DOCUMENT RESUME

ED 264 254 TM 850 611

AUTHOR Johnson, Mitzi M. S.; Greenwald, Anthony G.
TITLE Does the Generation Effect Apply to Stimuli as Well as to Responses?
PUB DATE 3 May 85
NOTE 10p.; Paper presented at the Annual Meeting of the Midwest Psychological Association (Chicago, IL, May 3, 1985).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Analysis of Variance; Associative Learning; *Cognitive Processes; Cues; Higher Education; *Language Processing; Learning Theories; *Paired Associate Learning; *Patterned Responses; Recall (Psychology); *Word Recognition
IDENTIFIERS *Generation Effect

ABSTRACT

An earlier study showed that responses are remembered better when subjects produce them from cues, than when subjects read cue-response pairs. The decided memory advantage for generated targets relative to read ones is known as the generation effect. The present research is designed to study the generation effect for cues, following a depth-of-processing interpretation. The task described is to produce a word, opposite in meaning to the cue, given the cue and target with two interior adjacent letters missing. Thirty-two undergraduate students viewed a cue-target pair for five seconds, wrote the target word, and viewed the completed target for three seconds. Control subjects received the cue and the entire target, wrote the target, and reviewed the target for three seconds. All subjects received twelve items and provided data on free recall, cued recall, and recognition. Half were tested for recognition of targets, and half for recognition of cues. Results showed that the generation effect does apply to cues as well as responses, although the effect for cues is weaker, suggesting that depth of processing cannot be the only process contributing to the generation effect. (LMO)

Does the Generation Effect Apply to Stimuli as Well as to Responses?

Mitzi M. S. Johnson and Anthony G. Greenwald
The Ohio State University

Does the generation effect apply to stimuli as well as to responses?

by
Mitzi M. S. Johnson and Anthony G. Greenwald
The Ohio State University

Paper presented at the Midwest Psychological Association Convention, May 3, 1985, Palmer House Hotel, Chicago, Illinois.

Slamecka and Graf (1978) found that responses are remembered better when subjects produce them from cues, than when subjects read cue-response pairs. For example, given the rule synonym, and the cue word rapid plus the letter F, the subject can readily generate the target response fast.

Figure 1 about here

The relationship between the cue and target, in this case synonym, is referred to as the generation rule. In the comparison condition, referred to as the read condition, subjects simply read completed cue-target pairs. Slamecka and Graf found a decided memory advantage for generated targets relative to read ones. They named this result the generation effect.

The generation effect has been empirically confirmed in a variety of settings. Slamecka and Graf, 1978 demonstrated a generation effect for targets on recall and recognition measures using a variety of relationship rules and under incidental and intentional learning conditions. Jacoby, 1978 also demonstrated an effect for targets generated in a task similar to a crossword puzzle. McFarland, Frey and Rhodes, 1980, extended the generation effect to include tasks in which subjects generated words that violated specified relationship rules. Slamecka and Fevreiski, 1983, found a generation effect for word targets even when subjects failed to successfully generate the word. It is remarkable that, despite the extensive research on the generation effect, there is not yet any established theoretical interpretation for the effect.

One attractive candidate as a theoretical interpretation is the familiar concept of depth of processing. According to a depth-of-processing interpretation, the generation condition obliges a deeper level of analysis of the cue for the purpose of producing the response -- perhaps involving richer or simply more cognitive operations -- and this establishes a larger number of potential retrieval routes to the target item. Such an interpretation, in terms of depth of processing or related ideas, has been offered by Bobrow and Bower, 1969, Slamecka and Graf, 1978 and Slamecka and Fevreiski, 1983. A clear implication of this depth-of-processing interpretation is that the generation effect should apply not just to the target, but also to the cue from which the target was generated. That is, the subject presumably must analyse the cue more deeply, or with a greater variety of operations, in the generate condition than in the read condition, and if such a deeper or richer analysis produces a memory benefit for the target word, then it should also produce a memory benefit for the cue word.

Unfortunately, the few existing tests of the generation effect for cues have not found the effect. Figure 2 presents the only two published tests, from the Slamecka and Graf (1978) article. Both tests show only slight tendencies toward a generation effect for cues -- not statistically significant, and certainly not any basis for support for the depth of processing interpretation.

Figure 2 about here

Because the depth of processing interpretation is such an attractive candidate as a theory for the generation effect, and because its difficulty is based on relatively little data, further tests were warranted. The present research sought the generation effect for cues under conditions that should enhance the possibility of observing that effect. We borrowed materials developed by Slamecka and Fevreiski (1983). In their experiment, the generation task was relatively difficult. Both cues and targets were uncommon words and the specified relationship rule used for generation constituted an unusual association between cue and target. It was reasoned that because the materials were unfamiliar to subjects and associations between cues and targets represented unfamiliar links, that subjects would be obliged to focus more than usual attention upon cues.

The generation task was to produce a word, opposite in meaning to the cue, given the cue and target with two interior adjacent letters missing.

Figure 3 about here

Subjects viewed the cue-target pair for five seconds, wrote the target word, and viewed the completed target for an additional three seconds. In the control condition, subjects were given the cue with the entire target, wrote down the target and viewed the target for an additional three seconds.

Method

Subjects. Thirty-two undergraduate students in introductory psychology classes at the Ohio State University participated in partial fulfillment of a course requirement.

Design. All subjects received 12 items in each of the generate and read conditions. They provided data on three dependent measures, free recall, cued recall, and recognition. Free recall measures were collected for all subjects for both cues and targets. As a between subjects factor, half of the subjects were tested for cued recall and recognition of targets, and half were tested for cued recall and recognition of cues. (Target words were presented as stimuli for the cued recall test for cues.)

Procedure. After subjects were greeted they were told that the experimenter was interested in their ability to remember trivia information. They were given the trivia questions and answers to study for ten minutes and told to expect a memory test over the materials. This material

contained question and answers, such as "Question: Morris, the famous spokescat for Nine-Lives Catfood, died in Chicago in 1978. How old was he? Answer: 17." Before being tested over the trivia materials, subjects were told that they would preview a short videotape designed to be used in another experiment.

Subjects viewed a mixed presentation of 12 complete and 12 incomplete word pairs. For each pair subjects were to asked to write down the second (target) word. If the word pair was incomplete, subjects were asked to fill in the word they thought completed the pair. Each item was initially presented for 5 seconds. Subjects were assured that regardless of whether the word pair was complete or incomplete, they would view the entire completed pair for an additional three seconds immediately after viewing the initial pair.

After the videotape presentation, subjects were given five minutes to provide the answers to the trivia questions they had studied earlier. Immediately following the trivia test the memory tests for the stimulus materials were administered. First, subjects were asked to spend three minutes recording any of the cues and targets from the videotape presentation they could remember. Subsequently, half of the subjects received cued recall and recognition tests for cues, while the other half of the subjects received cued recall and recognition tests for targets. In cued recall tests, subjects received a random order of either cues or targets as probes for the other member of the cue-target pair. Similarly, in recognition tests, subjects received a random order of either cues or targets and an equal number of distractor items. Distractor items were from the stimulus materials used by Slamecka and Fevreiski (1983). Each recognition test item required subjects to make a yes/no choice regarding whether they had previously seen the item. Finally, subjects were thanked for their participation and debriefed.

Results

Table 1 contains the mean percentages of cues and targets remembered in free and cued recall tests and the mean d' scores for the recognition tests. Recognition d's were calculated from the percentage rates of hits and false alarms for each subject. Due to a correlation of variances with means, a square root transformation of the scores was performed for all the subsequent analyses of variance on free recall and cued recall dependent measures.

In general, the results showed a strong generation effect for targets, and a weaker generation effect for cues.

A two way repeated measures analysis of variance of the free recall data revealed a highly significant main effect for the read vs. generate factor, and a significant main effect for the cue vs. target factor, [$F(1,31)=31.66$, $p<.0001$, $F(1,31)=56.50$, $p<.0001$]. This indicates that that generated items were better remembered than read items and that targets were better remembered than cues. A significant interaction effect, indicated that the main effect for generation was smaller for cues than for targets [$F=17.02$, $p<.001$,]. An additional, one-way repeated measures analysis of variance on the free recall data for cues only confirmed that the generation

effect was obtained for cues [$F(1,31)=4.64$, $p<.05$].

A one way repeated measures analysis of variance of the cued recall data for cues failed to indicate a significant effect for the read vs. generate factor, [$F(1,14)=1.80$, $p>.20$]. However, a similar analysis for targets did indicate a significant effect, [$F(1,14)=17.74$, $p<.001$], thus evidencing a generation effect for targets.

One way repeated measures analysis of variance of the d's for recognition of cues revealed a marginal effect for read vs. generate, [$F(1,14)=4.33$, $p=.0562$], while a similar analysis on targets revealed a highly significant effect, [$F(1,14)=31.68$, $p<.0001$].

Conclusion

As expected, free recall, cued recall and recognition data confirmed a generation effect for targets. This finding is robust and replicates earlier research (Slamecka & Graf, 1978; Slamecka and Fevreiski, 1983).

Free recall and to a lesser extent recognition data also confirmed a generation effect for cues. However, this effect is weaker for cues than the generation effect for targets. Cued recall data followed a similar pattern but did not indicate a significant generation effect for cues.

These findings support the levels of processing approach as a viable interpretation of the generation effect. Results show that memory for cues does benefit from the additional cognitive processing required by the generation task. In conclusion, the generation effect does apply to cues as well as to responses, although the effect for cues is weaker. Finding the effect for cues is theoretically significant -- it establishes the viability of the depth-of-processing interpretation of the generation effect. Nevertheless, it is apparent that the effect for cues is much weaker than for targets, and this suggests that depth of processing cannot be the only process contributing to the generation effect.

REFERENCES

Bobrow, S. A. & Bower, G. H. (1969). Comprehension and recall of sentences. Journal of Experimental Psychology, 80, 455-461.

Cohen, J. (1977). Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press.

Craik, F. I. M. (1983). On the transfer of information from temporary to permanent memory. Phil. Trans. R. Soc. Lond., 302, 341-359.

Craik, F. I. M. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Craik, F. I. M. & Tulving, E. (1975). Depth of processing and the retention of word in episodic memory. Journal of Experimental Psychology: General, 104, 268-294.

Fisher, R. P. & Craik, F. I. M. (1977). Interaction between encoding and retrieval operations in cued recall. Journal of Experimental Psychology: Human Learning and Memory, 3, 701-711.

Gardiner, J. M. & Hampton, J. A. (1984). On the generality of the generation effect. Paper presented at the Midwest Psychological Association Convention, Chicago.

Green, D. M. & Swets, J. A. (1966). Signal Detection Theory and Psychophysics. New York: Wiley.

Greenwald, A. G. (1968). Cognitive learning, cognitive response to persuasion and attitude change. In A. G. Greenwald, T. C. Brock, & T. M. Ostrom (Eds.), Psychological Foundations of Attitudes. New York: Academic Press.

Greenwald, A. G. (1981). Self and memory. In G. H. Bower (Ed.), The Psychology of Learning and Motivation, (Vol. 15). New York: Academic Press.

Greenwald, A. G. (1983). Self and memory. Grant proposal presented to the National Science Foundation.

Greenwald, A. G. & Albert, R. D. (1968). Acceptance and recall of improvised arguments. Journal of Personality and Social Psychology, 8, 31-34.

Jacoby, L. L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. Journal of Verbal Learning and Verbal Behavior, 17, 649-667.

Jenkins, J. J. & Palermo, D. S. (1964). Word Association Norms. Minneapolis: University of Minnesota Press.

Kelso, J. A. S. & Wallace, S. A. (1978). Conscious mechanisms in movement. In G. E. Stelmach (Ed.), Information Processing in Motor Control and Learning. New York: Academic Press.

Konorski, J. (1967). Integrative Activity of the Brain. Chicago: University of Chicago Press.

Lee, T. D. & Gallagher, J. D. (1981). A parallel between the preselection effect in psychomotor memory and the generation effect in verbal memory. Journal of Experimental Psychology: Human Learning and Memory, 7, 77-78.

Martenuik, R. G. (1976). Information Processing in Motor Skills. New York: Holt.

McElroy, L. A. & Slamecka, N. J. (1982). Memorial consequences of generating nonwords: Implications for semantic-memory interpretations of the generation effect. Journal of Verbal Learning and Verbal Behavior, 21, 249-259.

McFarland, C. E. Jr., Frey, T. J. & Rhodes, D. D. (1980). Retrieval of internally versus externally generated words in episodic memory. Journal of Verbal Learning and Verbal Behavior, 19, 210-225.

Raaijmakers, J. G. W. & Shiffrin, R. M. (1981). Search of associative memory. Psychological Review, 88, 93-134.

Roy, E. A. & Diewert, G. L. (1975). Encoding of kinesthetic event information. Perception and Psychophysics, 17, 559-564.

Slamecka, N. J. & Fevreiski, J. (1983). The generation effect when generation fails. Journal of Verbal Learning and Verbal Behavior, 22, 153-163.

Slamecka, N. J. & Graf, P. (1978). The generation effect: Delineation of a phenomenon. Journal of Experimental Psychology: Human Learning and Memory, 4, 592-604.

Stelmach, G. E., Kelso, J. A. S. & Wallace, S. A. (1975). Preselection in short-term motor memory. Journal of Experimental Psychology: Human Learning and Memory, 1, 745-755.

Thorndike, E. L. (1932). The Fundamentals of Learning. New York: Teachers College.

Wickelgren, W. A. (1977). Learning and Memory. Englewood Cliffs: Prentice-Hall.

Wollen, K. A. (1968). Effects of relevant or irrelevant pictorial mediators upon forward and backward recall. Paper presented at the meeting of the Psychonomic Society, St. Louis.

Table 1: Mean Recall Percentages and Recognition d's (with variances in parentheses)

	Cues		Targets	
	Read	Generate	Read	Generate
Free Recall Percents n=32	2.86 (25.10)	5.99 (35.88)	9.11 (95.65)	24.22 (180.90)
Cued Recall Percents n=16	8.85 (106.09)	16.66 (185.23)	15.10 (214.92)	36.46 (535.92)
Recognition d' scores n=16	.976 (.491)	1.128 (.982)	1.491 (.711)	2.807 (.632)

(RELATIONSHIP RULE: Synonym)

GENERATE CONDITION

X SEC. rapid - f _ _ _ (CUE)
fast (TARGET)

READ CONDITION

X SEC. rapid - fast

Figure 1: Generation Task used by Slamecka and Graf, 1978

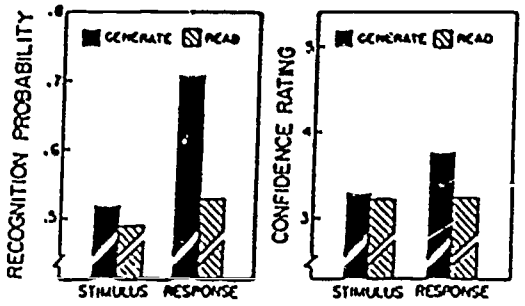

Figure 4. Mean recognition probabilities (left panel) and confidence ratings (right panel) for each condition and each type of test of Experiment 3.

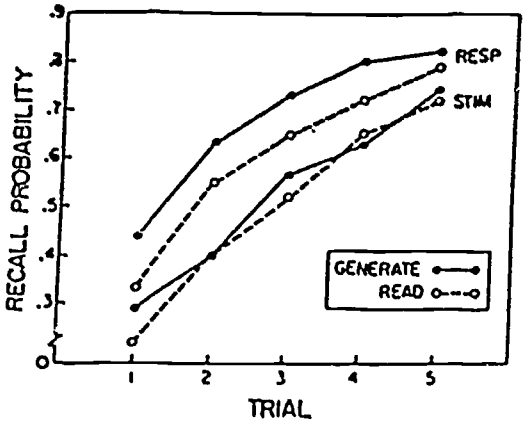

Figure 7. Mean cued-recall probabilities for each condition for each type of test of Experiment 5. (RESP = response; STIM = stimulus.)

Figure 2: Results of Experiments 3 and 5 from Slamecka and Graf, (1978) JEP: Human Learning & Memory, 4, 592-604.

GENERATE CONDITION

5 SEC. illusory - aut--ntic
3 SEC. authentic

READ CONDITION

5 SEC. meaningful - absurd
3 SEC. absurd

Figure 3: Experimental task