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Research report

Enactment versus conceptual encoding: Equivalent item memory but different source memory

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ABSTRACT

It has been suggested that performing a physical action (enactment) is an optimally effective encoding task, due to the incorporation of motoric information in the episodic memory trace, and later retrieval of that information. The current study contrasts old/new recognition of objects after enactment to a conceptual encoding task of cost estimation. Both encoding tasks yielded high accuracy, and robust differences in brain activity as compared to new objects, but no differences between encoding tasks. These results are not supportive of the idea that encoding by enactment leads to the spontaneous retrieval of motoric information. When participants were asked to discriminate between the two classes of studied objects during a source memory task, perform-encoded objects elicited higher accuracy and different brain activity than cost-encoded objects. The extent and nature of what was retrieved from memory thus depended on its utility for the assigned memory test: object information during the old/new recognition test, but additional information about the encoding task when necessary for a source memory test. Event-related potentials (ERPs) recorded during the two memory tests showed two orthogonal effects during an early (300–800 msec) time window: a differentiation between studied and unstudied objects, and a test-type (retrieval orientation) effect that was equivalent for old and new objects. Later brain activity (800–1300 msec) differentiated perform- from cost-encoded objects, but only during the source memory test, suggesting temporally distinct phases of retrieval.

1. Introduction

Over the last 25 years, numerous reports have indicated that performing a bodily action during initial study is an effective way of increasing the likelihood that the item will be remembered later. Enacting a bodily movement (''wave your hand''), pantomiming an action with an imaginary object (''brush your teeth''), and manipulating a real object all lead to better recall and recognition of the action phrases than simply listening to them, a phenomenon known as the *enactment effect* (Arar et al., 1993; Bäckman and Nilsson, 1985; Cohen, 1981; Engelkamp and Zimmer, 1989; Guttentag and Hunt, 1988; Kormi-Nouri et al., 1994; Nyberg and Nilsson, 1995; Svenson and Nilsson, 1989). Encoding by enactment – which we refer to as one

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variety of *action encoding* – is also referred to as a *subject-performed task* (*SPT*). In most enactment studies, participants are tested on their memory for the verbal commands, by making old/new recognition judgments about action phrases, writing down the commands they remember (free recall), or recalling the verb when given the noun (cued–recall). The memory advantage thus accrues to the verbal phrases which elicited actions during the study phase, whereas memory for the encoding task itself is not evaluated (we review the smaller number of studies which do test memory for the encoding task in Section 4 – Discussion).

Enactment is a potent encoding task so that, for instance, recognition accuracy after enactment is nearly perfect for up to 80 items (Engelkamp and Zimmer, 1997; Engelkamp et al., 1993; Knopf, 1991; Knopf and Neidhardt, 1989; Mohr et al., 1989; Norris and West, 1991). Encoding by enactment is also effective for older adults and for neurological populations with memory impairments (Bäckman and Nilsson, 1985; Brustrom and Ober, 1996; Butters et al., 1994; Guttentag and Hunt, 1988; Herlitz et al., 1991; Karlsson et al., 1989; Knopf and Neidhardt, 1989; McAndrews and Milner, 1991; Mimura et al., 1998; Nilsson and Craik, 1990; Norris and West, 1991).

The demonstrated efficacy of action encoding has led to strong claims that it has special properties for enhancing (at least) free recall. Zimmer et al. (2000, p. 658) have suggested that "By this mechanism, items pop into a person's mind without active search. These data support the theory that performing actions during study enhances the efficiency of an automatic pop-out mechanism in free recall". Zimmer (2001) further writes: "Very distinct and unique events attract the hippocampal component, and due to this resonance they pop into conscious memory. I assume that this pop-out mechanism, based on item-specific information, is enhanced by SPT, and I also believe that this supplementary mechanism substantially enhances free recall of performed actions… In summary, automatic retrieval should have a greater influence on memory for SPTs than memory for VTs [verbal encoding tasks]."

We suggest that the apparent ease of retrieval after action encoding has been exaggerated by comparison to very weak baselines. Memory for enacted items is usually compared to memory for items that were merely read or heard with instructions to remember, with no specific judgment or overt response of any sort required – referred to as a "verbal encoding task (VT)". In and of itself, the advantage of an active encoding task over intentional encoding instructions does not suggest any special properties of action encoding as a memory aid, because similar advantages are observed for a variety of encoding tasks over intentional instructions alone (Eagle and Leiter, 1964; Hyde and Jenkins, 1973; Warrington and Ackroyd, 1975). Because enacting a verbal command initially requires comprehension of the command, one can wonder whether action encoding is simply one variety of a deep encoding task (see Kormi-Nouri and Nilsson, 2001 for related discussion). One way that enactment is similar to "deep" conceptual encoding is in its lack of sensitivity to incidental versus intentional encoding instructions. When a semantic orienting task is assigned, fore-knowledge of the upcoming memory test is irrelevant (Craik, 1977; Hyde and Jenkins, 1969, 1973). Similarly, instructional manipulations about whether or not memory will tested do not influence recall after enactment (Watanabe, 2003; Zimmer and Engelkamp, 1999). However, the large majority of enactment studies have used intentional instructions, as we do here.

Surprisingly, the literature to date contains no simple evaluation of the efficacy of action encoding as compared to another encoding task that (1) mandates attention to the to-be-remembered stimuli by requiring a judgment about each one, and (2) requires assessment of conceptual properties that are inherent to the stimulus, but not for the domain of action.[1] A small number of published studies have included some encoding manipulation other than enactment versus intentional instruction alone, but these have been designed to assess whether the benefit of the other manipulation is additive with the benefit of enactment (Cohen, 1981; Nilsson and Craik, 1990). Zimmer and Engelkamp (1999) asked participants to judge whether a letter triplet occurred in an action phrase (nonconceptual task), or judge whether the described location was a good one for the action (conceptual task, e.g., "apply the postage stamp in the post office" or "…in the pub"). In both cases, the action phrases were performed after the judgment. Two additional study tasks consisted of the conceptual and nonconceptual tasks alone. For the no-enactment conditions, the conceptual encoding task led to higher recall than the shallow task. Free recall performance after action-plus-conceptual encoding was equivalent to conceptual encoding alone. From these results, one might conclude that the conceptual encoding task did all the work, and that action encoding did not add any additional benefit. After observing similar results, Nilsson and Craik (1990) suggested that "…the benefit of SPTs over verbal commands has something in common with the benefit associated with deep as opposed to shallow encoding… By this line of argument, SPTs are one means by which deep encodings may be achieved" (p. 320). However, it is also possible that the design of Zimmer and Engelkamp's (1999) study was non-optimal for finding a specific benefit of action encoding: the action encoding conditions required the performance of two encoding tasks (action plus additional deep or shallow task), whereas the non-action encoding conditions required the performance of only a single task (deep or shallow). It is possible that dividing attention between two study tasks diminished the benefit that might be obtained with action encoding alone (see Craik et al., 1996; Fernandes and Moscovitch, 2000 for the deleterious effects of divided attention at study).

In the present experiment, the efficacy of enactment for old/new recognition is compared to another encoding task that is cognitively effortful, but has no action component. Participants conduct a single encoding task on each trial. On *perform* trials, they are asked to perform a typical action with a real object; on *cost* trials, they are asked to verbalize their

[1] Some studies have compared enactment to other varieties of action encoding, such as watching the experimenter perform an action, or imagining performing an action (Arar et al., 1993; Cohen and Faulkner, 1989; Hashtroudi et al., 1990; Koriat et al., 1991). These comparisons are important and interesting for a variety of reasons that are outside the scope of the current paper (see Senkfor et al., 2002), but do not speak to the question of how action encoding may differ from purely conceptual encoding.