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The Role of Item-Specific Information for the Serial Position Curve in Free Recall

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The serial position curve in free recall of a list of action phrases differs depending on whether the phrases were memorized by listening/reading (verbal task; VT) or by additionally enacting the denoted actions (subject-performed task; SPT). In VTs there is a clear primacy effect and a short recency effect. In SPTs there is no primacy effect but an extended recency effect. H. D. Zimmer, T. Helstrup, and J. Engelkamp (2000) assumed that SPTs provide excellent item-specific information, which leads to an automatic pop-out of the items presented last. In the present study, the authors assumed that good item-specific encoding generally enhances the recency effect and that it hinders rehearsal processes and thereby reduces the primacy effect. This assumption was confirmed. An item-specific orienting task leads to parallel serial position curves in VTs and SPTs with no primacy effect but a clear recency effect. Moreover, the same serial position effects were shown with nouns as learning material. An item-specific orienting task changes the classical U-shaped serial position curve with verbal material and leads to the disappearance of the primacy and the enhancement of the recency effect.

Encoding action phrases such as "light the cigarette" or "iron the shirt" by reading or listening to them and by additionally performing the denoted actions (in subject-performed tasks [SPTs]) leads to better recall performance than only encoding the phrases verbally by reading or listening (in verbal tasks [VTs]; see Engelkamp, 1998; Nilsson, 2000; Zimmer, 2001, for overviews). This is a robust and powerful effect.

There is much agreement that the distinction between item-specific and relational information is very useful in explaining memory effects and particularly in explaining free-recall data (e.g., Hunt & McDaniel, 1993; Marshark, Richman, Yuille, & Hunt, 1987; McDaniel, Einstein, Dunay, & Cobb, 1986). *Item-specific information* refers to the information that is characteristic for each individual item. *Relational information* refers to interitem associations. Most authors explain the SPT effect by attributing it to better item-specific encoding in SPTs than in VTs (e.g., Engelkamp & Zimmer, 1997; Helstrup, 1987; Knopf, 1991; Kormi-Nouri, 1995; Saltz & Donnenwerth-Nolan, 1981).

In this study, we go beyond the SPT effect as a recall-level effect and take the serial position curve in free recall into account. We show that to explain the serial position curves of VTs and SPTs, one needs to consider both item-specific and relational encoding processes and their differential influence on retrieval strategies.

It is already known that the serial position curves differ in free recall for VTs and SPTs (Cohen, 1983), a finding that was replicated by Bäckman and Nilsson (1984, 1985; Zimmer, Helstrup, & Engelkamp, 2000). There were two essential changes in the shape of the usual serial position curves in SPTs. First, the typical primacy effect that occurs in VTs was not seen in SPTs. Cohen explained this lack of primacy effect by assuming that enactment goes along with encoding processes that are more automatic than in VTs. In line with the multistore model (e.g., Fischler, Rundus, & Atkinson, 1970; Rundus, 1971), the primacy effect was attributed to strategic rehearsal processes, which do not take place in SPTs. Therefore, no primacy effect occurs in SPTs.

Regarding the second change in the serial position curve through enactment, Cohen (1983) noticed that "SPT lists show a more extensive recency of more gradual slope" (p. 580). Still, this observation was not discussed in relation to the SPT effect until Zimmer et al. (2000). Zimmer et al. explained the serial position curve of SPTs by taking encoding as well as retrieval processes into account. SPTs lead to the encoding of excellent item-specific information and poor relational information. Because of the strong item-specific information, retrieval is dominated by an automatic pop-out that favors the terminal items of a list and leads to an extended recency effect, because "actions performed 'just a moment ago' provide memory entries that can be easily accessed for a short time. Each additionally encoded item reduces the distinctiveness of the previously encoded ones, and therefore the pop-out mechanism is most efficient in the recency part of a study list" (Zimmer et al., 2000, p. 668). Search-based retrieval processes that rely on relational information play a minor role in SPTs. In Zimmer et al.'s experiments, they focused on the question of whether the extended recency effect is based on an automatic pop-out. They considered the pop-out as being peculiar to SPT learning.

We agree to a large extent with the view on the serial position curve as suggested by Zimmer et al. (2000). In particular, we agree that to understand the serial position curve in free recall, one must take into account that item-specific as well as relational encoding

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processes take place during encoding and that these processes determine the retrieval strategies used during recall. This interplay allows us to predict the specific form of the serial position curve. However, we believe that the mechanism underlying the serial position curve of SPTs is less typical of SPTs, as Zimmer et al. assumed. We suggest that the predominance of a pop-out retrieval should be observed whenever item encoding focuses on item-specific information. Furthermore, we believe that Zimmer et al. considered the role of item-specific information too one-sided and that they paid too little attention to the role of relational information.

These are our detailed assumptions. Item-specific encoding should generally enhance the distinctiveness of the items of the list. If items are highly distinct because of rich item-specific encoding, this should trigger a distinctiveness-based retrieval, which in turn should lead to a recency effect.[1] On the other hand, relational encoding by which interitem associations are built up through rehearsal should induce a search-based retrieval that leads to a primacy effect. A distinctiveness-based retrieval should lead to a recency effect, because it is particularly efficient on the terminal list positions, and a search-based retrieval should be particularly efficient at the beginning of the list.

With regard to the recency effect, we assume, along with current models, that the last items of a list are particularly distinctive because of their most recent encoding. This is illustrated by a metaphor in which items presented at steady intervals stand for a series of regularly spaced telegraph poles (Baddeley, 1986; Crowder, 1976). The distinctiveness of the poles depends on both the distance of the poles from the end position (retention interval) and the distance between the poles (interpresentation interval). Through perspective, closer poles are more easily discerned because they appear larger and further away from their immediate neighbors. Distant poles, on the contrary, appear to be smaller and more accumulated (e.g., Bjork & Whitten, 1974; Glenberg et al., 1980; Neath, 1993; Rouder & Gomez, 2001; Tan & Ward, 2000). A distinctiveness-based retrieval strategy takes advantage of the greater distinctiveness of the items toward the end of the list. From this standpoint, distinctiveness is a function of the learning position and the interpresentation interval. We suggest that distinctiveness is not only a function of these two factors but that it is also due to good item-specific encoding induced by a corresponding task. Good position-independent, item-specific encoding of the items of the list should interact with the position-dependent distinctiveness and thereby enhance the usual recency effect. Thus, the extended recency effect in SPTs is the result of the generally better item-specific encoding relative to VTs.

The primacy effect is often attributed to active rehearsal during encoding (e.g., Glanzer & Cunitz, 1966; Rundus, 1971). A characteristic feature of this rehearsal strategy is that, by the nature of successive item presentations, the items presented first can be rehearsed more frequently and efficiently than items further down the list. The greater the number of items that are encoded, the more the time to rehearse has to be shared among these items. Hence, the relational encoding of the items further down the list is reduced. The more that the items of the list are relationally encoded, the more probable a search-based retrieval is. The first items benefit more than later items from this retrieval strategy. The fact that the rehearsal for the items at the top of the list is particularly good thus forms the basis for the primacy effect.

We assume that SPT learning focuses on item-specific encoding and hinders relational encoding because the enactment of denoted actions forces participants to cement the individual action concepts and to focus their attention on it to guarantee a smooth performance (Engelkamp, 1995). Because, by doing so, the enactment enhances the encoding of item-specific information, which particularly strengthens the distinctiveness of the last items, the recency effect should be pronounced in SPTs. However, this good item-specific encoding has its price. It reduces relational encoding (e.g., Engelkamp, 1986; Engelkamp & Seiler, 2003; Olofsson, 1997) and thereby the efficiency of search processes in recall. This reduction is reflected particularly in the recall of the first items, which do not show a primacy effect any longer.

In contrast with VT learning, we assume that, in lists of unrelated items under standard instructions, participants encode the items relationally and item-specifically in a balanced manner. Consequently, participants use both types of information during recall. Relational information enables the search for items. We assume, consistently with others, that relational encoding is particularly efficient for the first few items and that this leads to a particularly efficient search for these items that is reflected in the primacy effect. At the same time, participants encode item-specific information that triggers the distinctiveness-based retrieval. This retrieval mechanism is assumed to be especially efficient for the last items of a list because these are additionally distinctive due to their positions at the end of the list (e.g., Glenberg et al., 1980). This more balanced encoding and retrieval of both types of information leads to the typical U-shaped serial position curve with a recency and a primacy effect.

The greatest difference between our view and Zimmer et al.'s (2000) is that we find they go too far with their assumption that good item-specific encoding and pop-out retrieval are peculiar to SPT learning. In their experiments, Zimmer et al. focused the question of whether the extended recency effect of SPTs is indeed based on an automatic pop-out. They paid little attention to the question of whether item-specific and relational information could also vary because of other manipulations and with other material and whether such manipulations would change the serial position curves, as SPT learning does. It was our goal in the present study to manipulate item-specific information and explore its effect on the serial position curve.

To summarize, we assume, first, that in VT learning both types of encoding are balanced and both retrieval strategies are applied. Therefore the typical U-shaped serial position curve with a primacy and a recency effect can be observed.

Second, we assume that in SPT learning, in which item-specific encoding is favored and relational encoding is hindered, both types of encoding are unbalanced. This imbalance leads to the predominance of a type of retrieval that is based on distinctiveness over one that is based on search, which goes along with an enhanced recency effect and a disappearance of the primacy effect.

Third, we predict that the same effects that follow from focusing item-specific encoding by enactment will also be observed by other means of strengthening item-specific encoding with other

[1] We prefer to speak of distinctiveness-based retrieval instead of pop-out retrieval to leave the question open whether this retrieval is automatic or strategic.

learning materials. Each task that directs the attention of the participants on the encoding of single items should enhance item-specific information. At the same time it should hinder relational encoding. As a consequence, the distinctiveness-based retrieval of the last items should be enhanced by such a task and the search-based retrieval of the first items should be impaired compared with a verbal standard condition. The last presumption is corroborated by a study by Sharps, Price, and Bence (1996) in which they showed that rich item-specific information (e.g., through imagery instruction) eradicates the primacy effect.

Overview of the Experiments

We designed the experiments of the present study to test the above predictions. In the first experiment we demonstrate the basic interaction of the type of encoding (VT, SPT) and the serial position curve. The aim of the second experiment is to show that this interaction effect disappears if an explicit instruction to focus on item-specific encoding is given. A comparison between Experiments 1 and 2 should show that the explicit item-specific instruction does not change the serial position curve for SPTs, but it does change it for VTs. Under item-specific instructions in VTs as well as in SPTs, not a primacy effect but a clear recency effect should appear.

If item-specific encoding instructions reduce interitem relational encoding, abolish the primacy effect, and enhance the recency effect in VTs, congruent effects should be observed with this instruction if verbal material other than action phrases is used.

Therefore, in Experiment 3 we tested memory for a list of concrete nouns under standard learning instructions as well as under an item-specific orienting task. We expected the serial position curves in free recall to differ as a function of the type of encoding task.

Analyses of Serial Position Curves

In the present experiments, lists of 24 action phrases and 30 nouns were used. To analyze the serial position curves, three learning positions were summed up into 1 triplet, so that each curve consisted of 8 triplets in the lists of action phrases and 10 triplets in the lists of nouns.

The calculation of analyses of variance (ANOVAs) for the complete serial position curves allowed us to judge whether two curves were parallel.[2] To estimate the extent of primacy and recency effects, the following procedure was used. For all serial position curves, the level of the asymptote in the middle of the list was ascertained by calculating the mean of Positions 4–18 (Triplets 2–5) in Experiments 1 and 2 and 4–21 (Triplets 2–7) in Experiment 3, respectively. In general, primacy effects are limited to the first few positions. Testing the first triplet should therefore be sufficient to obtain the primacy effect. Concerning the terminal positions of the curve, we expected an extended recency effect in SPT that, according to the literature, should not affect more than 9 positions for a study list of 24 or 30 items. Therefore, we tested the last 3 triplets to ascertain the different expansions of the recency effects under different encoding conditions.

To detect significant differences between primacy and recency positions compared with the asymptotic level, the first and last three triplets were compared with the mean of the middle positions, with t tests for dependent measurements. With this procedure, four t tests were calculated for each single serial position curve. Because this could lead to an accumulation of the Type I error, we carried out an adjustment of α mistake to avoid an overestimation of significant differences. According to Bonferroni (Bortz, 1993, p. 249) the new level of significance was fixed at $p = .0125$.

Experiment 1

In Experiment 1 we compared two encoding conditions. The participants learned the lists of action phrases either verbally (i.e., VT) or by mimicking the denoted actions without using real objects (i.e., SPT).

The purpose of Experiment 1 was to replicate the basic finding of an interaction of the serial position curves for VTs and SPTs with a list length of 24 items. First, there should be an SPT effect. Free recall after learning in SPTs should be greater than after learning in VTs. Second, SPTs should lead to a different serial position curve than VTs (e.g., Bäckman & Nilsson, 1985; Cohen, 1983; Zimmer et al., 2000). According to earlier findings in VTs, we should find a U-shaped serial position curve with a primacy and a recency effect. On the contrary, in SPTs the primacy effect should disappear, whereas the recency effect should be extended and reach further into the middle of the list.

Method

Participants. Twenty-four students of the University of the Saarland took part in the experiment. German was their native language. The students were tested individually and paid 8 Euro for participating.

Material. The encoding material consisted of four lists each with 24 unrelated action phrases. The phrases described well-known everyday actions. Each phrase consisted of a verb, an article, and a noun, such as "light a candle" or "water the flowers." No object or verb appeared more than once during the experiment.

The learning positions of the action phrases were varied within each list by dividing all phrases into groups of three and presenting each triplet once in each segment of the list. The result was eight different orders of each list. This procedure guaranteed that the participants as a whole were presented each single item in each triplet of learning positions with the same frequency.

Procedure. The participants were informed that they were taking part in an experiment about action memory in which they had to learn four lists of action phrases with succeeding memory tests. Subsequently, they were presented four lists with 24 action phrases each. Participants had to learn two lists by attentive reading (VT). They learned the other two lists by reading the phrase and performing the denoted action with imaginary objects (SPT) afterward. To be able to control the effects of the sequence of the encoding condition, half of the participants learned two lists in VTs first and the others in SPTs. For the other half of the participants, the order was reversed. During the encoding phase, the phrases were presented on a computer screen for 4 s with an interstimulus interval of 1.5 s. Each learning list was followed by an oral free recall that was recorded by a tape recorder.

[2] The ANOVAs were calculated with serial positions merged into triplets. Carrying out the same analysis with single-item positions yielded the same main effects and interactions in all experiments.

Results

A previous analysis had shown that there were no effects of repeated testing and the sequence of the encoding condition. Furthermore, these factors did not interact with the encoding condition and the serial positions, and so the data of both repeated measures and both encoding sequences were collapsed.

A 2 × 8 ANOVA with the factors encoding condition (VT, SPT) and learning position (Triplets 1–8), which were both measured within subjects, showed an effect of the encoding condition, $F(1, 23) = 10.39$, $MSE = 0.0341$, $p < .001$. Recall was better for SPTs ($M = 0.42$, $SD = 0.09$) than for VTs ($M = 0.36$, $SD = 0.10$). The factor-learning position was also significant, $F(7, 161) = 8.47$, $MSE = 0.0405$, $p < .001$. Memory performance for the items in the middle of the list was lower than for the first and the last positions. Furthermore, there was an interaction between the encoding condition and the learning position, $F(7, 161) = 7.09$, $MSE = 0.0414$, $p < .001$. As can be seen in Figure 1, a classical U-shaped curve appeared in VTs. On the one hand, there was a clear primacy effect for the first triplet, $t(23) = 5.75$, $p < .0125$.[3] On the other hand, there was a short recency effect for the last triplet, $t(23) = 2.44$, $p < .0125$. The sixth and seventh triplets were not significant, $t(23) = 0.82$, $p > .0125$, and $t(23) = 0.19$, $p > .0125$, respectively. Therefore, the recency effect in VTs was not strongly pronounced. On the contrary, in SPTs there was no primacy effect, $t(23) = -0.03$, $p > .0125$, but there was an extended recency effect for the last two triplets, $t(23) = 3.88$, $p < .0125$, and $t(23) = 8.67$, $p < .0125$, respectively.

An additional analysis in which the extension of the primacy and recency effects were compared directly between the encoding conditions confirmed the different effects in serial position curves in VTs and SPTs. For this comparison, first, the differences between the recall level of the first triplet and that of the middle positions (Triplets 2–5) were calculated, as well as the differences between the recall level of each of the last three triplets and that of the middle positions. These differences, which are presented in Table 1, reflect the extent of primacy and recency effects within a serial position curve.

Second, a 2 × 4 ANOVA was calculated with the factor-encoding condition (VT vs. SPT) and the difference values for the four border positions (triplets: 1, 6, 7, 8). A significant interaction was observed, $F(3, 69) = 16.56$, $MSE = 0.0359$, $p < .001$. To localize the interaction, the differences between the values of the four border positions were compared between VTs and SPTs in t tests. There was a greater difference between the first triplet and middle positions in VTs compared with SPT, $t(23) = 3.90$, $p < .001$, and the differences between the recency and the middle positions were greater in SPTs than in VTs for the last two triplets, $t(23) = -2.06$, $p < .05$, and $t(23) = -3.14$, $p < .01$, respectively. This finding reconfirms the observation that both encoding conditions go along with qualitatively different serial position curves.

Discussion

The data confirmed our expectations. We replicated the well-established SPT effect. Free recall of SPTs was significantly greater than that of VTs. Furthermore, we replicated the basic interaction between the two serial position curves in VTs and in SPTs. In VTs, a primacy and a short and weak recency effect emerged, whereas in SPTs an extended recency without a primacy effect developed (e.g., Zimmer et al., 2000).

Experiment 2

In Experiment 2 we tested whether the serial position curve of VTs becomes similar to that of SPTs if item-specific encoding is increased by a corresponding orienting task. To enhance the item-specific encoding in Experiment 2, the participants were requested to judge the pleasantness of each single action during the encoding phase. A pleasantness rating procedure was used that is frequently used in orienting tasks to focus on item-specific information (e.g., Burns & Schoff, 1999; Hunt & Einstein, 1981; Klein, Loftus, Kihlstrom, & Aseron, 1989).

In SPTs, rich item-specific information is assumed to be encoded through enactment. Therefore, a corresponding instruction should not change encoding and retrieval strategies. In SPTs, the results should be exactly the same as in Experiment 1. Under standard conditions in VTs, however, item-specific encoding is assumed to play a smaller role. Therefore, pleasantness ratings should strengthen item-specific processes and attenuate relational encoding processes. Encoding and retrieval processes in VTs should approximate to SPT processes, and the participants should then show similar serial position curves in both encoding conditions. Pleasantness rating should lead to an enhanced recency effect in VTs. Furthermore, the primacy effect should disappear. On the whole, the two serial position curves in VTs and in SPTs should be parallel.

Method

Participants. Twenty-four students of the University of the Saarland, with German as their native language, took part in the experiment. They were tested individually and paid 8 Euro for participating.

Material. The material was identical to that in Experiment 1.

Procedure. The procedure of Experiment 2 corresponds to that of Experiment 1. In addition to the standard instruction, the participants were requested to judge the pleasantness of each single action on a scale from 1 (*unpleasant action*) to 5 (*pleasant action*) during the encoding phase both in VTs and in SPTs. The participants were asked to make a quick decision and the experimenter noted the answer. In SPTs, the rating followed the enactment.

Results

Once again, the repeated testing and the sequence of encoding condition had no effect on the recall, which is why the data were collapsed. Figure 2 shows the serial position curves for the two encoding conditions VT and SPT. To compare the two serial position curves in VTs and in SPTs, a 2 × 8 ANOVA was calculated with the factors-encoding condition (VT, SPT) and learning position (Triplets 1–8), both measured within subjects. There was an enactment effect, $F(1, 23) = 7.96$, $MSE = 0.0285$, $p < .01$. Recall was better for SPTs ($M = 0.34$, $SD = 0.09$) than for VTs ($M = 0.29$, $SD = 0.09$). Furthermore, the factor-learning position was highly significant, $F(7, 161) = 15.45$, $MSE = 0.0359$, $p < .001$, showing that the recall for the last items was better than

[3] Here, as in all further cases, we have used one-tailed t tests because we expected specific primacy and recency effects in all cases.

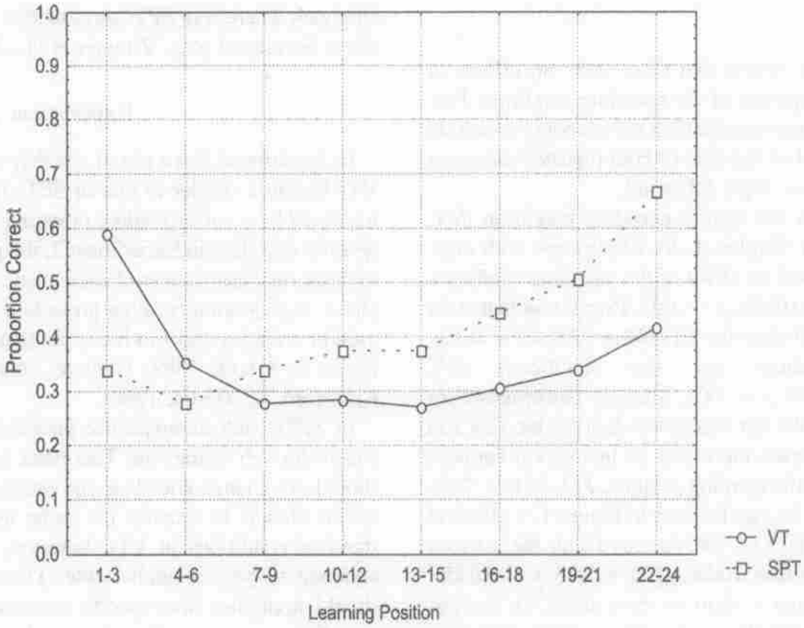

Figure 1. Serial position curves of Experiment 1 for standard verbal tasks (VTs) and standard subject-performed tasks (SPTs).

for items at the beginning or in the middle of the list. Most important, there was no interaction between the encoding condition and the learning position, $F(7, 161) = 1.34$, $MSE = 0.0284$, $p > .05$. Thus, the two serial position curves in VTs and in SPTs were parallel.

To reconfirm this lack of interaction, an additional analysis was carried out by calculating the differences between the border and the middle positions for VTs and SPTs (presented in Table 2) and then comparing the differences by a 2 (encoding condition) × 4 (difference between Triplets 1, 6, 7, and 8 and middle positions) ANOVA (see Experiment 1). No interaction was found, $F(3, 69) = 2.28$, $MSE = 0.0273$, $p > .05$, which means that there were neither deviations in the values of differences between the first triplet and the middle positions between VT and SPT, $t(23) = 1.33$, $p > .05$, nor were there deviations between the recency and the middle positions, $t(23) = 0.47$, $p > .05$; $t(23) = -1.54$, $p > .05$; and $t(23) = -1.00$, $p > .05$, respectively. This supports the conclusion that the two serial position curves do not differ.

With regard to the single effects of the serial position curves, there was no primacy effect in SPTs, $t(23) = -1.84$, $p > .0125$, but an extended recency effect was found on the last two triplets, $t(23) = 4.27$, $p < .0125$, and $t(23) = 6.48$, $p < .0125$, respectively. This curve had the same shape as in the standard condition in Experiment 1, which can be demonstrated in a 2 (experiment: 1, 2) × 8 (learning position: Triplets 1–8) ANOVA that includes SPT encoding only. There was no interaction between the experiment and the learning position, $F(7, 322) = 0.49$, $MSE = 0.0344$, $p > .05$, which shows that the pleasantness rating did not change the shape of the serial position curve in SPTs, although the recall level was higher in Experiment 1 than in Experiment 2 ($M = 0.42$, $SD = 0.09$ vs. $M = 0.34$, $SD = 0.09$; $F[1, 46] = 8.74$, $MSE = 0.0686$, $p < .01$).

In VTs, the serial position curve changed, showing the same pattern as in SPTs. No primacy effect appeared, $t(23) = 0.29$, $p > .0125$, but there was a clear recency effect on Triplets 8 and 6, $t(23) = 5.14$, $p < .0125$, and $t(23) = 2.52$, $p < .0125$, whereby the Triplet 7 just missed the level of significance, $t(23) = 2.03$, $p =$

Table 1
Mean Differences and Standard Deviations Between the First Triplet (1) and the Middle Positions and Between the Last Three Triplets (6, 7, 8) and the Middle Positions of Experiment 1 for Standard Verbal Tasks (VTs) and Standard Subject-Performed Tasks (SPTs)

	Triplet 1–mid		Triplet 6–mid		Triplet 7–mid		Triplet 8–mid	
Task	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
VT	0.29	0.25	0.01	0.23	0.04	0.26	0.12	0.24
SPT	−0.002	0.25	0.10	0.22	0.16	0.21	0.32	0.18

Note. mid = middle positions.

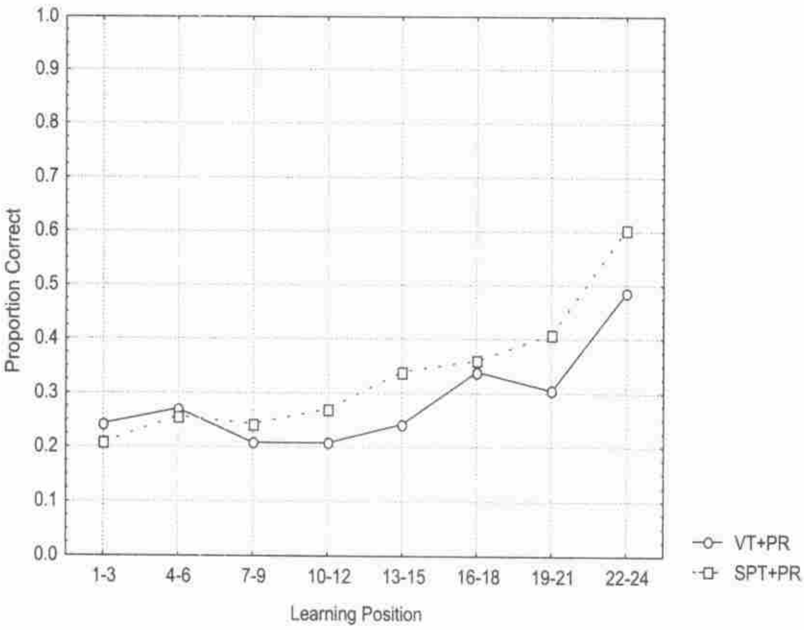

Figure 2. Serial position curves of Experiment 2 for standard verbal tasks (VTs) and subject-performed tasks (SPTs) in combination with pleasantness ratings (PR).

.05. Compared with the standard condition in Experiment 1, the recency effect was strengthened. This conclusion was confirmed by comparing the two serial position curves in VTs between Experiment 1 and Experiment 2 using a 2 (experiment: 1, 2) × 8 (learning position: Triplets 1–8) ANOVA. The interaction between the experiment and the learning position was significant, $F(7, 322) = 4.90$, $MSE = 0.0387$, $p < .001$. This finding shows that the pleasantness rating in Experiment 2 changed the shape of the serial position curve in VTs compared with the standard condition in Experiment 1. The interaction occurred because the primacy effect in the standard condition in Experiment 1 disappeared through the pleasantness rating in Experiment 2, whereas the recency effect was enhanced. Again, the level of recall was lower in Experiment 2 ($M = 0.29$, $SD = 0.09$) than in Experiment 1 ($M = 0.36$, $SD = 0.10$), $F(1, 46) = 6.06$, $MSE = 0.0708$, $p < .05$.

Because the interaction between standard VT (Experiment 1) and VT with an item-specific instruction (Experiment 2) is a theoretically important finding, we replicated it in an additional experiment. The material and the procedure were the same as in Experiments 1 and 2. Only the tasks were modified. We tested 24 participants in VTs under standard instructions and 24 participants in VTs with pleasantness ratings in two independent groups. In this experiment, too, the type of encoding interacted with the form of the serial position curve, $F(7, 322) = 2.86$, $MSE = 0.0377$, $p < .01$. Again, this interaction was due to a primacy effect on the first triplet, $t(23) = 4.28$, $p < .0125$, and a short recency effect on the last triplet, $t(23) = 2.88$, $p < .0125$, in VTs under standard instructions, whereas in the learning condition with item-specific encoding instructions, there was no longer a primacy effect, $t(23) = 2.49$, $p > .0125$, and the recency effect was reinforced and was significant in the last two triplets, $t(23) = 2.72$, $p < .0125$, and $t(23) = 5.56$, $p < .0125$. The different shapes of serial position curves in the standard and item-specific encoding were also confirmed by analyzing the differences between the border and the middle positions, which showed a significant interaction between the encoding condition and the primacy and recency position, $F(3, 138) = 3.59$, $MSE = 0.0401$, $p < .05$.

Table 2
Mean Differences and Standard Deviations Between the First Triplet (1) and the Middle Positions and Between the Last Three Triplets (6, 7, 8) and the Middle Positions of Experiment 2 for Standard Verbal Tasks (VTs) and Standard Subject-Performed Tasks (SPTs) in Combination With Pleasantness Rating (PR)

	Triplet 1–mid		Triplet 6–mid		Triplet 7–mid		Triplet 8–mid	
SPT + PR	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
VT + PR	0.01	0.18	0.11	0.21	0.07	0.18	0.25	0.24
SPT + PR	−0.10	0.18	0.08	0.20	0.13	0.15	0.33	0.25

Note. mid = middle positions.

Discussion

The pleasantness rating, which was assumed to enhance the item-specific encoding, has been shown not to change the serial position curve in SPTs. The same pattern in the serial position curve was observed as in Experiment 1. This finding was expected because SPTs, by nature, provide an excellent item-specific encoding that can hardly be enhanced (e.g., Nilsson & Cohen, 1988).

On the contrary, the pleasantness rating led to a significantly altered pattern of the serial position curve in VTs. As expected, there was a lack of primacy effect, and an enhanced recency effect appeared. VTs in standard conditions do not naturally focus on item-specific encoding. Performing the pleasantness rating enhances item-specific encoding and attenuates the relational encoding. Encoding and retrieval processes and, consequently, the pattern of the serial position curve resembled that of SPTs even though the recency effect was somewhat more restricted in VTs than in SPTs. In fact, the two serial position curves in VTs and in SPTs did not show an interaction after carrying out the pleasantness rating. Thus, a pleasantness rating that enhances item-specific encoding changed the pattern of the serial position curve in VTs, making it similar to the SPT encoding.

The finding of Experiment 2 that there was no longer a primacy effect in VTs, but an enhanced recency effect, is in agreement with the assumption that pleasantness ratings induce the item-specific and hinder the relational encoding in VTs. On the other hand, the finding that VTs and SPTs showed the same serial position curves in Experiment 2 is not compatible with the assumption that a solid item-specific encoding that triggers the pop-out strategy is peculiar to enactment (Zimmer et al., 2000). Rather, it seems that any kind of increase in item-specific information will strengthen the memory traces of individual items and reduce interitem associations, thereby abolishing the primacy and enhancing the recency effect, even if not to the same degree as enactment.

However, there seems to be something peculiar to the item-specific information generated by enactment (as assumed by Zimmer et al., 2000). This assumption is not only supported by the more extended recency effect in SPTs than in VTs with pleasantness ratings; it is also supported by the finding that, in spite of the parallel serial position curves in Experiment 2, there was still a clear-cut SPT effect. This effect should be observed if pleasantness ratings increase item-specific information in VTs and if this item-specific information is less efficient than the item-specific information provided by enactment. The assumption that the item-specific information provided by enactment is extremely efficient and can hardly be increased has occasionally been suggested (e.g., Nilsson & Cohen, 1988). This assumption is in agreement with the observation that it is hardly possible to increase the recall level of SPTs by generation or elaboration instructions (e.g., Cohen, 1983; Helstrup, 1987; Lichty, Bressie, & Krell, 1988; Nilsson & Cohen, 1988). In Experiments 1 and 2, the findings have supported our expectations.

Yet, there was one unexpected finding. Recall performance in Experiment 1 was better than in Experiment 2 after VTs as well as after SPTs. This finding is somewhat surprising because pleasantness rating is considered to enhance item-specific encoding and recall. In the literature, pleasantness rating was either used in the context of the level-of-processing approach (e.g., Tharpar & Greene, 1994; Zimmer & Engelkamp, 1999) or it emerged in the discussion about item-specific and relational information in free recall, and pleasantness rating as an item-specific encoding task was compared with a relational encoding task, such as sorting out categories in the context of strongly related and weakly related items of the list (e.g., Burns, 1993; Hunt & Einstein, 1981). A direct comparison of recall levels between standard condition and pleasantness rating was not possible. However, the findings from the later studies consistently showed that free-recall performance was poorest if pleasantness ratings were applied with lists of weakly related items (Burns, 1993; Hunt & Einstein, 1981; Klein et al., 1989; McDaniel, Moore, & Whiteman, 1998). This finding fits with the assumption that the recall of verbal material is dependent on both item-specific and relational information. Lists of weakly related items primarily trigger item-specific encoding and provide little relational encoding. If an item-specific encoding instruction such as pleasantness rating is combined with such lists, item-specific encoding is further increased and relational encoding further decreased. For the recall of a VT, these effects denote that the negative effect of poor relational encoding outweighs the positive effect of good item-specific encoding by a pleasantness rating so that a recall decline compared with a verbal standard task may be the result.

In our opinion, there must be a different reason for the recall decline of SPTs. We assume that, in this case, the pleasantness rating functioned more like an interference task. It somewhat reduced the quality of encoding by enactment. The strong item-specific encoding by enactment might thus be reduced slightly by the rating task, and this reduction might reduce the recall level compared with the standard SPT condition.

Experiment 3

In Experiment 3 we replicated the important finding that the serial position curve of a standard verbal learning task is changed if an explicit item-specific encoding instruction is given with a different type of material. In addition, we also retested whether the pleasantness rating had a negative effect on recall performance. To this end, participants either learned lists of 30 nouns under standard verbal instructions or they had to judge the pleasantness of the objects denoted by the nouns.

Method

Participants. Twenty students of the University of the Saarland took part in the experiment. German was their native language. All participants were tested individually and paid 8 Euro.

Material. The encoding material consisted of four lists with 30 unrelated nouns each. To construct these lists, the nouns were taken from the action phrases of Experiments 1 and 2 and 6 additional nouns were added to each list.

As in the previous experiments, the learning positions of the nouns within each list were altered by dividing the nouns into groups of three and presenting each triplet once in each segment of the list, thereby creating 10 different orders for each list.

Procedure. The procedure of Experiment 3 corresponded to that of the previous experiments. Participants learned four lists with 30 nouns successively. They had to learn two of the lists by attentive reading (VT) and two by also judging the pleasantness of each single noun, similar to Experiment 2 (VT + PR). Half of the participants learned two lists by reading first and then learned two lists by rating the pleasantness. The order was reversed for the other half of the participants. During the encoding phase, the nouns were presented on a computer screen for 2.5 s with an interstimulus interval of 0.5 s. Each learning list was followed by an oral free recall.

Results

There were neither effects of repeated testing nor of the sequence of the encoding condition. Therefore, the data of both repeated measures and of both encoding sequences were collapsed.

An ANOVA with the two factors encoding instruction (without vs. with pleasantness rating) and learning position (Triplets 1–10) yielded a significant effect of the encoding instruction, $F(1, 19) = 13.98$, $MSE = 0.0727$, $p < .01$. Free recall was better for VTs ($M = 0.50$, $SD = 0.14$) than for VTs combined with pleasantness ratings ($M = 0.39$, $SD = 0.08$). The factor learning position was highly significant, $F(9, 107) = 5.21$, $MSE = 0.2201$, $p < .001$. Most important, both factors interacted, $F(9, 107) = 2.99$, $MSE = 0.1072$, $p < .01$. The serial position curves are shown in Figure 3.

The item-specific encoding instruction changed the serial position curve of VT. The serial position curve under the standard VT condition showed a strong primacy effect, $t(19) = 6.02$, $p < .0125$. No recency effect was observed: Last triplet, $t(19) = 1.66$, $p > .0125$. Under the item-specific encoding instruction, there was no longer a primacy effect, $t(19) = 2.10$, $p > .0125$. The recency effect was reinforced and was significant in the last triplet, $t(19) = 4.68$, $p < .0125$.

The different shapes of serial position curves between standard verbal learning and verbal learning combined with pleasantness ratings were supported by an additional analysis. As before (see Experiment 1), the differences between the border and the middle positions were calculated for both encoding conditions (presented in Table 3) and compared by a 2 (encoding condition) × 4 (differences between Triplets 1, 8, 9, and 10 and middle positions) ANOVA. There was a highly significant interaction, $F(3, 57) = 5.28$, $MSE = 0.0446$, $p < .01$, which, on the one hand, was caused by the greater difference between the first triplet and the middle positions in VT than in VT combined with pleasantness ratings, $t(19) = 3.52$, $p < .001$, and, on the other hand, was caused by the greater difference between the recency and the middle positions in VT combined with pleasantness ratings compared with standard verbal learning, which was significant for the last triplet, $t(19) = -1.78$, $p < .05$.

Discussion

The data confirmed our expectations. There was an interaction between the serial position curve of standard verbal learning and verbal learning in combination with the pleasantness rating. In the standard learning condition, a clear primacy effect occurred, whereas no significant recall advantage for the last items was observed. In standard verbal learning, interitem associations are built up and used for search-based retrieval and distinctiveness-based retrieval is attenuated. On the contrary, the item-specific encoding task led to a disappearance of the primacy effect, on the one hand, and to the reinforcement of the recency effect, on the other. The focusing of item-specific information changes encoding and retrieval processes, reinforces distinctiveness-based retrieval, and reduces a search-based retrieval, thereby changing the shape of the serial position curve.

Because we used nouns instead of action phrases in this experiment, the findings support the assumption that distinctiveness-based retrieval or pop-out is not confined to action phrases as material.

As we saw in the comparison between Experiment 1 and Experiment 2, the recall level in Experiment 3 was again seen to be

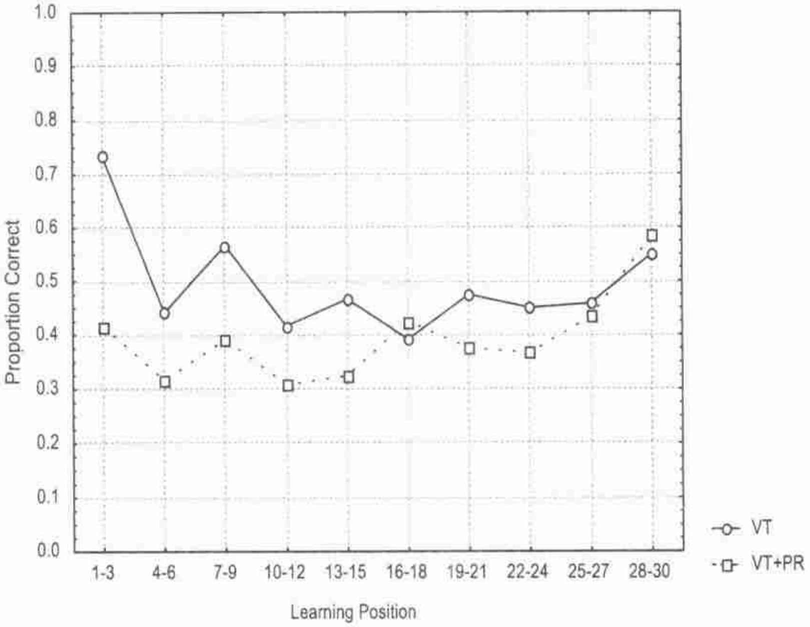

Figure 3. Serial position curves of Experiment 3 for standard verbal tasks (VTs) and verbal tasks in combination with pleasantness ratings (PR).

Table 3
Mean Differences and Standard Deviations Between the First Triplet (1) and the Middle Positions and Between the Last Three Triplets (8, 9, 10) and the Middle Positions of Experiment 3 for Standard Verbal Tasks (VTs) and Verbal Tasks in Combination With Pleasantness Ratings (PR)

	Triplet 1–mid		Triplet 8–mid		Triplet 9–mid		Triplet 10–mid	
Task	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
VT	0.27	0.20	−0.01	0.18	−0.001	0.23	0.09	0.24
VT + PR	0.06	0.13	0.01	0.17	0.08	0.26	0.23	0.22

Note. mid = middle positions.

lowered by a pleasantness rating. This finding indicates, again, that an additional item-specific task not only forces participants to focus on item-specific information but hinders them from building up interitem associations. For the free recall of unrelated verbal lists, this effect denotes that the relational encoding drops below the level needed for an efficient recall. The positive effect on item-specific encoding relative to a standard verbal instruction does not compensate for the negative effect of pleasantness rating on relational encoding. As a consequence, the recall level after pleasantness rating falls below that of standard VTs.

General Discussion

The main results can be summarized as follows. First, the serial position curves in free recall differ between standard VTs and standard SPTs. VTs show the typical serial position curve with a short primacy and a short recency effect. SPTs show no primacy but an extended recency effect.

Second, focusing encoding on item-specific processes does not change the serial position curve of SPTs, but it does so with VTs. The serial position curves of VTs become similar to that of SPTs if an item-specific encoding instruction is used. The primacy effect disappears and the recency effect is reinforced.

Third, what holds true for action phrases in VTs also holds true for lists of concrete nouns. In this case, too, an item-specific encoding instruction makes the primacy effect disappear and reinforces the recency effect.

Fourth, the SPT effect is independent of additional item-specific encoding instructions. In addition, if VTs are combined with a pleasantness rating, the recall of SPTs is better than the recall of VTs.

Theoretically, these findings are explained by assuming that standard VTs provide relational interitem associations and item-specific information, which lead to balanced retrieval processes that are based on search processes using relational information as well as distinctiveness-based processes that used particularly item-specific information. Search processes are reflected in the primacy effect and distinctiveness-based processes in the recency effect. Because of a balanced encoding and use of both kinds of information, standard verbal learning leads to a U-shaped serial position curve with a primacy and a short recency effect.

Because SPTs, by their very nature, provide excellent item-specific information but little relational interitem associations, the recall of SPTs is dominated by distinctiveness-based retrieval. This dominating pop-out is reflected by a strong and extended recency effect and a lacking primacy effect (cf. Zimmer et al., 2000).

We suggested that solid item-specific information generally went along with weak relational information as long as participants were not explicitly requested to build up interitem associations. Therefore, an item-specific encoding task should enhance the recency effect and reduce or abolish the primacy effect. Hence, the increasing item-specific information of action phrases in VTs or of any other verbal material should make their serial position curve similar to the serial position curves of SPTs. This assumption was clearly confirmed by the present experimental findings. Whatever type of item-specific information is used, by the time it is strong enough, the information leads to a predominance of a distinctiveness-based retrieval with the effect of a reduced or abolished primacy effect and reinforces the recency effect. We demonstrated those effects for lists of action phrases and for lists of nouns. In both cases, under an item-specific encoding instruction, the form of the serial position curve corresponded to that under SPT instructions.

Hence, by holding this view, we are giving up the claim that the form of the serial position curve after SPTs is peculiar to enactment, as postulated by Zimmer et al. (2000). We make the generalized assumption that a focus on item-specific encoding increases item-specific information and hinders interitem relational encoding through any kind of item-specific orienting tasks, thereby leading to the lack of a primacy and an enhancement of the recency effect.

There are two assumptions that distinguish our standpoint from other explanations of the serial position curve in free recall. We consider item-specific encoding as a process that hinders relational interitem associations and we claim that item-specific and relational information have a differential influence on the retrieval strategies used during recall. These assumptions not only allow us to explain the differential serial position curves between VTs and SPTs but also between VTs and VTs combined with an item-specific orienting task. Previous explanations can hardly account for these differential serial position curves.

According to the classical two-store explanation (e.g., Glanzer & Cunitz, 1966, Rundus, 1971), the primacy effect is attributed to the long-term store and the recency effect to the short-term store. This explanation, which ascribes the recency effect to the limited capacity of the short-term store, cannot explain why the extension of the recency effect differs between VTs and SPTs or VTs and

VTs plus pleasantness rating, because the same short-term store should be responsible for the recency effect. Furthermore, the extended recency effect in SPTs clearly exceeds the capacity of the short-term store (cf. Zimmer et al., 2000).

In addition, current models that explain the recency effect by pointing out the better distinctiveness of the last items (e.g., Bjork & Whitten, 1974, Glenberg et al., 1980; Neath, 1993; Rouder & Gomez, 2001) have problems explaining the differential serial position curves between VTs and SPTs and VTs and VTs plus pleasantness rating for identical items under identical presentation rates. From this theoretical view, the distinctiveness of the study items depends on their position in the learning list. Items that are presented late are more distinctive than items presented earlier. This standpoint ignores that the position-independent encoding of item-specific information by the specific task enhances the position-dependent recency effect. Therefore, this approach provides no explanation for the unequal recency effects in VTs and SPTs and no explanation for those in VTs and VTs in combination with pleasantness ratings.

A weakness of the other theoretical suggestions may be seen more generally in that they do not discuss the influence of item-specific encoding on relational encoding. Item-specific encoding, however, modulates the primacy effect by reducing search-based retrieval processes.

This leaves us with our last finding that the SPT effect in terms of recall level was independent of the additional item-specific encoding instructions. How is the SPT effect to be explained? We assume that the SPT effect under standard conditions results from the fact that the degree of item-specific information provided by SPTs and VTs differs. SPTs provide better item-specific information than VTs (cf. Helstrup, 1987; Knopf, 1991; Kormi-Nouri, 1995). This difference is mirrored in the improved recall of the last six or more items of SPTs, which clearly outweighs the advantage of relational interitem associations of VTs over SPTs as reflected in the short primacy effect of the first 3 items. In short, SPTs gain more from their strong item-specific information than they lose from their weaker relational information compared with VTs. However, why is there still an SPT effect if VTs are encoded under an explicit item-specific instruction? We suggest that enhancing the encoding of item-specific information in VTs reduces their advantage in relational interitem encoding but does not provide item-specific information to the same degree or, better, of the same quality as SPTs do. In some ways, the item-specific information provided by SPTs seems to be enactment specific, as postulated by Zimmer et al. (2000). According to Engelkamp (2001), this specificity may be rooted in the motor processes that are inherently bound to SPTs (see also Nyberg et al., 2001).

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