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Comparing Performance on Implicit Memory Tests G F49620-92-J-0437

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The second year of this grant saw progress on 9 projects briefly described below. In particular, in the past year 5 papers or chapters have been published, 6 are in press, 3 are in preparation, and data are being collected on several new projects. My students and I have presented 6 papers on work conducted under the auspices of the grant at national and international meetings in the past year. We have completed projects on the following topics: 1. Effects of imagery on nonverbal implicit tests; 2. Effects of high priority events on implicit tests; 3. Specificity of priming on verbal and nonverbal perceptual tests; 4. Direct comparison of two methods of testing for contamination of implicit tests by conscious recollection; 5. The experiential basis of serial position effects; and 6. A new paradigm for the study of false memories. Four or five other projects should be completed during the final year of the grant.

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Progress Report for AFOSR grant F49620-92-J-0437
August 1, 1993, through July 31, 1994

This progress report covers the second of three years of work under AFOSR grant F49620-92-J-0437, "Comparing Performance in Implicit Memory Tasks." I will briefly try to summarize the progress we have made on a number of different fronts. I will begin by describing recently completed projects that have been submitted for publication (or that are already in press) and then describe other projects still under way. References appear below, under Publications.

1. Effects of imagery on implicit memory tests. Kathleen McDermott and I have conducted a series of experiments on this topic, showing that when people are given words and asked to form mental images of the words, increased priming occurs on implicit memory tests involving naming picture fragments. The rationale for this prediction is given in the proposal, but in one sense the finding is surprising, viz, most experiments manipulating strategies of encoding have been shown not to affect priming on implicit tests. The reason for the exception reported in our experiments is that these tests are perceptual in nature and so imaginal encoding--thought to give rise to the same cortical mechanisms as underlie actual perception--do support priming. A paper based on this research has been accepted for publication in the *Journal of Experimental Psychology: Learning, Memory, and Cognition*. In addition, this work constituted Kathleen McDermott's Master's thesis, for which she won the Shahin Hashtroudi Memorial Award for the "Best Master's thesis or dissertation in the psychology of learning and memory" for 1994. McDermott received the award at the summer meetings of the American Psychological Society.

2. Guynn and Roediger (in press) conducted a series of experiments asking about the effect of high priority events on priming on implicit memory tests. Prior work had shown that if subjects were told to pay careful attention to an event, these "high priority" instructions produced enhanced memory for that event, but produced "retrograde amnesia" (forgetting) for events occurring just prior to the critical event. We replicated this retrograde amnesia effect in free recall (albeit rather weakly and with some difficulty), but could find no evidence for it on implicit memory tests. However, we did find evidence for the high priority event effect even on the implicit test. We report three experiments on this phenomenon in a special issue of *Psychological Research* to be devoted to implicit memory.

3. Jones and Roediger (in press) reported an experiment not proposed in the original grant, but an offshoot of that work. In particular, following research by Endel Tulving (1985), we asked if the standard serial position curve reported in virtually all memory experiments has its basis in subjects "remembering" or "knowing" about their past. Briefly, Tulving argued that we can vividly remember some events of our past, but only know that others happened to us. He also developed techniques for applying this distinction of two bases of knowledge of the personal past to standard list learning situations in the psychological laboratory. We used his techniques and showed that both

the primacy and recency effects in the serial position curve reflect enhanced remembering. This paper is in press in the *European Journal of Cognitive Psychology*.

4. Other work conducted on the specificity of perceptual priming is reported in a paper by Weldon, Roediger, Beitel and Johnson (*Journal of Memory and Language*, in press). In that paper we show that manipulations of pictures and words (such as their repetition) have large effects on explicit memory tests, but little or no effect on the implicit memory tests of word fragment completion and picture fragment naming. This result agrees with other research from our lab in showing that priming on most tests depends heavily on perceptual operations between study and test.

5. Many researchers worry about whether ostensibly implicit memory tests--thought to reflect automatic or even unconscious processes--really fulfill these claims. Some researchers believe that the tests are badly contaminated by conscious or explicit uses of memory. Two techniques have arisen to evaluate this problem. One is the retrieval intentionality criterion suggested by Schacter and his associates, and a second is called the process dissociation procedure and is advocated by Jacoby and his collaborators. The space here does not permit details of these methods, but each method has its attractions and demerits. At the moment, groups of researchers use one method or the other method, but not both. Another line of work Todd Jones, Kathleen McDermott and I are conducting at Armstrong Laboratories is to directly compare these two methods. We are manipulating a variable (levels of processing) that sometimes has small effects on implicit memory tests and is often taken an index of whether an implicit test is contaminated by explicit or conscious recollection. We are testing large numbers of subjects under four different conditions that will allow us to directly compare the conclusions from the retrieval intentionality criterion and the process dissociation procedure. The results of a very sizable first experiment (testing some 240 subjects) are now in, and the data are wonderfully clear. The conclusions are that both the retrieval intentionality criterion and the process dissociation procedure are useful in distinguishing intentional from incidental retrieval; that both lead to similar conclusions; and that (at least under our test conditions) implicit memory tests are not contaminated by explicit recollection. We obtained no levels of processing effect whatsoever on perceptual priming. We plan to write up these results this fall and hope to have them submitted by winter (the Jones, McDermott, & Roediger, in preparation, reference listed below).

6. The grant has also supported the writing of two chapters that are now in press. One chapter is "Remembering and Knowing as states of consciousness during recollection," by Suparna Rajaram (a former graduate student at Rice) and me. It includes a review of the Remember/Know literature and in particular some new experimental results that are problematic for the leading account of Remember/Know performance. This chapter will appear in *The Carnegie-Mellon Symposium on Consciousness*, to be published by Lawrence Erlbaum and edited by Jonathan Cohen and Jonathan Schooler. A second chapter supported by the grant is by me and Melissa Guynn and is entitled "Retrieval processes in memory," and it will appear in E. L. Bjork and R. A. Bjork

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(editors) *Human Memory*, to be published by Academic Press, which will constitute Volume 10 of the *Handbook of Perception and Cognition*.

Several other projects are ongoing but have not yet reached the stage of completion.

7. Todd Jones is conducting research on priming of possible and impossible objects. In particular, in his dissertation he is proposing a series of experiments to test ideas in this realm developed from transfer appropriate processing framework. In particular, he hopes to identify conditions under which it would be possible to observe priming on impossible objects, a result not obtained in prior work by Schacter, Cooper, and their collaborators. He is proposing a series of four experiments that will be conducted over the next year.

8. Chris Schacherer, a graduate student working with me, is applying David Rubin's "unit analysis" technique to study differences and similarities among explicit and implicit memory tests for his dissertation. The unit analysis approach treats individual items (or units) in experiments as the entity of interest and examines whether performance is correlated across items on two tests. To the extent that there are positive correlations, he infers similarity in processes underlying the tests. To the extent that the correlations are zero, or even negative, he infers that processes underlying the tests must be different. No one has yet applied the unit analysis approach to similarities and differences of implicit and explicit tests, which Schacherer intends to do in a series of three experiments to be conducted during the final year of the grant.

9. Lynn Goff, a first year student at Rice, is conducting research on the levels of processing effect and its impact (or lack thereof) on implicit memory tests. Briefly, earlier research had shown that levels of processing had little or no effect on priming on implicit memory tests, even in the same paradigm where huge effects were observed on standard explicit tests. However, later research has tended to undermine this simple conclusion by sometimes obtaining effects. In addition, and in contradiction to many other studies, the effects are actually larger in between-subjects manipulations of levels of processing than in within-subjects manipulations. I have hypotheses as to why this curious state of affairs may have arisen and Goff is testing these ideas in her first year project.

10. Finally, although it is research not proposed in the original grant, I have also become interested in the psychology of false memories and, in collaboration with Kathleen McDermott, have developed a paradigm (first studied by Deese in 1959, but never developed since then) that produces huge false memory effects. Subjects study a list of related words such as "bed, rest, nightmare, awake, drowsy..." and later are asked to recall it. The lists are 15 words long, and the ones we have developed produce high levels of false recall and recognition. In one experiment, we find that subjects falsely recall the critical omitted 55% of the time. In addition, on a later recognition test, subjects falsely recognize the omitted word such as *sleep* at the same level they correctly recognize words that were actually on the list, like *bed* and *rest*. We have recently submitted two initial

experiments on this paradigm to the *Journal of Experimental Psychology: Learning, Memory, and Cognition*. We believe it is a promising one for the study of false memories under laboratory conditions and McDermott will be conducting her dissertation on this topic in the next year.

The above list summarizes the main projects conducted under the auspices of AFOSR grant number F49620-92-J-0437 in the past year. I have been quite brief about most of these topics, but at least for the first five an accompanying *in press* paper provides more details if they are needed.

Publications: Articles and Chapters

The list below is of articles and chapters published under support of the grant. These include some articles supported by my prior grant from AFOSR (91-NL-038).

Published Papers:

Roediger, H. L., & McDermott, K. B. (1993). Encoding specificity in perceptual priming. In A. Garriga-Trillo, Minon, P. R., Garcia-Gallego, C., Lubin, P., Merino, J. M., & Villarino, A. (Eds.), Fechner Day '93: Proceedings of the Ninth Annual Meeting of the International Society for Psychophysics. (pp. 227-232). Madrid, Spain.

Roediger, H. L., Wheeler, M. A., & Rajaram, S. (1993). Remembering, knowing and reconstructing the past. In D. L. Medin (Ed.), The psychology of learning and motivation: Advances in research and theory. New York: Academic Press.

Roediger, H. L., & McDermott, K. B. (1994). Implicit memory in normal human subjects. In F. Boller & J. Grafman (Eds.), Handbook of neurology, Vol. 8. (pp. 63-131). Amsterdam: Elsevier.

Roediger, H. L., Guynn, M. J., & Jones, T. C. (1994). Implicit memory: A tutorial review. In P. Eelen & G. d'Ydewalle (Eds.), Contributions to the Brussels International Congress of Psychology. Hillsdale, N. J.: Erlbaum.

Roediger, H. L., & McDermott, K. B. (1994). The problem of differing false alarm rates for the process dissociation procedure: Comment on Verfaellie and Treadwell (1993). Neuropsychology, 8, 284-288.

In Press

Guynn, M. J., & Roediger, H. L. High-priority event instructions affect implicit and explicit memory tests. Psychological Research.

Jones, T. C., & Reodgier, H. L. The experiential basis of serial position effects. European Journal of Cognitive Psychology.

McDermott, K. B., & Roediger, H. L. Effects of imagery on perceptual implicit memory tests. Journal of Experimental Psychology: Learning, Memory, and Cognition.

Rajaram, S., & Roediger, H. L. Remembering and knowing as states of consciousness during recollection. In J. D. Cohen & J. Schooler (Eds.), The Carnegie-Mellon Symposium on consciousness and cognition. Hillsdale, N. J.: Erlbaum.

Roediger, H. L., & Guynn, M. J. Retrieval processes. To appear in E. L. Bjork and R. A. Bjork (Eds.), Memory. Volume 10 of the Handbook of perception and cognition. New York: Academic Press.

Wheeler, M. A. Improvement in recall over time without repeated testing: Spontaneous recovery revisited. Journal of Experimental Psychology: Learning, Memory, and Cognition.

Submitted

Roediger, H. L., & McDermott, K. B. Creating false memories: Remembering words not presented in lists.

In Preparation

Jones, T. C., McDermott, K. B., & Roediger, H. L. Direct comparison of Jacoby's process dissociation procedure and Schacter's retrieval intentionality criterion as methods of assessing test differences.

McDermott, K. B., & Roediger, H. L. Effects of exact and conceptual repetition on implicit and explicit memory tests.

Roediger, H. L., & McDermott, K. B. Implicit memory tests (usually) measure incidental retrieval.

Names of Participating Professionals

Listed here are the names of people who worked under the auspices of the grant during its second year.

(1) Henry L. Roediger, III; Principal Investigator. Lynette S. Autrey Professor of Psychology at Rice University, Ph.D., 1973, from Yale University.

(2) Melissa J. Guynn; Graduate student; Rice University; B.S., in Psychology, Furman University, 1991. M.S., 1994. I planned to support her from this grant during its second year; however, she won a National Science Foundation Fellowship and therefore saved the grant money.

(3) Todd C. Jones; Graduate student; Rice University; B.S. and M.S. in Psychology from Southern Methodist University in 1990 and 1991, respectively.

(4) Kathleen B. McDermott; Graduate student; Rice University; B.S. in Psychology, University of Notre Dame, 1990. M.S., Rice, 1994.

(5) Chris Schacherer, Graduate student; Rice University; B.S. from Iowa State University in 1987 and M.S. from the University of Nevada at Las Vegas in 1989.

(6) Ron Haas, Undergraduate student; Rice University; Sophomore psychology major.

(7) Bettina A. Johnson; Undergraduate student; Rice University; B.A. in Psychology expected, May, 1995.

(8) Keith Rozendal; Undergraduate student; Rice University; B.A. in Psychology expected, May, 1995.

Presentations at Professional Meetings

Listed below are presentations made at professional meetings by me or the four graduate students who worked on grant-related projects.

Jones, T. C. (1994). The experiential basis of serial position effects. Texas Cognition Conference; San Antonio, May, 1994.

McDermott, K. B. (1994). Creating false memories: Remembering words not presented in lists. Texas Cognition Conference; San Antonio, May, 1994.

McDermott, K. B., & Roediger, H. L. (1994). Effects of imagery on perceptual implicit memory tests. The Midwestern Psychological Society, Chicago. [Paper presented by Roediger].

Roediger, H. L. (1993). Perceptual priming. International Soceity for Psychophysics, 9th Annual Meeting. Palma de Mallorca, Spain.

Roediger, H. L. (1993). Implicit memory tests (usually) measure incidental retrieval. Symposium on Implicit Memory. British Psychological Society. Brighton, England.

New Inventions, Patents, etc.

Although there were certainly new discoveries during the first year of this grant, there were none that involved inventions or any work that would be patented.

Additional Statement

I feel we have made considerable progress towards attaining the goals of the proposal "Comparing Performance on Implicit Memory Tests." During the upcoming year we will be beginning new projects concerned with Sections 4 and 5 of the original proposal. These are, respectively, (4) investigations of factors affecting priming on conceptual implicit memory tests, and (5) individual differences (both in subjects and in

materials) and how these affect priming on implicit memory tests. In sum, the second year of support under AFOSR grant F49620-92-J-0437 has been most productive. I and my graduate students are quite appreciative of this excellent support, which has enabled us to make considerable progress towards these stated goals.

Henry L. Roediger, III