

# Exploring the Mechanisms Underlying Movement Effects on Verbal Recall

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### **I. Project Summary**

Extensive research has demonstrated that action-phrases such as "move the pen" are better remembered when actually performed than when studied under standard verbal learning instructions (e.g., Engelkamp, 1991; Engelkamp & Zimmer, 1994; for reviews see, Cohen, 1989). Recently I have extended this line of inquiry by showing that movements not connected with the accompanying verbal material (except at a very high level of abstraction) also produce superior memory (Noice & Noice, in press; Noice, Noice & Kennedy, 2000; Noice & Noice, 1999). The proposed experiment will test two potential explanations for such movement-effects on verbal recall. Approximately 60 Elmhurst students will be randomly assigned to one of three groups. Participants in the first group will perform a series of actions that do not duplicate the meanings of verbal phrases they simultaneously speak; however, both actions and words will be consistent with the same overall goal. The second group will perform actions and speak phrases that are not consistent with the same goals. The third (control) group will speak the same phrases without accompanying movements. If the first group outperforms the others on a subsequent memory test for the spoken phrases, it would indicate that the non-literal movement effect indeed functions like the standard SPT effect, implying that the SPT phenomenon has far wider application than heretofore suspected. However, if the second group should equal the performance of the first, it would argue that both types of movement effect are actually mediated by physiological activation.

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### **II. Narrative**

1. Current Situation: Last summer, along with my research collaborator, Tony Noice, I carried out an experiment that demonstrated a connection between verbal memory and physical movement (Noice & Noice, in-press). Fifty-four Elmhurst College students were given the same five pages of dialogue to study for exactly 5 minutes. Results showed that those students who were specifically told NOT to try to memorize the material but rather to read it aloud while moving about the room learned more than those who deliberately memorized the same script. This experiment greatly extended the well known phenomenon called, "subject performed tasks" (SPTs) inasmuch as the usual SPT effect requires that the subject literally perform the action called for by the verbal phrase. That is, in order to learn "move the ashtray" one would move an ashtray or pantomime moving one (for a review, see Nilsson, 2000). However, the movements made by our participants never duplicated the meaning of the verbal utterance (e.g., a student was instructed to say, "Might as well start here -- the dining room" while crossing over to the other side of the room). Despite this lack of a literal match between movement and verbal meaning, those in the moving condition retained significantly more material than controls. Furthermore, when the recall of participants in the moving condition was analyzed on a speech by speech basis, speeches that had been accompanied by movements were better recalled than those that had been uttered when that same participant had remained in one place.

In addition to the practical applications for students who must make verbal presentations from memory, these findings have important theoretical implications. Recently, Art Glenberg

and his associates (e.g., Glenberg, 1997; Glenberg & Robertson, 1999; Kaschak & Glenberg, 2000) have proposed a theory of human thinking referred to as "embodied cognition." By this view, comprehension and memory are derived from our interactions with the physical universe. For example, the statement, "I scratched my back with a computer disk" makes sense, whereas the statement, "I scratched my back with a short piece of thread" does not. This is because we know that, although it would be an unusual application, the disk's form with its solid edges would allow it to relieve an itch. An overview of this theory would be that comprehension and memory are based on the physical affordances of the experiential properties of the universe. This view is revolutionary because it eliminates the role of manipulation of mental symbols (the software analogy) that is central to much current cognitive theory.

2.The Project Plan: The proposed experiment extends my line of research by attempting to identify the cognitive mechanisms that underlie both the standard SPT effect and our newly discovered non-literal movement effect. A search of the SPT literature reveals that no studies appear to have been done to rule out the notion that the SPT effect is based on physiological processes such as increased blood flow to the brain or a higher level of mental activation. Undoubtedly, such inquiry was considered unnecessary up to now, given the literal connection between a phrase such as "lift the cup" and the action of lifting one. That is, heretofore the interdependency between actions and words in SPTs was so obvious that a researcher would hardly be tempted to seek an alternate explanation. However, our finding of a non-literal movement effect would seem to prompt further exploration of this issue. If non-literal movements result in better memory for accompanying verbal material, are the effects due to a linkage between the meaning of the movement and the meaning of the verbal utterance, a linkage

that exists at a higher level of abstraction than that demonstrated by traditional SPT research? Or is the non-literal effect due to movement-induced physiological states that benefit memory?

To answer these questions, I plan to recruit approximately 60 Elmhurst students. All students will be given the same list of phrases, then assigned to one of 3 conditions: the action-consistent condition, the action-inconsistent condition, and the no-movement (control) condition. Participants in the first condition will be instructed to read each phrase aloud and will be given an action to perform that is somewhat consistent with the meaning of the phrase (but not a direct enactment of it as in an SPT). For example, with the phrase, "How dare they treat me like this!", the participant would rise from his or her chair and walk quickly to the door. Participants in the second condition would read the same phrase while walking from one wall to another. Participants in the third condition would simply read the same phrase aloud without movement. All participants will be given the identical amount of time (4 seconds) to process each phrase.

After the participants have gone through the entire list of phrases, they will perform a distracter task (a series of simple arithmetic problems) to prevent them from maintaining the stimuli in working memory. They will then be asked to perform a free recall task, writing down all the phrases they can remember in any order. If the participants in the action-consistent condition remember significantly more material than those in the action-inconsistent condition, it would supply evidence that the non-literal movement effect is dependent on a connection between movement and memory similar to that responsible for the standard SPT effect although existing at a higher level of abstraction (e.g., the action of walking away from someone, and the statement, "I don't believe a word you're saying" are both forms of rejection, but this linkage is far less direct than that between the action of moving an ashtray and the statement, "Move the

ashtray.")

Conversely, if participants in the phrase-inconsistent condition remember the same or more material, it would suggest that the explanations usually offered for the SPT effect (e.g., establishment of multimodal memory codes) are insufficient. Thus it would appear that the movements themselves (regardless of their connections with the verbal material) induce physiological changes, and that these changes are responsible for increased mental efficiency and hence increased memory. This experiment would allow us to test these alternate explanations for the first time.

Moreover, if my prediction is correct that the consistent movement condition will produce superior memory, this would give us a further reason to seriously investigate theories of embodied cognition. That is, such a finding would indicate that human utterances are understood and remembered because their meanings mesh with actions designed to reach goals, suggesting that cognition may be derived from our interaction with the physical universe. I believe this experiment would have great impact on my work here at EC because it would enable me and my students to perform research that combines practical, real-world consequences with cutting-edge theoretical speculation.

3. Faculty Expertise: I feel my expertise in this area is demonstrated by my journal articles, book chapters, and my own book on the subject, as listed in Section V. Since this proposal concerns an investigation central to my main body of research, all these publications would appear to be relevant. My work in this area has also been funded by NIH, NSF, the Pew Charitable Trust, the Elmhurst College Faculty Development Fund, and the Augustana Research Foundation.

Another indication of my expertise would be that my work in this field has been cited (and sometimes described at length) in a number of standard cognitive textbooks, including:

- Benjafield, J. G. (1997). Cognition.
- Galotti, K. M. (1999). Cognitive Psychology in and out of the Laboratory.
- Haberlandt, K. (1999). Human Memory: Exploration and Application.
- Reed, S. K.(1999): Cognition: Theory and Application.
- Rubin, D. C. 1995). Memory in Oral Traditions.
- Schacter, D. (1996). Searching for Memory.
- Solso, R. L.(1998). Cognitive Psychology.

4. Plans for Evaluation and Dissemination: As with all empirical investigations, evaluation is built into the process; the results supply (or fail to supply) evidence for the hypothesis. Assuming the expected significant results, a number of outlets are available. An article based on this experiment would certainly be suitable for Memory, Discourse Processes, Memory and Cognition, and other journals in which my work has been published. As for national or international conference presentations, there are many organizations I frequently address including the Psychonomic Society, The Society for Text and Discourse, the International Society for the Empirical Study of Literature (IGEL), and the Society for Applied Research in Memory and Cognition (SARMAC). Although this research would be suitable for all of them, I feel that Psychonomics, 2001 (to be held in November in Orlando, FL) would provide the ideal audience for this presentation.

Another very important reason for performing this study is that it would supply preliminary data for a multi-experiment proposal for the National Science Foundation. There is

an excellent NSF program called Research Opportunity Awards (ROA), which supports collaborations between professors at primarily undergraduate institutions and those at major research universities where sophisticated testing equipment is available. I would like to propose a collaboration with Art Glenberg at the University of Wisconsin on how this work grows logically out of an embodied cognition account of human memory. In our paper describing the findings of the movement experiments we performed last year, we pointed out the parallels with embodied cognition theory. Glenberg (who happened to be one of the peer reviewers) immediately wrote to us, asking permission to cite our findings based on the manuscript itself, rather than wait for the necessarily long delays involved before academic publications reach the distribution stage. Subsequent correspondence has made confirmed our mutual interests, and I feel that this type of joint inquiry would be an ideal candidate for an NSF/ROA because U of W, Madison has the necessary equipment to identify brain sites that might mediate the action/memory connection.

### **III. Time Line**

Because the actual running of the experiment would require individually testing each participant, it would take a few weeks and would occur during the latter part of the Spring semester while students are still available. However, the overwhelming majority of the work would take place during the summer, including the scoring and analyzing of the data, the writing of the submission for presentation, and the writing of the paper itself. Since I did not request any summer teaching, I would be able devote that entire time frame to these efforts.

**IV. Budget**

1. Travel for presentation (airfare, hotel, food, registration)	\$1,100.00
2. Faculty Salary	\$2,000.00
3. Photocopying of test booklets and scoring materials	\$ 50.00
4. Office supplies (e.g., printer cartridges, paper, file folders, etc.)	\$ 50.00
5. Undergraduate student salary	\$ 300.00

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Total: \$ 3,500.00

**Budget Justification:**

Although I am only requesting the amount of salary I would be paid for teaching a single course during the summer, I plan to spend at least two summer months working on the project full-time. In addition to running the study, and analyzing and writing up the results, I will train an undergraduate student to score verbal protocols, a task requiring great precision. The results will be compared to the same data that I will have scored myself in order to establish interrater reliability. My long-time collaborator (and husband) will continue to work with me but, of course, he will not receive a salary. No other grant funds are being sought for this project, although, as already stated, I plan to cover some of the same ground in a more extensive multi-experiment proposal to NSF.

**V. Current and Previous Grants**

2001	Memory improvement in older adults through theatre training. National Institute of Aging (requested amount of \$100,000 for subject to final NIH budget adjustment)
2 1/2 years is	
2000	The effect of movement on the learning of text

Elmhurst Faculty Development Grant, \$3,500.

1997 The influence of nonliteral movement on recall accuracy  
NSF REU grant, \$ 4,000 (Student: Cara Kennedy)

1997 Long-term verbatim memory for complex material when  
retrieved by

verbal and

motoric cues

National Science Foundation (Research Planning Grant),

\$ 18,000

## VI. Publications

### 1. Journals, Books, Chapters

Noice, H. & Noice, T. (in press-a). Learning dialogue with and without movement. Memory & Cognition.

Noice, T. & Noice, H. (in press-b). Very long-term recall and recognition of well-learned material. Applied Cognitive Psychology.

Noice, H. & Noice, T. (2000). Two approaches to learning a theatrical script. In U. Neisser & I. R. Hyman, Jr. (Eds.), Memory observed: Remembering in natural contexts. New York: Worth Publishers.

Noice, H. & Noice T. (1999). Long-term retention of theatrical roles. Memory, 7 (3), 357-382.

Noice, T. & Noice, H. (1997a). Expertise of professional actors: A cognitive view. Hillsdale, NJ: Lawrence Erlbaum Associates.

Noice, T. & Noice, H. (1997b). Effort and active experiencing as factors in verbatim recall. Discourse Processes, 23, 51-69.

Noice, T. & Noice, H. (1997c). Verbatim retention of theatrical scripts by

means of character analysis. In S. Toetoesy de Zepetnek & Irene Sywenky (Eds.), The systemic and empirical approach to literature and culture as theory and application (pp. 485-504). Edmonton, Alberta: University of Alberta.

Noice, H. & Noice, T. (1997d). Long-term memory for verbal material as a result of accompanying non-literal action events. Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society. Hillsdale, NJ: Lawrence Erlbaum.

Noice, H. & Noice T. (1999). Optimierung der Gedächtnisleistung durch den Einsatz eines Schauspieltrainings. In P. Perrig-Chiello, H. B. Staehelin, & W. J. Perrig (Eds.), Wohlbefinden, Gesundheit und kognitive Kompetenz im Alter (pp.137-144). Bern, Switzerland: Verlag Paul Haupt.

Noice, H., Noice, T., & Kennedy, C. (2000). The contribution of movement on the recall of complex material. Memory, 8 (6), 353-363.

Noice, H., Noice T., Perrig-Chiello, P. & Perrig, W. (1999). Improving memory in older adults by instructing them in professional actors' learning strategies. Applied Cognitive Psychology, 13, 315-328.

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(to studies other than my own)

Cohen, R. L. (1989). Memory for action events: The power of enactment. Educational Psychology Review, 1, 57-80.

Engelkamp, J. (1991). Memory of action events: Some implications for memory theory and for imagery. In C. Cornoldi & M. A. McDaniel (Eds.), Imagery and cognition. New York: Springer Verlag.

Engelkamp, J., & Zimmer, H. D. (1994). The human memory: A multimodal approach. Seattle: Hogrefe & Huber.

Glenberg, A. M. (1997). What memory is for. Behavioral and Brain Sciences, 20, 1-55.

Glenberg, A. M., & Robertson, D. A. (1999). Indexical understanding of instructions. Discourse Processes, 28, 1-26.

Kaschak, M. P., & Glenberg, A. M. (2000). Constructing meaning: The role of affordances and grammatical constructions in sentence comprehension. Journal of Memory and Language, 43, 508-529.

Nilsson, L-G. (2000). Remembering actions and words. In E. Tulving & F. I. M. Craik (Eds.), The Oxford handbook of memory (pp. 137-148). New York: Oxford University Press.