity for long-term memory and their ability to report such memories at a given point in life (e.g. Lie & Newcombe, 1999; Nelson & Fivush, 2004). It is well established, that the ability to remember specific events (or elements hereof) does not function at an adult level in the beginning of life, but also that such memory is developing rapidly from birth throughout childhood (Bauer, 2007; Hayne, 2004).

Although many studies investigating the long-term memories of infants and young children have focused on memory intervals from days to weeks (e.g. Bahrick, Gogate, & Ruiz, 2002; Barr, Dowden, & Hayne, 1996), some studies have found evidence of young children's memory after intervals of months (e.g. Bauer, Wenner, Dropik, & Wewerka, 2000; Bornstein, Arterberry, & Mash, 2004; Morgan & Hayne, 2011) or even years (e.g. Myers, Perris, & Speaker, 1994). In addition to the retention interval, the methods used, the specific age group, and the material to be remembered vary greatly in such studies. Thus, it can be very difficult to directly compare the results from these diverse approaches. However, in a review of infant memory development, Hayne (2004) identified four principles that seem to be valid *across* different methodological approaches: (1) That *older infants encode information faster*; (2) that *older infants remember longer*; (3) that *older infants exploit*

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a wider range of retrieval cues; and (4) that *forgotten memories can be retrieved through the presentation of a reminder*. Even though it is possible in this way to deduce generally valid principles from the wealth of empirical studies on children's event memory it may be argued that some studies are more easily related to the childhood amnesia than others. For instance, some studies are targeting children's long-term memory for *specific* or *unique* real world episodes. When considering childhood amnesia, memories for unique episodes experienced in infancy are of special interest since these are the ones that for the most part do not make it into the later childhood and adulthood, after the offset of childhood amnesia (Bauer, 2007). For instance, Myers, Clifton, and Clarkson (1987) reported that "almost threes" retained memory for action sequences experienced between 6 and 40 weeks of age, a very long retention interval for this age-group indeed. However, since these action sequences were experienced on 15–19 different occasions, the relation to one-off experiences becomes unclear. In a similar study, Perris, Myers, and Clifton (1990) reported that 2½-year-olds who had on one occasion reached for a sounding object in the dark at the age of 6½ months as a part of a study on auditory localization, would reach more for such an object when brought in a similar condition compared to a control group. The children thus exhibited long-term performance-memory after a single experience only, a result more easily related to memory for specific events.

Another important issue related to memory early in life is the ability to report these memories verbally or non-verbally. The inability to verbally report preverbal experiences has been one of the most prominent factors in the suggested explanations for childhood amnesia (Bauer, 2007; Hayne & Jack, 2011). In a seminal study, Simcock and Hayne (2002) found that children (29, 33, or 39 months of age) were able to remember and produce event-relevant actions related to a distinct event after a delay of 6 or 12 months, but they were unable to translate their preverbal memory of this event into language in spite of having acquired the necessary vocabulary. In contrast, Morris and Baker-Ward (2007) found that two-year-olds in some cases *were* able to use newly acquired words to describe preverbal memories when provided with sufficient contextual support during the verbal memory assessment in the form of physical reminders of the original event (see also, Bauer et al., 2004). It is evident from this ongoing dispute that the question of translating preverbal memories into language later in development is far from settled. Yet, it is at the heart of theory-building on childhood amnesia to understand *when* and *how* in development verbal report of early experiences is possible.

In the present study we sought to investigate young children's long-term memory for a one-off and highly controlled episode experienced in infancy. We wanted to include both verbal and non-verbal measures of the children's memory to be informed about the role of language in the remembering or forgetting of such an event. More specifically, we tested children's memory for a unique event experienced 28 months (range 24–32) earlier at the age of 12 months. All participating children had taken part in an experimental study on object cognition in our lab (see detailed description in Kingo & Krøjgaard, 2012), and their parents had allowed us to contact them again for additional studies. During the original lab visit the children were presented with various novel and custom made test objects and interacted with an engaging experimenter for approximately 45 min in what we found to be a unique and highly salient event (see also Section 2). For several reasons this provided an excellent opportunity to test these children's memory for their previous lab visit: (1) We knew the exact date of each visit and the exact age of the infants when they visited; (2) we had good control over what the infants experienced during their first visit, since every step of the experimental procedure was carefully planned and kept constant between infants; (3) furthermore, we had a unique video recording of the experiment-event for each participant. Finally (4), the test could take place in exactly the same lab/location as where the original experiment was conducted. In short, it would be possible to employ massive cuing related to the original unique experience. As an additional feature, some of the infants were originally tested by a Scandinavian–Caucasian male experimenter (Person A), while others were originally tested by a Mixed Scandinavian–African male experimenter (Person B). This fact provided a good opportunity for conducting a contrasted recognition test.

We hypothesized that reintroducing the children in the test group to the original lab room, some of the original props, and a video recording (specific to each child) of the original experimenter and actions would strongly cue the memory of the prior lab visit if such a memory trace was available after this very long retention interval (Newcombe, Lloyd, & Ratliff, 2007; Perris et al., 1990). Given the age of our participants, the encoding conditions, and the length of the retention interval, there was no simple way to predict whether such a memory trace would reveal itself as a novelty or a familiarity preference (see Hayne, 2004; Houston-Price & Nakai, 2004; and Cohen, 2004 for discussions). The typical preference-pattern for visual recognition memory has been suggested to follow four phases such that short retention intervals (Phase 1, associated with strong memory traces) produce novelty preferences, intermediate retention intervals produce null preferences (Phase 2), long retention intervals (Phase 3) associated with weak memory traces) produce familiarity preferences and very long retention intervals (Phase 4, associated with inaccessible memory traces) produces null preferences again (Bahrick & Pickens, 1995). In their particular study Bahrick and Pickens suggested that Phase 1 was found after 1 min, Phase 2 after 1 day to 2 weeks, Phase 3 after 1–3 months, and Phase 4 after even longer retention intervals. They also stated, however, that these phases were not discrete. The duration of each phase may differ depending of several factors such as subject's age and the level of encoding. In any case, following this suggested retention pattern, we should expect to find a familiarity preference (if any) given that our retention interval was more than two years which must be considered to be long or very long. On the other hand, other factors besides retention interval have been known to affect the retrievability of memory traces in visual recognition studies. Bahrick, Hernandez-Reif, and Pickens (1997), for instance, found that retrieval cues could shift visual preference towards novelty to resemble more recent memories. Hayne (2004) in her review of infant memory development concluded that infants exploit a wider range of retrieval cues with age, and Newcombe et al. (2007) have recently argued that event memory is facilitated if one succeeds providing a match of distinctive features between the original to-be-remembered