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Mikael Heimann

Linköping University, Swedish Institute for Disability Research

Jane S. Herbert

University of Sheffield, herbertj@uow.edu.au

Tomas Tjus

University of Gothenburg

Jerker Rönnerberg

Swedish Institute for Disability Research, Linköping University

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Abstract

In order to learn about memory development one must start from the beginning. An infant goes through remarkable changes during the first years of life; they begin to crawl, talk, and actively engage with the world around them. Much too often in the history of psychology, the abilities present during the first years of life have been neglected, overlooked, or not given much weight in theory building. For example, because adults fail to recall events from the first years of their life, assumptions were made about the nature and form of memory during early development (for review, see Hayne & Jack, 2011). We do not claim that everything needed for mature memory abilities is there from the beginning, but most of the observations to date make us feel confident in stating that the memory of infants is much better than previously believed.

Keywords

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Recent advances in early memory development – Research on typical and atypical children

Mikael Heimann^{1,3}, Jane S. Herbert⁴, Tomas Tjus⁵ and Jerker Rönnerberg^{1,2,3}

¹Department of Behavioural Sciences and Learning, Unit for Psychology, Linköping
University

²Linnaeus Centre HEAD, Linköping University

³Swedish Institute of Disability Research

⁴Department of Psychology, University of Sheffield

⁵Department of Psychology, University of Gothenburg

In order to learn about memory development one must start from the beginning. An infant goes through remarkable changes during the first years of life; they begin to crawl, talk, and actively engage with the world around them. Much too often in the history of psychology, the abilities present during the first years of life have been neglected, overlooked, or not given much weight in theory building. For example, because adults fail to recall events from the first years of their life, assumptions were made about nature and form of memory during early development (for review, see Hayne & Jack, 2011). We do not claim that everything needed for mature memory abilities is there from the beginning, but most of the observations to date make us feel confident in stating that the memory of infants is much better than previously believed.

Our knowledge of early memory development has changed dramatically over the last decades. From being seen as a slowly emerging skill observable by the end of the second year of life (Piaget, 1962; Schacter & Moscovitch, 1984), we now know that the ability to recall past events is already present by 6 months (Barr, Dowden & Hayne, 1996). Infants' event memories are of special interest because they have been proposed to be early signs of higher order memory processes, such as non-verbal declarative memory (for a review, see Richmond & Nelson, 2007). A substantial body of research now shows that infants can recall novel events that are temporally dated. However, it is considerably more difficult to determine whether infants' memories are accompanied by a subjective awareness that the event happened in the past to "me", because they are unable to give a verbal report of their subjective experience (a problem also encountered by researchers working with other non-verbal species; e.g., Clayton & Dickinson, 1998). Thus, it is still difficult to quantify how early infant memory abilities fit within the declarative memory system distinction of episodic and semantic memory proposed by Tulving (1972, 2005). Regardless of the debate about whether infant memories are declarative, or simply declarative-like, some striking findings

have emerged from systematic studies of changes in memory across early development; infants learn rapidly, they can remember for a long time and, with age, they can use what they learn in increasingly novel situations (for review see Hayne, 2004; Jones & Herbert, 2006; Rovee-Collier, Hayne & Columbo, 2001).

One key reason for why the infancy period was frequently neglected in memory research is that infants are difficult to work with. Infants have short attention spans, rapid changes of state, limited motoric abilities, and perhaps most challenging of all, limited verbal abilities. Methodology is, therefore, a key issue because we have to rely on indirect observation of learning and memory; we cannot ask the infant directly what they remember. One way to counteract this problem is to use information based on different but converging methods. There are now several well established methods available for studying infant memory, and they all build to some extent on conditioning paradigms, recognition memory, or deferred imitation. The papers in this special issue present the reader with several good examples of how these methods are currently used by infant researchers and how they can be applied for use at older ages or with special populations.

The first three papers cover findings on typically developing infants in the first one and a half years of life. The questions asked include: what are infants learning in new situations, and what conditions can we provide for infants which may facilitate their ability to learn and remember? In the opening paper, Rovee-Collier, Mitchell and Hsu-Yang propose a new theoretical approach, associative potentiation, which could account for the rapid learning occurring during infancy. The findings they present show that infants remember a novel event for much longer if the learning takes place “in the presence of a prior association than when they learnt it alone”. Such associative potentiation can guide us in understanding why young infants are able to learn many things despite the fact that other studies have demonstrated rapid forgetting in early infancy.

The next two papers consider the impact of attention and language cues on developing memory abilities. Taylor and Herbert use eye-tracker methodology to study age-related changes in infant attention and recognition memory at 6- and 9-months of age. Although a growing body of literature shows that older infants remember for longer periods of time and have more flexible memory retrieval than younger infants, the authors found no differences in gaze patterns between 6- and 9-months-old infants as they watched a learning demonstration. The authors conclude that attentional changes are an unlikely candidate for explaining age-related changes in memory performance at these ages. We would like to note here that we feel it is important that papers which have shown non-significant differences between groups begin to receive equal attention within the published literature, especially when the sample sizes are sufficient for the questions being addressed (as in this study and the next). By considering studies in which effects are present, in conjunction with studies in which effects are not present, we can truly begin to develop our understanding of how memory abilities change across development and the factors that contribute to these changes. In the next study, we see how cues that have previously been shown to be effective with older infants may have no impact for younger infants. Zack, Gerhardstein, Meltzoff and Barr investigate to what extent language cues can facilitate infants' ability to transfer learning from one source (e.g.: a 2-dimensional source) to a new situation (e.g.: a 3-D situation). Given that previous studies have shown the effectiveness of language cues in facilitating infant memory abilities, the interesting but surprising finding that Zack and colleagues report is that linguistic cues did not help their 15-month-old infants. The authors conclude that in some situations, language cues may increase the cognitive demands on young infants, and may actually interfere with their performance on complex tasks. This may especially be the case when infants are just making that transition to language use themselves.

The fourth paper also explores typically developing infants but encourages us to start to consider individual differences in early memory development. Heimann, Nordqvist, Rudner, Lindgren and Johansson studied to what degree electrophysiological indices co-vary with behavioural measures of memory, as assessed by deferred imitation. In short, associative learning, as measured through event-related-potentials (change scores based on Nc, a middle latency component), predicted memory performance measured in 14-15 month old children. These findings add to our knowledge on how brain measures help us understand individual difference in early memory performance.

Building on the methods and knowledge gathered from the infancy research presented in the first four papers we now move to somewhat older typically developing children, as well as to children with atypical development. In the fifth paper, Loucks and Meltzoff use deferred imitation to investigate how 3-year old children's non-verbal memory is organized. Their findings show that children are efficient processors of information when they are presented with complex action sequences. Specifically, even at this young age, the goal of the action (i.e. the end state that is being aimed for) was more memorable than the sequential order in which the actions were produced. This is the first study to compare if children prefer goal information or sequential information using a pure non-verbal task, and provides insight into how children organise knowledge garnered from the social world around them.

Papers six and seven investigate memory in atypically developing children. The study by Jones, Blades, Coleman and Pascalis focuses on the ability of children with autism to recognize smiling and neutral faces, and compares their performance to typically developing children and children with developmental delays. Although the typically developing children were better than the other two groups at recognizing the set of moving faces they had been familiarized with, there was no specific autism deficit. Children with autism are also the focus of the paper by Strid, Heimann and Tjus although they used a different memory measure,

deferred imitation. More specifically, they investigated memory, pretend play and parent-child interaction in two groups of children with autism (speaking and non-speaking), and a group of typically developing children. The authors found that both deferred imitation abilities and the duration of pretend play was reduced among children with autism compared to children with typical development. Deferred imitation was also related to parent interaction style, where parents of non-speaking children with autism especially seem to differ in their verbal comments during play compared to the other parents.

The last paper in this special issue takes us back to the importance of considering multiple methods when assessing memory abilities. In a study that has implications for forensic situations, Morgan, Dorgan and Hayne investigate the extent to which 5- to 10 year old children and adults recall where and how often they have been touched during a staged event (an interaction with a clown). The study compares recall when participants are asked to point to their own body compared to pointing to a body map. The findings show no support for the use of body maps when retrieving information from children.

Taken together, the articles in this special issue provide an overview of how far the field of early memory development has come over the past few decades, and highlight the heterogeneity that still characterizes the field. We are no longer restricted to asking adults what they remember about their childhood as a way of determining what children remember. However, we will always be constrained by the fact that infants, and other non-verbal groups, cannot tell us what they remember. Learning and memory has to be observed from changes in behaviour rather than from subjective reports from these individuals. We are still a long way from knowing when advanced abilities such as episodic memory emerge, and we must be careful not to over-estimate, or under-estimate, early abilities. To this end, infancy researchers will continue to be dependent on having a consensus across studies using different methods before they can confidently state whether the memory abilities observed in infants are

declarative or simply declarative-like. However, as this special issue shows, a wide range of paradigms that are now available for use across the lifespan means that an exciting range of questions can be addressed about how memory representations are formed, stored and retrieved at different ages and what impact individual differences may have on these abilities. According to Maria and the children in the Sound of Music (1965) “When you sing you begin with do-re-mi”. We hope that our readers now understand why we would like to add “When you study memory you begin with infancy”.

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