Journal of Experimental Child Psychology 108 (2011) 747–761

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

Interactive context integration in children? Evidence from an action memory study

Silvia Mecklenbräuker [a,*], Melanie C. Steffens [b,*], Petra Jelenec [b], N. Kristine Goergens [b]

[a] Department of Psychology, University of Trier, D-54286 Trier, Germany
[b] Institute of Psychology, Friedrich Schiller University Jena, D-07743 Jena, Germany

ARTICLE INFO

Article history:
Received 10 September 2009
Revised 20 November 2010
Available online 6 January 2011

Keywords:
Memory development
Enactment
Action memory
Interactive context
Free recall
Retrieval

ABSTRACT

Action–object phrases (e.g., "lift the bottle") are remembered better if they have been enacted rather than learned verbally. This enactment effect is largest in free recall for phrases with objects (e.g., "bottle") present because these phrases can be interactively encoded with those context objects (*interactive context integration*) that serve as retrieval cues. The current study investigated whether 6- and 8-year-olds are already capable of interactive context integration. Experiment 1 demonstrated interactive context integration with 8-year-olds. This was hindered in a condition where attention was directed away from context objects. Experiment 2 demonstrated interactive context integration with 6-year-old kindergartners. Taken together, our findings show that even 6-year-olds are capable of incidental context integration through enactment and that this process is attention based.

Introduction

Performed actions are typically remembered better than action descriptions, a finding referred to as the enactment effect. This effect has been investigated in a substantial number of adult studies (for reviews, see Engelkamp, 1998; Zimmer & Cohen, 2001). Most studies compare intentional verbal learning of lists of action–object phrases with an encoding condition where in addition to intentional verbal learning, the same phrases need to be performed. Phrases are enacted using body parts (e.g., "scratch your head"), objects present in the study context (e.g., "point to the window"), or objects that

* Corresponding authors. Fax: +49 3641 945 112 (M.C. Steffens).
E-mail addresses: mecklen@uni-trier.de (S. Mecklenbräuker), melanie.steffens@uni-jena.de (M.C. Steffens).

0022-0965/$ - see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.jecp.2010.12.002

are imagined (e.g., "lift the bottle"). Enactment typically increases retention as compared with verbal learning; that is, the enactment effect is demonstrated (for an overview, see Engelkamp, 1998). Recent studies with adults have shown that the enactment effect in free recall is based on those action phrases where objects are present in the study context (e.g., Steffens, Buchner, & Wender, 2003). Apparently, these phrases can be interactively encoded with the context objects (*interactive context integration*) that then serve as retrieval cues. For instance, if the phrase "lift the bottle" is to be learned, participants who are asked to pretend performing this action in the enactment condition (i.e., performing the movement of lifting without being given a bottle) may imagine lifting the specific bottle present in the experimental room even if the bottle is out of reaching distance (and not actually touched). Consequently, the phrase is interactively encoded with that bottle, and during free recall the bottle (still present) is a particularly powerful retrieval cue. The aim of the current study was to determine whether 6- and 8-year-olds are already capable of such interactive context integration.

Does children's memory performance profit from carrying out actions? Only a few studies have addressed memory for simple self-performed actions in children (for a review, see Foley & Ratner, 2001). Cohen and Stewart (1982), for example, found age-related improvements for word recall from 9 to 13 years but not for the recall of performed actions. However, they did not compare enactment of action–object phrases with verbal learning of the same phrases or with an observation condition (i.e., children watching the experimenter perform the actions). The studies that have included a verbal learning condition and/or an observation condition have yielded mixed results (see Foley & Ratner, 2001). Most of these studies showed age-related improvements in action memory between 6 and 10 years (e.g., Baker-Ward, Hess, & Flanagan, 1990; Foley & Johnson, 1985; Parker, 1995; Ratner & Hill, 1991; Wippich, Mecklenbräuker, & Sidiropoulos, 1990). Whereas some of these studies found an age-invariant enactment effect (e.g., Baker-Ward et al., 1990; Wippich et al., 1990), others obtained an age-related improvement in the enactment effect (e.g., Foley & Johnson, 1985; Ratner & Hill, 1991).

The study by Ratner and Hill (1991) is one of the few child studies where simple isolated actions needed to be performed on imagined objects; in most child studies, real objects were provided. Acting during encoding facilitated recall performance for all age groups (6-year-olds, 9-year-olds, and adults) as compared with verbal learning; however, the facilitation was less for the youngest group. In sum, existing findings on children's action memory are contradictory. Importantly, very few studies used simple isolated actions performed on imagined objects (Ratner & Hill, 1991; Wippich et al., 1990) or compared an enactment condition with a verbal learning condition (Ratner & Hill, 1991).

An important aim of action memory research with adult participants has been to establish the processes brought about by enactment that determine memory performance. Most authors assume that people may remember performed actions well without the use of additional self-initiated encoding strategies such as rehearsal and semantic elaboration (i.e., linking the action with other meaningful information) because carrying out actions, as compared with other encoding conditions, ensures the semantic processing of the action–object phrases themselves (e.g., Engelkamp, 1998; Steffens et al., 2003). Performing an action–object phrase makes the action become more specific (cf. Hunt & Einstein, 1981, for the distinction between item-specific and relational processing). For instance, for the action "lift the bottle," the specific understanding of the action "lift" is distinguished from the meaning suggested by the action "lift the trunk" (cf. Earles & Kersten, 2002). Furthermore, performing actions ensures encoding of sensory and perceptual features (cf. Parker, 1995). The action–object relation is also processed well, leading to a unitized memory representation (Kormi-Nouri, 1995; Mangels & Heinberg, 2006) because during enactment an image of the object in combination with the action is formed.

In contrast, enactment does not generally enhance the processing of relations between different to-be-learned action phrases (for a review, see Koriat & Pearlman-Avnion, 2003) or integration with an *independent context* (Baddeley, 1982), that is, a context unrelated to the meaning of the action phrases (e.g., the kitchen in "brush your teeth in the kitchen"). However, the *interactive context* should provide more effective retrieval cues after enactment than after verbal learning (Steffens, Jelenec, Mecklenbräuker, & Thompson, 2006; Steffens et al., 2003): The interactive context changes the way in which the stimulus is encoded (Baddeley, 1982). This can be shown for phrases with objects present during study and test (see also Goff & Roediger, 1998; Nyberg, Nilsson, & Bäckman, 1991). For instance, if the phrase "lift the bottle" is to be learned, participants in the enactment condition who