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Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 15(0)

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Publication Date
1993

Peer reviewed

Post-encoding Verbalization Impairs Transfer on Artificial Grammar Tasks

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Abstract

In a series of studies, Schooler and Engstler-Schooler (1990) showed that verbalization of previously encountered non-verbal stimuli can impair subsequent memory performance. The present study investigates the possibility that the verbal disruption of non-verbal processes, called verbal overshadowing, may be applied to implicit learning, i.e., where what is learned is difficult to verbalize. One frequently studied area of implicit learning is artificial grammars (e.g., Reber & Lewis, 1977). In the artificial grammar research, it has been shown that subjects can learn information about regularities in letter strings generated from a finite state grammar, as measured by transfer tests, while being unable to usefully state what those regularities are. The apparent disparity between subjects' competent performance on artificial grammar tasks and their inability to explain the rules of those tasks suggests the possibility that verbalization following memorization of artificial grammar strings may impair subjects' performance on a transfer task. In this study, subjects memorized a subset of grammatical letter strings, then half of them verbalized the rules they learned during memorization. The verbal subjects performed significantly worse than the no-verbal subjects on a transfer task, providing preliminary evidence that verbalization may impair transfer when the learned information is difficult to verbalize.

Introduction

In a series of studies, Schooler and his colleagues (Fallshore & Schooler, 1993; Schooler & Engstler-Schooler, 1990; Schooler, Ohlsson, & Brooks, in press) have shown that there are some situations where having subjects verbalize about what they are doing can impair their performance compared to subjects who do not verbalize. This phenomenon, called verbal overshadowing, has been shown to occur with faces (Schooler & Engstler-Schooler), taste (Wilson & Schooler, 1991), and problem solving (Schooler et al.). In the standard verbal overshadowing experiment (Schooler & Engstler-Schooler), subjects are shown a face and half of them verbally describe the face. All subjects are then shown an array of 6 to 8 faces and are asked to pick the original face from the array. The subjects who described the face are less likely to correctly recognize the face than are the subjects who did not describe the face.

Recent evidence suggests that verbal overshadowing may interact with the verbalizable and non-verbalizable processes that are differentially associated with perceptual expertise. In a study by Fallshore and Schooler (1993), White subjects were shown either own- or other-race faces and described or did not describe the faces. Verbalization disrupted own-race face recognition (standard verbal overshadowing effect) but had no effect on other-race face recognition. Fallshore and Schooler proposed that the disruption of face recognition may be due to an excessive emphasis on the featural information associated with verbalization (Wells & Hryciw, 1984; Wells & Turtle, 1987) and a de-emphasis on the non-verbal, holistic information typically associated with expert face recognition (Rhodes, Tan, Brake, & Taylor, 1989).

If verbalization does in fact cause subjects to emphasize less useful verbal information to the relative exclusion of more useful non-verbal information, then verbalization may also disrupt transfer of learning when the information to be learned is difficult to verbalize. One area where subjects learn about a difficult to verbalize system is artificial grammars. A series of studies by Reber and his colleagues (e.g., Reber, 1967; Reber, Kassin, Lewis, & Cantor, 1980; Reber & Lewis, 1977) has

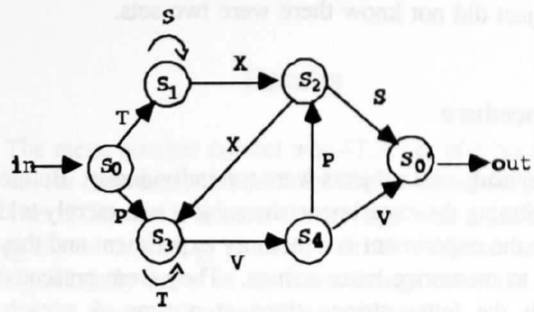

Figure 1. The finite state grammar used to create grammatical letter strings (from Reber & Lewis, 1977).

shown that subjects can successfully memorize letter strings created using a finite state grammar such as the one illustrated in Figure 1. Following memorization, subjects can also show learning as measured by transfer tasks, such as recognizing new strings as being grammatical or not, but when asked to explain what they learned, the level of their verbal explanation does not generally match the level of their transfer task performance. Therefore, while artificial grammar type tasks can be learned, it is difficult for subjects to verbalize exactly what they have learned. Furthermore, Reber argues that because of the difficulty of abstracting verbal rules from studying the grammar, then the grammar is best learned implicitly, i.e., without conscious effort to discover the rules during acquisition.

According to Reber, subjects are implicitly abstracting the rules of the grammar during memorization. By manipulating instruction set, i.e., giving subjects either explicit rule search instructions during memorization or implicit memorization instructions, it has often been shown that the explicit subjects take longer to memorize the strings and do more poorly on the transfer test than the implicit subjects providing some evidence for the claim that artificial grammars are best learned implicitly (see Reber, 1989, for a review). Other interpretations of *what* information subjects acquire during learning have been suggested (e.g., exemplars as in Brooks, 1978, and Wattenmaker, 1991). Nevertheless, most agree that the optimal learning method is implicit rather than explicit rule or exemplar search (although see Dulany, Carlson, & Dewey, 1984).

When subjects are given explicit instructions to search for rules, their search is likely to be in some verbal form. That is, explicit rule search is probably equivalent to having the subjects verbalize during memorization. However, previous studies examining the effects of learning instructions cannot directly address the issue of whether verbalization overshadows implicitly learned information because the explicit instructions are invariably provided prior to learning. Thus, from these studies, it is possible that the detrimental effect of explicit instructions simply reflected reduced attentional resources at the time of encoding. In order to determine whether verbalization may actually overshadow previously learned implicit information, it is necessary to examine the effects of verbalization after the implicit material has already been encoded. The present experiment attempted to expand verbal overshadowing to learning and a different domain, that of artificial grammars. Using Reber's artificial grammar paradigm (specifically, Reber & Lewis, 1977), subjects were instructed to memorize letter strings created using the artificial grammar depicted in Figure 1 (the standard implicit learning instructions). Letter strings were created beginning at the S_o node, following the arrows to the S_o' node. A subset of these "grammatical" letter strings was memorized by subjects. Following memorization, subjects either verbalized the rules they learned through memorization or not. All the subjects then performed a discrimination task, sorting new, never-before-seen letter strings based on whether or not they followed the same rules as the original strings. If verbalization overshadows previously encoded implicit information, then subjects in the verbalization condition should do worse on the discrimination task (i.e., get fewer correct) than the no-verbal subjects.

Method

Materials

Creation of letter strings. The grammar illustrated in Figure 1 was used to create the letter strings, yielding 43 strings with three to eight letters each. The strings created in this manner will be called "grammatical". Of the 43 strings, 15 were used for memorization training (same as Reber & Lewis) and 22 were used for the discrimination task (6 were randomly discarded, again to replicate Reber & Lewis). Table 1 shows the 37 letter strings used; those used in learning are marked with an *.

Table 1. Grammatical letter strings used in the present study (the ones marked with * were used in acquisition).

*PVV	TXXVPS	PTTTTVPS
*TXS	PTTTTVV	PTTVPXVV
PTVV	*PTTTVPS	*PTVPXTVV
PVPS	PTVPXVV	*PVPXTVPS
*TSXS	PVPXTVV	*TSSSSSXS
PTTVV	*PVPXVPS	TSSSXXVV
*PTVPS	TSSSSXS	TSSXXTVV
TSSXS	*TSSXXVV	TSXXTVPS
TXXVV	*TSXXVPS	TSXXTTVV
*PTTTVV	TSXXTVV	*TXXVPXVV
*PVPXVV	TXXTTVV	TXXTTVPS
*TSSSXS	TXXTVPS	TXXTTTVV
TSXXVV		

Table 2. Non-grammatical letter strings used for the discrimination test. The offending letter is underlined.

TPXS	TXXTVS	TSSSSXV
PTXVV	TVPXVPS	PTSXXVPS
PTVSS	PSXXTVV	TXPTTVPS
TTTVPS	PXPXTVV	TSXXPTVV
TPXXVV	PPTTVPS	TSSPSSXS
PTSVPS	TSSSPXS	PTTTTVXS
PTTVXS	PVPXTPS	PVPXTTVS
TSSPXS		

The non-grammatical strings were created by taking 22 grammatical strings and replacing one letter with a letter that would make the string non-grammatical. Table 2 shows the non-grammatical strings with the offending letter underlined.

Presentation. The letter strings were mounted on blank 3 x 5 cards. They were printed on a laser printer in bold type using a 36 point font. For the discrimination test strings, two identical sets were made so the subject would unknowingly see all the test strings two times in order to get a consistency-of-sort measure.

The cards were shuffled for each subject in order to randomize the order of presentation. For the 15 learning strings, the subjects learned the cards in five sets of three cards each. The cards were shuffled for each subject in such a way that there were never more than two cards per set of three with more than 6 letters and no more than two cards per set starting with the same letter. For the test cards, the two sets were shuffled separately in such a way that no more than three grammatical or three non-grammatical strings could occur in succession. All 88 of the test cards were handed to the subject in one stack so the subject did not know there were two sets.

Procedure

Learning. All subjects were run individually. Before beginning the experiment, the subject was merely told that the experiment is a memory experiment and they are to memorize letter strings. They were presented with the letter strings three at a time, 5 s each, following standard artificial grammar procedures. Immediately following presentation, the subject attempted to write the strings they saw from memory. The experimenter scored the subject's answers and told them which they got right (no other feedback was given). When the subject got all three right two times in a row, the experimenter moved on to the next set until all 15 strings were learned. The method of presentation and criterion for success was explained to the subject. There were two constraints on this procedure, not explained to the subjects. First, due to the frustrating nature of the task, if the subject did not succeed after 7 trials, the experimenter went on to the next set. If their first success was on a seventh trial, one more trial was administered to try to get two in a row correct. Second, any subject who failed to learn 4 or more sets was not used.

Verbalization. Following completion of learning, subjects either verbalized the rules they learned during memorization (verbal condition) or they verbalized rules of the sport of their choice (no-verbal condition) for 4 min. This was the first mention of the rules for the verbal subjects. No-verbal subjects had not been told about the rules at this point.

Discrimination test. After writing, no-verbal subjects were informed of the existence of the rules, but not about the nature of them. All subjects were presented with the full stack of test cards and were told that half follow the rules while half do not and that their task is to sort the cards according to whether they believe they follow the rules or not.

Subjects

A total of 27 introductory psychology students served as subjects in the experiment. Six were not used because they did not learn 4 or more of the sets of letter strings in the allotted trials, yielding 10 verbal and 11 no-verbal subjects. All subjects participated in the Fall 1992 term at the University of Pittsburgh and received credit toward their course for participating.

Results

The mean number correct was 47.7, out of a possible 88, for the verbal and 56.1 for the no-verbal subjects. The difference between the groups was significant ($t(19) = 2.509$, $p < .01$); verbal subjects sorted significantly fewer of the letter strings correctly than did the no-verbal subjects, as predicted.

Discussion

The basic hypothesis of this experiment was supported: Verbalization of rules impaired subjects' ability to correctly sort letter strings compared with subjects who did not verbalize the rules. It has been argued elsewhere (see Reber, 1989, for a review) that the rules that underlie artificial grammars are difficult to ascertain explicitly and that subjects learn better when they are not explicitly instructed to look for rules (e.g., Reber, 1976). In other words, the best method for learning the letter strings is implicit, as previously discussed. It should be noted, however, that while the present findings are consistent with previous observations of the advantage of implicit over explicit artificial grammar learning, they significantly extend this research. Specifically, previous studies have manipulated instructions at the time of encoding thereby potentially reducing the resources allocated to learning the actual letter strings. However, in the present case, the verbal manipulation occurred *following* encoding rather than *during* encoding, meaning that all subjects presumably had the same resources available for memorization; it was only after memorization that the task was changed. Thus, the present results indicate that verbalization may disrupt the access to already encoded implicit knowledge.

The present results also provide information about the generalizability of the verbal overshadowing effect. Heretofore, the verbal overshadowing paradigm has only been applied to areas of knowledge where subjects were assumed to already have some level of expertise (face recognition or decision making) or at least some a priori established skill (problem solving). The present results provide evidence that verbal overshadowing is not limited to tasks where subjects are using established skills. Rather, the results provide evidence that the verbal overshadowing effect may also subsume learning.

If future studies continue to confirm the hypothesis outlined in the present paper, it could have implications for future studies in cognitive psychology where verbal protocols are used and also in education where the trend in recent years has been to have students discuss in great detail what they are learning. While discussion is undoubtedly useful in many learning situations, it may be that there are areas where premature verbalization may impair learning as it does with artificial grammars. Future research will continue to explore these issues.

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Acknowledgements

The research reported in this paper was supported in part by an NIMH grant to the second author. We thank Dianne Asher for helping with the arduous task of running subjects, and Robert Ryan for his comments on this final copy.