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Reza Kormi-Nouri · Lars-Göran Nilsson · Lars Bäckman

The dual-conception view reexamined: attentional demands and the encoding of verbal and physical information in action events

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Abstract In two experiments the influence of attentional demands at encoding on recall of different features of subject-performed tasks (SPTs) was studied. In Experiment 1, memory of verbs and colors of objects was tested, with object names serving as cues. In Experiment 2, object and color memory were tested, with verbs serving as cues. Results from both experiments indicated that SPTs were affected by divided attention at encoding. In contrast to previous research, verbal and physical properties of SPTs were not differently affected by the requirements of dual-task performance (i.e., the combination of an SPT task and a secondary task). The results are discussed in terms of the nature of the secondary task.

Introduction

In several studies it has been demonstrated that verbal commands (e.g., break the match, fold your arms) are recalled better when they are encoded with enactment than without such enactment. This result is commonly referred to as the *SPT effect*, where SPT denotes subject-performed task (Cohen, 1981). Since this SPT effect was first demonstrated (Cohen, 1981; Engelkamp & Krumnacker, 1980), a considerable amount of research has been conducted to determine the reason for its origin.

On the basis of the notion that different laws might be responsible for learning and memory of action events and learning and memory of verbal events, Cohen (1981, 1983; Cohen & Stewart, 1982) proposed that memory of enacted events is nonstrategic, whereas memory of nonenacted events is strategic. Rehearsal, organization, and association are examples of strategies that affect memory of non-enacted verbal information. According to Cohen, such strategies are of little or no importance to SPT recall.

Bäckman and Nilsson (1984, 1985), in contrast to Cohen, suggested that the processing of SPTs may be nonstrategic in some respects and strategic in others. Bäckman, Nilsson, and Chalom (1986) proposed a dual conception of SPTs, assuming that the verbal component of SPTs is encoded with effort and strategies, whereas the physical components (e.g., color, weight) are acquired relatively automatically.

In two recent studies, Bäckman and colleagues (Bäckman, Nilsson, Herlitz, Nyberg & Stigsdotter, 1991; Bäckman, Nilsson, & Kormi Nouri, 1993) found support for the dual-conception view of SPT encoding. Subjects in these studies were tested on recall of the verbal features of SPTs (i.e., the imperatives) and recall of physical features of the objects involved (color and weight). SPTs were encoded under conditions of focused attention (FA) or divided attention (DA). Thus, the effect of the attentional manipulation was used as an index of the requirement of cognitive effort at encoding (e.g., Schneider, & Shiffrin, 1977; Shiffrin & Schneider, 1977). In agreement with the prediction, recall of physical features was found to suffer less than recall of the verbal component of SPTs under DA conditions. On the basis of these data, it was suggested that the encoding of verbal features of SPTs is attention-demanding and effortful, whereas physical features may be acquired with little effort and without deliberate encoding strategies.

The DA conditions in the studies of Bäckman and colleagues were accomplished by having subjects count backward at the time of encoding of the SPTs. The purpose of the present study was to explore whether the type of secondary task is responsible for the results obtained, or whether the dissociation holds equally well with another type of secondary task. It is possible that the backward-counting task used in the previous studies poses different demands on the encoding of verbal and physical features of SPTs. Specifically, it may be that the verbal nature of backward counting interferes more with the encoding of

R. Kormi-Nouri (✉) · L.-G. Nilsson
Department of Psychology, University of Umeå, S-901 87 Umeå, Sweden

L. Bäckman
Department of Psychology, University of Gothenburg, Sweden

verbal components than with the encoding of physical components. Thus, the finding of a larger drop in the DA condition for the verbal component of SPTs, may be due to the verbal character of the secondary task.

To test this possibility, the secondary task used in the present study was designed to involve both a verbal and a physical component, similar to the physical feature under scrutiny in the SPTs (color). Subjects learned SPTs under conditions of FA or DA. The secondary task was to have subjects count dots of a specific color presented briefly at the same time as the SPTs were performed, and to add up the number of these dots. Bäckman et al. (1993) examined the effects of intentionality on the recall of verbal and color features of SPTs. In line with some previous research (e.g., Cermak & Craik, 1979; Hyde & Jenkins, 1973), they found the same pattern for incidental and intentional learning. Thus, in the current study this manipulation was excluded; all subjects received intentional-learning instructions.

Experiment 1

Method

Design. The design was a 2 (type of attention: FA or DA) × 2 (type of recall: verbal or color). Both factors varied between subjects.

Subjects. Forty-eight subjects from the city of Umeå were randomly assigned to the two encoding conditions. Twenty-four subjects encoded the SPTs under conditions of FA and the same number of subjects encoded the SPTs under conditions of DA. In each encoding condition, half of the subjects were given verb recall and the other half color recall. Age ranges were: 16–36 (Mean = 22.42) for the FA-verb condition, 16–35 (Mean = 22.50) for the FA-color condition, 16–25 (Mean = 19.92) for the DA-verb condition, and 16–25 (Mean = 20.58) for the DA-color condition. The subjects were paid the equivalent of $ 10 (US) for participating in the experiment, which lasted approximately 20 min.

Materials. Two lists of 24 SPTs were used as the items to be remembered (TBR) (e.g., open the wallet, roll the candle, touch the flower, turn the comb, fold the napkin, drum with the hanger). The SPTs were selected so as to be nonorganizable with respect to the semantic category of the nouns in each imperative (cf. Bäckman et al., 1986), and each SPT required the presence of one object (e.g., wallet, candle, flower, comb, napkin, hanger). Twenty-four objects were randomly prepared in one of six different colors (blue, green, orange, black, white, and pink) with four objects in each color. No objects with prototypical colors (e.g., tomato, hockey puck, piece of chalk) were included in the lists. Six different action verbs (open, fold, roll, touch, drum, and turn) were used so that each verb was randomly associated with four objects. The reason for using two lists was to have different combinations of verbs, objects, and colors. All the items were counterbalanced in the lists, so that all the objects were used with different colors and action verbs. Each lists was presented to half of the subjects in each encoding condition.

Procedure. Each subject was tested individually. All subjects sat at a table facing a screen. The experimenter presented each SPT by instructing the subject what to do. For example, the experimenter presented a wallet with the instruction "open the wallet". The rate of presentation was 6 s and the interstimulus interval was 3 s. All subjects were instructed to remember as many verbs or colors of objects as possible for subsequent recall.

Table 1 Mean number of verbs and colors correctly recalled across encoding condition

	Type of recall	
Encoding condition	verb	color
Focused attention		
M	20.50	17.50
SD	2.15	3.15
Divided attention		
M	18.17	14.00
SD	2.29	5.27

Subjects assigned to the FA condition were asked to perform 24 short and simple tasks. Subjects assigned to the DA condition also received these instructions. However, the latter were also informed of a secondary task. In addition to remembering the verbal or color components of the SPT task, they were told to count the number of dots shown on an adjacent screen. The dots were shown on slides by means of a projector before the presentation of the TBR items. The dots were in two colors, red and black. The number of dots varied for each presentation (8–12 dots). The counting task consisted of estimating the number of red dots and consecutively adding the number of red dots in each presentation.

After the presentation of the last SPT, the subjects were given a 30-item vocabulary test. The main purpose of administering a vocabulary test was to eliminate the effects of short-term memory. Another reason for including the vocabulary test was to assess an important background factor that might influence memory performance for the sake of comparing subjects in the four different conditions. The mean scores for the vocabulary test were: 22.50 for the FA-verb condition, 23.75 for the FA-color condition, 23.25 for the DA-verb condition, and 21.17 for the DA-color condition. An ANOVA showed no differences in vocabulary among the subjects in the different conditions. Following the vocabulary test, all subjects were given a cued-recall test with the object names serving as cues to recall the verbs or the colors. Five minutes were allowed for the cued-recall test.

Results and discussion

A strict procedure of scoring recall of the verbal and color components of SPTs was adopted. That is, responses were accepted as correct only if they were exactly the same as in the study list. Table 1 shows verbal and color recall across encoding condition.

It can be seen from Table 1 that memory performance is higher in the FA than in the DA condition, and that verbal information is recalled better than color information. There seem to be no different effects of DA on verbal and color recall.

A 2 (List) × 2 (Type of Attention: FA/DA) × 2 (Type of Recall: verbal/color) ANOVA was performed. There was no effect involving List ($p > .70$); hence, the data were collapsed across this factor. The ANOVA revealed significant main effects of Type of Attention F (1,44) = 8.58, MS_e = 11.90, $p < .01$, and Type of Recall F (1,44) = 12.95, MS_e = 11.90, $p < .001$. The interaction between Type of Attention and Type of Recall was nonsignificant ($p > .50$).

The results of this study did not support the dual-conception view of SPT encoding (e.g., Bäckman et al., 1991; 1993). Their studies both revealed a larger drop in

Table 2 Mean number of objects and colors correctly recalled across encoding condition

Encoding condition	Type of recall	
	object	color
Focused attention		
M	15.83	8.67
SD	3.90	3.65
Divided attention		
M	13.33	5.67
SD	3.77	2.67

performance from FA to DA for verbal than for color memory; there was no such interaction in the present study. The verbal and color components of SPTs were affected to the same extent by increasing attentional demands. Like the study of Bäckman et al. (1993), memory performance was better for the verbal component than for the color component. Nor did the present data provide support for the nonstrategic view of SPTs advocated by Cohen (1981, 1983). Verbal and color features of SPTs were recalled worse under DA conditions than under FA conditions. These results indicate that encoding of both types of features may require cognitive effort.

Experiment 2

The main purpose of Experiment 2 was to replicate and extend the generality of the results from Experiment 1. In Experiment 2, the variables were the same as in Experiment 1, with one exception: here, memory of the colors of objects and that of the object names were assessed with the verbs serving as cues.

Method

Subjects. Another 48 subjects from the city of Umeå were randomly assigned to four conditions: FA object, FA color, DA object, and DA color. Age ranges were: 18–32 (Mean = 22.16) for the FA-object condition, 18–40 (Mean = 24.33) for the FA-color condition, 16–38 (Mean = 27.41) for the DA-object condition, and 21–34 (Mean = 25.41) for the DA-color condition. The mean scores for the 30-item vocabulary test were 24.58 for the FA-object condition, 25.75 for the FA-color condition, 25.58 for the DA-object condition, and 26.58 for the DA-color condition. An ANOVA on the vocabulary data showed no differences among the conditions. The subjects were paid the equivalent of $ 10 (US) for their participation. The experiment lasted approximately 20 min.

Materials. Two new lists of 24 SPTs were used as TBR items (e.g., lift the bullet, hide the napkin, hold the candle). Each SPT involved one unique action verb. Six different objects were used (bullet, napkin, candle, cube, paper-clip, washing brush). As in Experiment 1, no objects with prototypical colors were used. The objects were colored in one of six different colors (red, green, orange, black, white, and yellow). Each object could appear in four different colors and was associated with four action verbs. As in Experiment 1, the main reason for using two lists was to have different combinations of verbs, objects, and colors. Items were counterbalanced in the lists, so that all action verbs were used with different objects and colors. The items in each list were presented in different random orders and each list was presented to half of the subjects in each encoding condition.

Procedure. The procedure for the presentation of study lists and tests was identical to that used in Experiment 1, with two exceptions: here, half the subjects in the FA and DA conditions were instructed to remember the object names, whereas the other half were instructed to remember the color of the objects. Also, the 24 action verbs were used as cues in the recall tests, and the subjects were asked to write down as many object names or colors as possible. Again, all subjects were informed about the subsequent recall test.

Results and discussion

As in Experiment 1, a strict scoring criterion was adopted. The results of Experiment 2 are shown in Table 2.

As can be seen from Table 2, the pattern of results from Experiment 2 was similar to that obtained in Experiment 1. Object memory was considerably higher than color memory, and recall performance was higher in the FA than in the DA condition. Again, memory for verbs and colors were not differently affected by requirement of DA.

A 2 (List) × 2 (Type of Attention) × 2 (Type of Recall) ANOVA was conducted. Because there was no difference the two lists ($p > .60$), the data were collapsed across this variable. The ANOVA showed significant effects of Type of Attention, $F\ (1,44) = 7.26$, $MS_e = 12.49$, $p < .01$, and Type of Recall, $F\ (1,44) = 52.84$, $MS_e = 12.49$, $p < .001$. The interaction between these variables was not reliable ($p > .80$).

These results replicate and extend those of Experiment 1. Again, the results were not consistent with those reported by Bäckman et al. (1991; 1993), which revealed a larger drop for recall of objects than for recall of colors under DA conditions. Thus, the dual-conception view of SPT encoding was not supported by the present data. This study also revealed higher performance for recall of objects than for recall of colors.

General discussion

The dual-conception view of SPT encoding assumes that the acquisition of the verbal features of SPTs is attention-demanding and effortful, whereas the physical features of SPTs may be encoded with relatively little attention and effort. The purpose of the present study was to test this hypothesis, using a secondary task with two components: a verbal and a physical (color). If the present results are compared with those reported by Bäckman et al. (1991; 1993), it appears that the nature of the secondary task may play an important role in the evaluation of the dual-conception view of SPT encoding. In the previous studies, the secondary task (counting backwards) was verbal, and a larger drop for verbal than for physical features was found under DA conditions. In the current study, in which the

secondary task (counting and adding red dots) was both verbal and physical and, consequently, interfered with both verbal and physical components of SPTs, there was no such interaction effect. Hence, the type of secondary task may have been responsible for the results obtained in the previous studies. This indicates that the encoding of verbal and physical components of SPTs may not differ with respect to attentional demands. That is, SPTs are entirely attention-demanding and effortful.

The present study, like the Bäckman et al. (1993) study, revealed that verbal memory was better than color memory. One interpretation of this finding may be that the verbal component of SPTs contains more information than does the color of objects. Information about movement may provide the basis for a rich encoding of action verbs, whereas color information is not a rich encoding of the object component of SPTs. Furthermore, the difference between verbal and color memory was more in Experiment 2 than in Experiment 1. The difference between the two experiments is interpreted as being due to cue effectiveness. Object names served as cues in Experiment 1, whereas verbs served as cues in Experiment 2. There is research (Engelkamp, 1986; Epstein, Rock, & Zuckerman, 1960) that shows that nouns are more effective cues than verbs. In the present study, this was especially so for color memory.

The results of the present study and the studies of Bäckman et al. (1991; 1993) indicated that the nonstrategic view of SPTs by Cohen (1981, 1983) may not be accurate. SPT recall was significantly lower following DA than in FA conditions. This suggests that SPTs are entirely affected by attentional demands. If SPTs are encoded automatically and without any contribution from acquisition strategies, the SPT memory should not be affected by attentional demands. This was not the case in the present, or in previous, studies.

The findings of a dual-task effect on SPT memory with verbal features (Bäckman et al., 1991; 1993), and with both verbal and physical features (the present study) raise some questions as to the findings reported by Saltz and Donnenwerth-Nolan (1981) and Zimmer and Engelkamp (1985). They found selective-interference effects based on the nature of the secondary task. It was found that SPT memory can be affected by a motor-interference task, but not by a verbal- or a visual-interference task (Saltz & Donnenwerth-Nolan, 1981), and not by a kinematic-interference task (Zimmer & Engelkamp, 1985). The facilitation of enactment was interpreted as due to the storage of a motoric image, and not to visual imagery or verbal mediation.

A possible reason for these discrepant findings is that neither the study of Saltz and Donnenwerth-Nolan (1981) nor the study by Zimmer and Engelkamp (1985) used an appropriate control condition (i.e., a condition without any distractor task). Although Saltz and Donnenwerth-Nolan (1981) employed a baseline condition, using a neutral secondary task (deck of playing cards, which involved motor, visual, and verbal features), this is not a real control condition because it involves a secondary task (i.e., playing cards). Thus, the conclusion that verbal and visual secondary tasks have no effects on SPT memory cannot be drawn on the basis of these studies. The present study and the studies of Bäckman et al. (1991; 1993), on the other hand, compared FA conditions involving no distractor task with DA conditions involving a distractor task. Our data indicate that SPT memory can be affected by both verbal and visual secondary tasks. We agree with Saltz and Donnenwerth-Nolan (1981) and Zimmer and Engelkamp (1985) that SPT memory is affected by a motoric secondary task. In fact, these findings provide further support for the strategic nature of SPTs. However, the notion that SPT memory is not affected by a verbal or a visual secondary task may have been premature.

In summary, the results from the two experiments reported in this article suggest that the recall of SPTs is affected by attentional demands at encoding. Verbal and physical (color) components of SPTs were not differently affected under conditions of DA. The reason for this result, in comparison to previous data, may be that the secondary task in the current experiments was both verbal and physical. Previous research addressing the nature of SPT encoding has employed a secondary task with merely verbal features.

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