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Disciplines

Education | Social and Behavioral Sciences

Publication Details

Herbert, J. S. (2011). The effect of language cues on infants' representational flexibility in a deferred imitation task. *Infant Behavior and Development*, 34 (4), 632-635.

The effect of language cues on infants' representational flexibility in a deferred imitation task

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Running head: Language cues and imitation

Acknowledgments

The author would like to thank Laura Robertson and Harriet Bibbings for assistance with data collection and coding, Harlene Hayne for providing the stimuli, and the infants and parents who participated in this project.

Abstract

Twelve- and 15-month-old infants who received simple verbal cues at encoding and retrieval exhibited superior representational flexibility on an imitation task compared to infants who did not receive those cues. Verbal cues can help early-verbal infants overcome perceptual dissimilarity and express knowledge in novel situations.

Key words: Infancy, memory, language, representational flexibility, deferred imitation

Highlights

- Adults' language has a pervasive effect on young children's memory
- We examine whether verbal cues improve the flexibility of infant memory
- Verbal cues improved memory performance at both 12- and 15-months
- Language cues may be special retrieval cues, or simply highly salient for infants

Adults' language has a pervasive effect on the memory abilities of young children. Preschool children's verbal reports of previous experiences are influenced by their language abilities at the time of the event (Simcock & Hayne, 2002) as well as the discussions they have during or after the event (e.g., Haden, Ornstein, Eckerman, & Didow, 2001; McGuigan & Salmon, 2004, 2006; Tessler & Nelson, 1994). For example, elaborative talk (compared to empty, uninformative talk) by an experimenter during the event facilitates 3- to 5-year olds verbal recall two weeks after participating in a staged novel event (McGuigan & Salmon, 2004). Furthermore, elaborative talk (e.g. "*Now I would like you to put the red ribbon on the giraffe's tail*") by an experimenter during a novel event facilitates the amount and accuracy of 5- to 6-year olds behavioral recall when they are asked to "*show me what you did with these things when we went to visit the pretend zoo*" (McGuigan & Salmon, 2006). In fact, young children's non-verbal recall seems so sensitive to language cues that even a non-specific verbal cue "*Can you remember coming here two weeks ago? Can you remember what face you saw last time you came?*" provided only at the time of retrieval facilitates 4-year olds' memory for a previously experienced visual stimulus (Morgan & Hayne, 2007).

By using imitation paradigms, researchers have begun to show that verbal cues can enhance memory recall well before infants become proficient talkers (e.g., Bauer, Hertsgaard, & Wewerka, 1995; Bauer, Wenner, Dropik, & Wewerka, 2000; Hayne & Herbert, 2004). For example, in Hayne and Herbert (2004), 18-month olds who received a verbal label for the event (e.g., "*We can use these things to make a rattle*") and a description of the target actions (e.g., "*Put the ball in the cup. Put the stick on the cup. Shake the stick to make a noise*") imitated significantly more target actions 4-weeks later compared to infants who received only empty narration. Under some circumstances the effectiveness of these types of cues may be seen with infants as young as 13 months (Bauer et al., 2000).

Whilst it is valuable for infants to remember specific events over the long term, an important function of memory is to enable the learner to use their previous experience when encountering similar situations in the future. The ability to retrieve memories with cues or in contexts not previously experienced is referred to as representational flexibility (Eichenbaum, 1997), and is considered to be an important hallmark of memory development (for review, see Jones & Herbert, 2006). Providing 24-month olds, but not 18-month olds, with verbal information during the demonstration (e.g., “*We can use these things to make a thornby*”) and test session (e.g., “*Yesterday I showed you how to make a thornby. Here are some other things that you can use to make a thornby. Can you show me how to make a thornby with these things*”) facilitates their ability to remember the target actions in the presence of physically dissimilar test stimuli 24 hours later (Herbert & Hayne, 2000).

To date, there is no evidence that language cues impact on representational flexibility in imitation tasks by infants younger than 24 months. However, a simple verbal label facilitates category identification during the first year of life (e.g., Waxman & Braun, 2005) and results in 10-month olds treating two perceptually dissimilar categories of novel pictures as one broader category (Plunkett, Hu, & Cohen, 2008). Thus, language cues may facilitate representational flexibility if the task demands were reduced.

The present study examined 12- and 15-month olds’ representational flexibility on a well established puppet imitation task (e.g., Hayne, MacDonald & Barr, 1997). Previous research has shown that 12-month olds are less successful at retrieving their memory for the target actions when there is a change in the form of the target stimulus (the puppet) at the 10-minute test than when they are tested with the original demonstration stimulus (Hayne et al., 1997; Jones & Herbert, 2008). It was hypothesized that verbal information would enhance representational flexibility across the form change in this task; although it was unclear whether language cues would be equally effective for 12- and 15-month olds.

The participants were 36 12-month olds and 36 15-month olds. Half of the participants were female. Data was excluded from an additional 16 infants: infant was excessively fussy or failed to remain seated during testing ($n = 12$) experimenter error ($n = 3$), parental interference ($n = 1$). At each age, infants were randomly assigned to one of two experimental conditions (Empty Narration or Cue+Action Narration) or a Baseline control condition ($n = 12$ infants per group). To assess language comprehension abilities in the experimental groups, caregivers completed the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI; Fenson et al., 1993) prior to their visit. Questionnaires were not assessed prior to experimental group assignment.

The stimuli were 4 hand puppets (30cm in height) used in previous imitation studies (e.g., Hayne et al., 1997). The color (pink or grey) and form (mouse or rabbit) of the stimulus used during the demonstration was counterbalanced across age, gender, and experimental condition. A removable felt mitten (8cm x 9cm) was placed over the right hand of each puppet and matched the color of the puppet. A large jingle bell was secured to the inside of the mitten in the demonstration conditions, or the back of the puppet in the control conditions. The bell was removed during the test session in all conditions to avoid prompting memory retrieval.

All infants participated in a demonstration and test session, separated by 10 minutes. The infant sat on their caregiver's lap on a chair and the Experimenter knelt directly in front of them. In the experimental conditions, the Experimenter demonstrated a sequence of three target actions. First, she removed the mitten from the puppet's right hand. Second, she shook the mitten three times, ringing the bell inside it. Third, she replaced the mitten on the puppet's right hand. This sequence of actions lasted approximately 15 seconds and was repeated twice. During the demonstration session, the infant was unable to touch the puppet or perform the target actions.

The experimental conditions were differentiated by the Experimenter's language during the demonstration and test sessions. In the Empty Narration condition, the Experimenter used general statements such as "*Look at this*" "*Wow*" "*Did you see that?*" during the demonstration and "*Here he is*" during the test. This kind of narration is typically used in deferred imitation studies; it maintains infant attention but provides no additional information about the target actions or the event goal (see Hayne & Herbert, 2004). In the Cue+Action Narration condition, the Experimenter used verbal cues to focus the infant's attention on the event goal and the target stimulus. When the puppet was revealed, the Experimenter said "*Look. A puppet.*", then each target action was labeled once as they were demonstrated: "*Off*", "*Shake*", "*On*". At the start of the test session, the Experimenter repeated the verbal label for the stimulus, "*Look. A puppet.*".

In the Baseline control condition, the Experimenter held the puppet in front of the infant and shook the puppet three times, causing a bell attached to the back of the puppet to ring (for identical baseline procedure, see Hayne et al., 1997). The sequence of actions lasted approximately 15 seconds and was repeated twice. The language cues used in the control condition were identical to those in the Empty Narration condition.

Ten minutes after the demonstration session, all infants were tested for their ability to produce the target actions using a puppet that was the same color but differed in form from the one present during the demonstration (e.g., if the demonstration puppet was a pink rabbit, then the test puppet was a pink mouse). Infant behavior was video-taped for later analysis.

The number of target actions (max = 3) produced by each infant was scored from videotape. Infants were credited with producing a target action if it occurred at any time during the 90sec test. A second observer, blind to the hypotheses of the study, scored a randomly chosen 50% of the test sessions; inter-observer reliability was 95% ($\kappa = .94$)

An imitation score was calculated for each infant by summing the number of target behaviors produced during the test session (range 0 to 3). Preliminary analyses indicated that performance did not differ as a function of the stimulus used during the demonstration (pink or grey, mouse or rabbit), or infant gender; data were therefore collapsed across these variables.

The mean imitation score produced as a function of experimental condition is shown in Figure 1. To assess whether there were any group differences in imitation score, the data were subjected to a 2 (Age: 12, 15) x 3 (Condition: Baseline, Empty Narration, Cue + Action Narration) ANOVA. There was no significant interaction ($F(2,71) = 0.80, p = .46$) and the main effect of Age did not reach conventional levels of significance ($F(1,71) = 3.12, p = 0.08$). There was, however, a significant main effect of Condition ($F(2, 71) = 16.99, p = 0.00$). Post-hoc Dunnett tests (2 sided) indicated that both experimental groups produced significantly more target actions than the Baseline Control group (smallest p value = 0.01). Thus, consistent with previous research (Jones & Herbert, 2008) infants in all experimental conditions showed some ability to recall their knowledge across a change in the stimulus. A planned independent samples t-test revealed that infants in the Cue + Action Narration groups produced significantly more target actions than infants in the Empty Narration group ($t(46) = 2.32, p = 0.03$). In other words, providing 12- and 15-month olds with verbal cues enhanced representational flexibility.

To determine whether any of the experimental conditions varied as a function of language ability, infants' comprehension scores from the CDI were subjected to a 2 (Age: 12, 15) x 2 (Condition: Empty Narration, Cue + Action Narration) ANOVA. As expected, 15-month olds comprehension scores ($M = 141.96, SE = 16.50$) exceeded those of 12-month olds ($M = 66.30, SE = 11.32$), $F(1, 47) = 13.88, p = .001$. There were no other significant main

effects or interactions. Thus, experimental groups did not differ as a function of language ability within an age.

The results of this experiment demonstrate the pervasive effects of verbal cues on infant memory. The present findings are consistent with the effect of verbal cues on non-verbal recall during the second year of life (e.g., Bauer et al., 2000; Hayne & Herbert, 2004), and replicate and extend research demonstrating the effectiveness of verbal cues in facilitating representational flexibility (Herbert & Hayne, 2000). Interestingly, 12-month-olds' imitation across a stimulus change when provided with verbal cues in the present study ($M = 1.25$, $S.D. = .33$) approaches the levels of imitation observed in Jones and Herbert (2008) when this age group received empty narration but were tested with the original demonstration stimulus ($M = 1.83$, $S.D. = 1.03$).

Why do verbal cues facilitate the memory abilities of young infants? Elaborative verbal information can serve to highlight which aspects of an event are important and interesting to recall, which in turn influences the content, quality, and organization of the child's subsequent verbal report (e.g., Haden et al, 2001; McGuigan & Salmon, 2004; Tessler & Nelson, 1994). It is possible that verbal information may have the same impact on the structure and organization of non-verbal recall.

The use of a common verbal label across exemplars has also been proposed to serve as an invitation to early-verbal infants to form a category when multiple similar stimuli are experienced (e.g., Waxman & Braun, 2005). However, an alternative explanation in representational flexibility tasks when only two exemplars are experienced (one at the demonstration and one at the test), is that the common verbal label may simply provide infants with an additional retrieval cue to exploit at the test (see also Herbert & Hayne, 2000). It is well established that successful memory retrieval is dependent on the number and type of retrieval cues that the individual can encode and exploit during the memory procedure (e.g.,

Tulving, 1983). Language cues may simply function as a highly salient retrieval cue for the young infant. Whether the specific words used, or the timing of their presentation in relation to the learning event, are important for enhancing memory flexibility, remains to be determined. The next step in this research is to examine whether consistency in verbal cues at encoding and retrieval, or descriptions of target actions during learning, are central to infants benefitting from language when they retrieve their knowledge in new situations.

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Figure 1. The mean number (± 1 SE) of target actions produced as a function of experimental condition. An asterisk indicates that the group's mean imitation score is significantly above the score of their age-matched baseline control condition.