Item and order information in semantic memory: students' retention of the "CU fight song" lyrics

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Abstract University of Colorado (CU) students were tested on memory for the "CU Fight Song" in order to examine serial position effects in semantic memory while controlling for familiarity across positions. In Experiment 1, students reconstructed the order of the nine lines of the song. Students with previous exposure to the song performed better and showed a more bowed serial position function than did students with no knowledge of the song. Experiment 2 added a task assessing memory of item information. One word was removed and replaced with a blank in each line, and an alternative word was offered as an option, along with the correct word. Students selected the word that fit into each blank and then reconstructed the order of the lines. There was a bow-shaped curve for order reconstruction, but not for item selection, which implies that the serial position function in semantic memory stems from order, rather than item, information.

Keywords Serial position effects · Memory · Semantic memory

The bow-shaped serial position function is the tendency to recall the first and last items in a list best (primacy and recency effects, respectively; Nipher, 1878). This function was observed in memory tasks that exposed participants to a list of items and then immediately asked them to recall as many items as they could from the list (e.g., Murdock, 1962). The phenomenon was explained by a *dual-store* account, or *two-factor* hypothesis, that attributes primacy to

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the rehearsal and transfer of the earliest items into a long-term store and recency to the output of items from a limited-capacity short-term store (Glanzer & Cunitz, 1966).

There have been several other theories that have been proposed to explain serial position effects. The positional distinctiveness model was first proposed by Murdock (1960), and he defined the distinctiveness of a given stimulus as the extent to which a given position stands out from the other positions in a list. He offered a method for quantifying the distinctiveness of a stimulus, which is defined by the sum of the absolute values of the differences between its position and all the other positions in the list (using logarithms of the numbers for each position). These distinctiveness values result in the classic bow-shaped curve when they are plotted as a function of serial position. Although this model offers an explanation for primacy and recency effects, it assumes that such distinctiveness values remain constant across lists varying in stimulus type, rate of presentation, and any other factors affecting overall recall level. An expanded model based on distinctiveness was proposed by Brown, Neath, and Chater (2007). In addition to providing for positional distinctiveness, this SIMPLE model includes a parameter that determines how local or global the influence of other items on a given target item is. This model is able to accommodate the effects of various encoding and retrieval variables influencing recall level by varying only the value of this single parameter (Bonk & Healy, 2010).

The start–end model (SEM; Henson, 1998) is an alternative explanation for the bow-shaped serial position effects in short-term memory. Its core assumption is that the start and end of a sequence are the most salient positions and act as anchors, and each item in the list has a strength dependent on its relation to the start and end anchors (with the end of the sequence anticipated before it arrives). However, this model is based on short-term memory tasks

and has not been applied to long-term memory. In fact, Henson specifically admits that SEM does not account for long-term learning.

Research has revealed, though, that bow-shaped serial position effects also occur in both long-term episodic memory and semantic memory. In these instances, a dual-store account cannot explain the recency effect, because a short-term store is no longer relevant. Although Henson's (1998) SEM was credited only to mechanisms in short-term memory, it is possible that this theory could be adapted to explain why similar effects occur in long-term memory systems. The distinctiveness-of-position model has also been argued to explain serial position effects in long-term memory studies (see, e.g., Neath, 2010; Neath & Brown, 2006).

In a semantic memory task, Roediger and Crowder (1976) had students recall the names of the U.S. presidents and found that performance was best at the beginning and end of the series. They concluded that the initial and final positions in a series are the most distinct in our semantic memory system. However, they also acknowledged the possibility that the bow-shaped serial position function could be due simply to different frequencies of exposure to information about the presidents as a function of their chronological position.

Healy, Havas, and Parker (2000) and Healy and Parker (2001) extended Roediger and Crowder's (1976) study, presenting participants with an alphabetical list of the U.S. presidents or vice presidents and then requiring them to reconstruct the names into the correct chronological order. In some experiments, they also had each participant rate their familiarity with each name. The results showed that the primacy and recency effects in the order reconstruction task were significantly correlated with participants' familiarity ratings. These findings provided evidence that the observed bow-shaped serial position functions could be explained by familiarity, rather than by distinctiveness of positions (but see Healy, Shea, Kole, & Cunningham, 2008).

Following these studies involving semantic memory, Maylor (2002) attempted to control for familiarity by having churchgoers complete a reconstruction-of-order task for six-verse hymns. She argued that the hymns would be part of semantic memory because they are repeatedly sung over the course of several years. To establish that serial position effects occurring in semantic memory are not due to familiarity or differences in frequency of exposure, she stated, "Further search for serial position effects in semantic memory would seem to require lists of items that people encounter under incidental learning conditions in a fixed serial order on multiple occasions such that exposure to each item in the sequence is equivalent" (p. 817).

The present experiments were designed to follow up Maylor's (2002) study, which found a bow-shaped serial position function for hymns sung by churchgoers. One important problem with her experiment, as she acknowledged, is that the advantage she observed for the first position could have been due, at least in part, to familiarity, because the first verse of a hymn is often announced in church before singing begins. To avoid this problem and meet the other requirements prescribed by Maylor, we chose to study the "CU Fight Song," because the words in the title occur throughout the song and are not a specific verse in the song. Nor is the title announced before it is sung. This song consists of nine lines and is sung multiple times by University of Colorado (CU) students at sporting events. It is always sung in its entirety from beginning to end, and all nine lines of the song are displayed together on the back of tee shirts worn by many CU students. Furthermore, students who have attended CU games will have been exposed to the song enough times that the lyrics presumably have become part of semantic memory.

In Experiment 1, students who were familiar with the song were included in the experimental group, and as a control, students without any knowledge of the song were included to show that a bow-shaped serial position function occurs only in semantic memory and that it is not possible to reconstruct the song into the correct order on the basis of the content of each line. Because the song does not have a rhyme scheme, it seems that it would be difficult for someone with no knowledge of the song to place the lines into their correct sequence. By controlling for familiarity, serial position effects could be explained by a model based on distinctiveness of positions (Brown et al., 2007; Murdock, 1960) or, possibly, by an expansion of the SEM (Henson, 1998), where the recency effect could be attributed to the students' anticipation that the song is coming to an end.

Previous research has shown differences in the retention of order and item information, in short-term memory studies, based on differences in error types (Bjork & Healy, 1974; Healy, 1974). In a task in which participants recalled strings of four consonants, Bjork and Healy examined both transposition errors (order errors occurring when a correct letter from a given string was recalled, but in the wrong position) and confusion errors (item errors occurring when an incorrect letter having acoustic features similar to those of the correct letter was recalled). They demonstrated that transposition errors did not result from acoustic confusion errors, thus providing evidence that order and item information are independently retained in short-term memory. Most important for the present purposes was their finding that order errors, but not item errors, showed bow-shaped serial position functions.

Estes (1972) proposed a model for explaining how order information becomes disturbed over time and how forgetting is the result of changes over time in the relative positions of the items in the participants' memory representation of the sequence. In this model, items that occur at one of the endpoints of the sequence are less likely to perturb, or drift, in the memory representation, because they are able to move in only one direction, whereas items in the middle may move forward or backward. The bow-shaped serial position function is, thus, essentially explained in the perturbation model by differences in the items' likelihood to swap positions in the memory representation. Although Estes's model was based on immediate retention, Nairne (1990, 1991) demonstrated that the perturbation model can also be applied to long-term memory.

In Experiment 2 of the present study, an additional measure was incorporated in order to assess students' ability to identify item information at each serial position. We wondered whether students would perform best at selecting the correct items for the beginning and ending lines in the sequence or whether only performance on order reconstruction would show a bow-shaped curve. A multiple-choice item selection task was given separately for each line. In each line, a word was removed and replaced with a blank. Then the correct word and an alternative word that fit the context of the remaining words in the line was offered as a multiple-choice option. This measure provides a way to determine how well students remember the contents of each line of the song, similar to the way in which Bjork and Healy (1974) assessed the retention of item information through confusion errors. We predicted that if the bowed serial position function occurs in semantic memory due to distinctiveness of positions, students would perform best at selecting the correct items for the beginning and ending lines in the sequence. Alternatively, if the bowed serial position function is due to the retention of order, but not item, information, it should be found only for the reconstruction-of-order task, not for the item selection task, even though the reconstruction-of-order task is not a pure measure of order information (see Neath, 1997).

Experiment 1

Method

Participants Twenty-seven undergraduate students, 1 former student, and 1 graduate student from CU participated. Students were divided into the two knowledge groups on the basis of their responses to the follow-up questionnaire, yielding 17 students in the knowledge group and 12 students in the no-knowledge group. Ten of the participants were recruited on a purely volunteer basis, and 19 were enrolled in an introductory psychology course and received partial course credit for their participation. An additional 45 students who had memorized the song before the experiment were not included.

Design A mixed factorial design was used, with the between-subjects factor of knowledge and the within-subjects factor of serial position. Participants' knowledge of the "CU Fight Song" and serial position were, thus, the independent variables, and the percentage of correctly placed lines was the dependent variable examined.

Materials The official lyrics to the "CU Fight Song" (see Appendix A) were used. To avoid any visual characteristics that could be used to identify a line's position in the song, each line was typed in all capital letters, and all punctuation marks were removed. Each line was typed in Times New Roman, 22-point size font and was glued to the center of a 3×5 in. plain white index card.

All the participants were given a consent form prior to the experiment. At the end of the experiment, they were given a brief questionnaire that asked them whether they had had previous knowledge of the song and whether they had memorized the song.

Procedure Participants were given verbal instructions to reconstruct the nine lines of the "CU Fight Song" in the correct order to the best of their ability. They were given each line on a separate index card, and the cards were shuffled into a random order for each participant. Students were tested individually and were allowed to take as much time as they needed. After finishing the reconstruction-of-order task, each student's results were recorded by the experimenter, who then gave the student the follow-up questionnaire.

Results

Figure 1 shows the proportion of correctly placed lines as a function of knowledge group and serial position. A 2×9 mixed factorial analysis of variance (ANOVA) yielded a significant main effect of knowledge, $F(1, 27) = 18.575$, $MSE = .339$, $p = .0002$, $\eta^2 = .408$. The overall accuracy for students with previous knowledge of the song was .51, whereas students with no knowledge of the song averaged only .19 correct. The main effect of serial position was also significant, $F(8, 216) = 4.948$, $MSE = .162$, $p < .0001$, $\eta^2 = .155$, as was the interaction of knowledge group and serial position, $F(8, 216) = 2.499$, $MSE = .162$, $p = .0130$, $\eta^2 = .085$. Separate planned ANOVAs showed that serial position had a significant effect for students with knowledge of the song, $F(8, 128) = 6.466$, $MSE = .184$, $p < .0001$, $\eta^2 = .288$, whereas this effect was not significant for the control group, $F(8, 88) = 1.449$, $MSE = .129$, $p = .1878$, $\eta^2 = .116$.
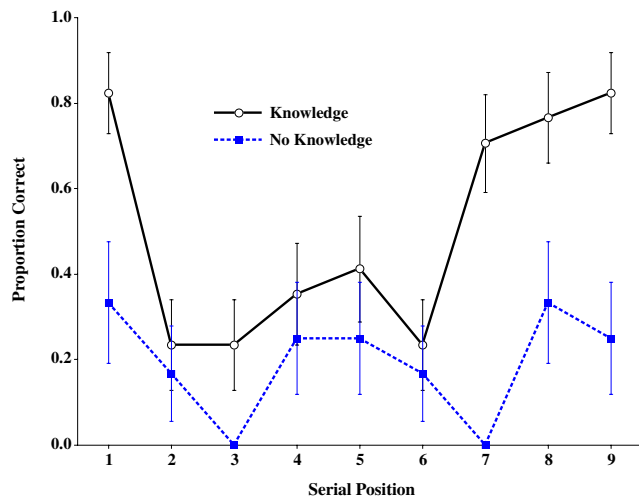
Fig. 1 Proportion of correct responses on the reconstruction of order task in Experiment 1 as a function of knowledge group and serial position (i.e., line number). Error bars represent standard errors of the means

Experiment 2

Participants in Experiment 2 were given the lines of the song on nine separate slips of paper in a pseudorandomized order. The participants' first task was to select, for each line, which contained one word replaced by a blank, which one of two alternatives fit better into it. For each line, they were also asked to rate their confidence in their selection on the basis of a 3-point scale where a 3 represented *absolute certainty*, a 1 represented *just guessing*, and a 2 represented *neither certainty nor guessing*. Then they were asked to take the nine lines and reconstruct them in the correct order. Data analysis was based on the percentage correct that occurred at each line for the item selection and order reconstruction tasks and on the average ratings for each line on the confidence scale.

Method

Participants Fifty-seven undergraduate students from CU participated in the study. All of the participants were enrolled in an introductory psychology course and received partial course credit for their participation. All 57 students had knowledge of the "CU Fight Song" prior to participating in the study, as indicated by their responses to the follow-up questionnaire. An additional 32 students had the song completely memorized prior to participating in the experiment and, thus, were not included in the analyses.

Design The design included within-subjects factors of task (item vs. order) and serial position. Unlike in Experiment 1, there was not a between-subjects factor of knowledge. The type of task participants completed and serial position were the independent variables. The percentage of correctly selected items, the confidence rating for each item, and the

percentage of correctly placed lines were the dependent variables examined.

Materials The official lyrics to the "CU Fight Song" (see Appendix A) were used. Each line was typed in Cambria, 12-point size font with one word taken out and replaced with a blank. Then the correct word and a similar word (consisting of the same number of syllables and a similar meaning and sensible to the line's context) were placed above or below each blank. For example, for the second line, which goes, "CU must win," the word *must* was replaced by a blank, and the similar word *will,* which fits the context of the line, was offered as the alternative choice (see Appendix B). Two versions of each line were developed, one having the correct item on top of the blank, with the incorrect item underneath the blank, and the second having the incorrect item on top and the correct item on the bottom. Note that on each occasion, for a given line, the same single word was removed and compared with a foil, the only difference being the placement of the correct and foil items. Also note that only the initial word of each line was capitalized in each case.

Each line was printed on standard computer paper and then cut into individual slips (approximately 2 × 8.5 in.) so the lines could be given to participants one at a time and then be used in the order reconstruction task. After each line was cut out, the numbers 3, 2, and 1 were handwritten vertically in descending order in a blank space toward the right side of the slip, to be used as a confidence-rating scale.

All the participants were given a consent form prior to the experiment. At the end of the experiment, they were given a brief questionnaire that asked them if they had had previous knowledge of the song and if they had memorized the song.

Procedure Participants were first told that the experiment involved assessing their memory of the "CU Fight Song." They were given verbal instructions to select which item they believed correctly completed each line by circling it and then to rate their confidence on each selection by circling a 3 if they were certain that the item was correct, a 1 if they were just guessing, or a 2 if they were neither certain nor guessing. Each line was handed to the participant, one at a time, in a predetermined pseudorandom order.

Each student was given the lines in a unique order. For each line, there were two ways that the question could have been displayed; either with the correct word that fit in the blank on top and the incorrect word on the bottom or with the incorrect word on top and the correct word on the bottom. Although each of the 57 participants saw a unique variation of items, there were 15 basic pseudorandom orders that were used, each having four variations (with only one of the four variations used for the last order). For each participant, the correct answer was on top for four or five

of the lines and was on the bottom for the remaining lines. The assignment of lines to correct position was pseudorandom. Thus, across participants, each line occurred almost equally often with the correct response on top and on the bottom. For example, the first participant received the lines in the pseudorandom order (5, 8, 9, 1, 4, 2, 7, 6, 3) with the first line (line 5) containing the correct item on top of the blank (A). Then the second participant received the same order (5, 8, 9, 1, 4, 2, 7, 6, 3); however, this time, for the first line (line 5), the incorrect word was on top (B). Likewise, the relative placement of the correct and incorrect items was reversed in form B from that used in form A for the other eight lines of the song. The third participant received the reverse order (3, 6, 7, 2, 4, 1, 9, 8, 5),with the same item options as the first participant (A), whereas the final participant for this set got the reverse order (3, 6, 7, 2, 4, 1, 9, 8, 5) with the same item options as the third participant (B).

After the participants had completed the item/confidence-rating task, they were asked to take the nine lines of the song and reconstruct them into the correct order to the best of their ability. They used the same nine slips of paper that they had been given during the first task for reconstructing the order of the lines.

Students were tested individually and were allowed to take as much time as they needed. After participants finished reconstructing the order, the experimenter recorded the order in which they had placed the lines and gave them the follow-up questionnaire.

Results

Separate analyses were performed for the three tasks: item selection, confidence rating, and reconstruction of order. The dependent variables were the proportion of correct item responses, the confidence ratings for the item selections, and the proportion of correct responses on the reconstruction-of-order task, respectively. Each analysis consisted of an ANOVA with a within-subjects factor of serial position. In addition, an overall ANOVA compared the item and order tasks on the proportion of correct responses. Note that the variable of serial position refers, in each case, to line number. Position within a line could not be examined for the item selection task, because only a single word in a given line was tested and the particular word tested varied from line to line (see Appendix B).

Students performed significantly better, overall, on the item selection task ($M = .838$) than on the order reconstruction task ($M = .573$), $F(1, 56) = 41.345$, $MSE = .436$, $p < .0001$, $\eta^2 = .425$. This difference can be attributed in part to the different guessing levels in the two tasks, because chance performance is .50 for the item task (which has only two options) but is .11 for the order task (which has nine options).

Importantly, the two tasks yielded different serial position functions (see Fig. 2); the interaction of task and serial position was significant, $F(8, 448) = 6.000$, $MSE = .112$, $p < .0001$, $\eta^2 = .097$, as was the main effect of serial position, $F(8, 448) = 9.190$, $MSE = .133$, $p < .0001$, $\eta^2 = .141$. When the first serial position is eliminated from the analysis, the same effects are significant. Specifically, there was still a main effect of task, $F(1, 56) = 56.488$, $MSE = .375$, $p < .0001$, $\eta^2 = .502$, a main effect of serial position, $F(7, 392) = 10.602$, $MSE = .128$, $p < .0001$, $\eta^2 = .159$, and, importantly, an interaction of task and serial position, $F(7, 392) = 3.058$, $MSE = .100$, $p = .0038$, $\eta^2 = .052$.

Item selection With two alternatives, the percentage correct by guessing alone is .50 for the item selection task. The experimental participants showed a mean percentage correct of .838, which is considerably above the chance level. The percentage correct did depend on the serial position of the items. The main effect of serial position was significant in the item selection task, $F(8, 448) = 5.647$, $MSE = .114$, $p < .0001$, $\eta^2 = .092$; however, this effect did not reflect a bow-shaped curve that would indicate primacy, as well as recency, advantages; instead, accuracy showed an overall increase from the first to the last position, with a recency advantage but no primacy advantage (see Fig. 2).

To establish a baseline for item response accuracy, we tested an additional 17 control participants with no knowledge of the song, using the same procedures as those for the experimental participants, but some of these participants were not CU undergraduate students, although they were all found on the CU campus. These participants showed a mean percentage correct close to the chance level ($M = .536$). The serial position function in this case was significant, $F(8, 128) = 4.076$, $MSE = .214$, $p = .0002$, $\eta^2 =$
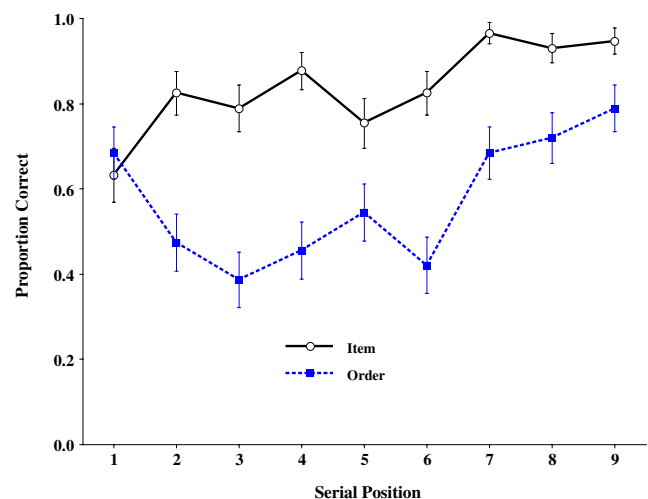

Fig. 2 Proportion of correct responses on the reconstruction of order and item selection tasks in Experiment 2 as a function of serial position (i.e., line number). Error bars represent standard errors of the means

.203, but yielded a jagged pattern quite different from that for the experimental participants (M = .412, .353, .647, .882, .353, .176, .765, .588, and .647, for positions 1–9, respectively). In a comparison of performance by the experimental and control participants, the main effect of participant group, $F(1, 72) = 45.717$, $MSE = .236$, $p < .0001$, $\eta^2 = .388$, the main effect of serial position, $F(8, 576) = 8.483$, $MSE = .136$, $p < .0001$, $\eta^2 = .105$, and the interaction of participant group and serial position, $F(8, 576) = 3.565$, $MSE = .136$, $p = .0005$, $\eta^2 = .047$, were all significant. Comparing the results of the experimental participants with those of the control participants makes it clear that the results found for the experimental participants cannot be attributed to guessing.

Item confidence rating Overall, participants' confidence ratings for their item selections were relatively high across serial positions (M = 2.257, ranging from 2.263 to 2.877); however, there was a slight increase in confidence from the first to the last line (see Fig. 3). Although the ANOVA indicated that the main effect of serial position was significant, $F(8, 448) = 7.790$, $MSE = .280$, $p < .0001$, $\eta^2 = .122$, the effect did not result in a bow-shaped function that would reflect primacy, as well as recency.

Order reconstruction Analyzing the percentage of correctly placed lines in the order reconstruction task indicated that the main effect of serial position was significant, $F(8, 448) = 9.545$, $MSE = .131$, $p < .0001$, $\eta^2 = .146$. The function (see Fig. 2) shows both primacy and recency effects. Performance was best on the last line, followed by the second to last line, and was third best for both the very first line and the third-to-last line. These results are similar to the findings in Experiment 1, in which students with knowledge of the song were most accurate with the placement of the first and last lines of the song, demonstrating primacy and recency effects.

Error gradients were calculated by computing the mean proportion of times lines 1–9 were placed in serial positions 1–9 (see Fig. 4). These gradients show that generally, but not in all cases, when making an error by placing a line in the wrong serial position, participants placed the line in a neighboring serial position.

Discussion

Experiment 1 resulted in a significant interaction between knowledge and serial position in order reconstruction. As was predicted, students with knowledge of the song performed significantly better than those without any knowledge of the song. Students with knowledge of the song demonstrated primacy and recency effects, performing best on the first and final lines. Serial position did not have
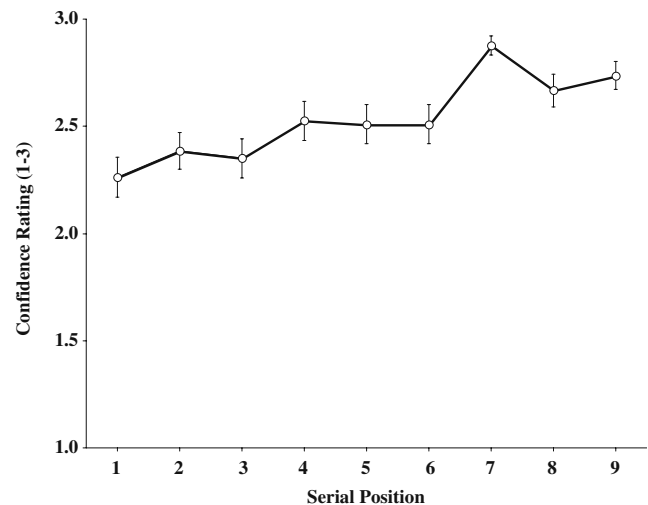

Fig. 3 Mean confidence ratings (1–3) on the item selection task in Experiment 2 as a function of serial position (i.e., line number). Error bars represent standard errors of the means

a significant effect for the control group of students with no knowledge of the song. The jagged line in Fig. 1, representing the no-knowledge group's performance, and the separate ANOVA that determined that there was no significant effect of serial position for this group together demonstrate that the no-knowledge participants were simply guessing and that there is no way to determine the order of the lines on the basis of their content alone.

The fact that the "CU Fight Song" is always sung in its entirety, with an equal amount of exposure for each line, controlled for any effects being the result of familiarity. This is an important difference from Maylor's (2002) study, in which an advantage for the first position could have resulted from the first verse being announced prior to singing, increasing its exposure.
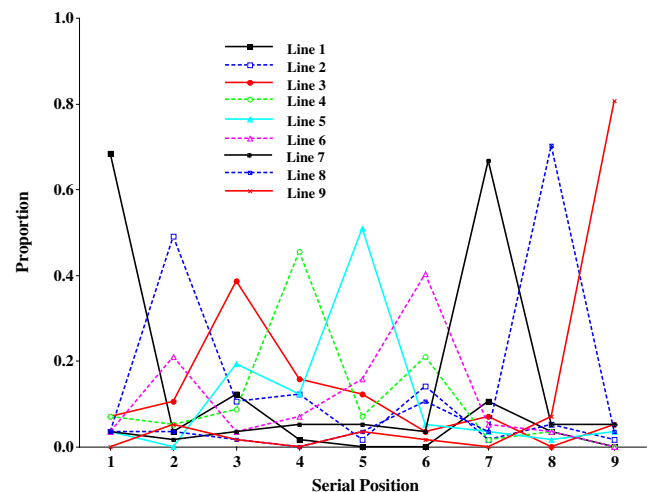

Fig. 4 Mean proportion of times lines 1–9 were placed in serial positions 1–9 in the reconstruction-of-order task in Experiment 2

The results from Experiment 1 suggest that serial position effects did not result from familiarity or differences in exposure. The fact that individuals naïve to the song could not determine its order supports the hypothesis that the observed primacy and recency effects were due to how students encoded and retrieved information in semantic memory. This study, thus, successfully demonstrates that serial position effects can be extended to the semantic memory system.

Experiment 2 included only students with knowledge of the "CU Fight Song" but tested 57 participants, as compared with 17 in Experiment 1. This experiment was able to replicate primacy and recency effects, using a similar order reconstruction task. An additional item selection task was implemented to study further students' retention of the lyrics. However, analysis of this feature did not yield a bow-shaped serial position curve like that for the order task; instead, only a recency effect, but no primacy effect, was evident. It should be noted (see Appendix B) that for four of the lines (lines 1, 3, 8, and 9), the same two word options (*fight* and *go*) were given, and the correct word was always the same (*fight*). At least for those four serial positions, there was no confounding of serial position and either the two alternatives provided or the correct option. Any effects of serial position found for the item selection task cannot, then, be attributed to either the alternative words or the correct word. In particular, the presence of a recency advantage for the last line and the absence of a primacy advantage for the first line cannot be attributed to the word options, because they were the same and, in fact, involved the first word in the line in both cases.

These findings suggest that the serial position function in semantic memory occurs because of the retention of order, rather than item, information. This conclusion is also consistent with the observation by Roediger and Crowder (1976) that the serial position effect was clearer and more regular when they used a strict position criterion for scoring recall of the U.S. presidents, as opposed to a free recall criterion.

Initially, on the basis of the findings from Experiment 1, it was reasonable to believe that the observed serial position effects were the result of distinctiveness of positions within semantic memory. However, Experiment 2 demonstrated that a primacy effect did not occur when students were tested on item information (although a recency effect was evident in that case). If distinctiveness of positions applied to semantic memory, item information should have also demonstrated primacy, as well as recency, effects. By including two dimensions in the SIMPLE model, one for order (position) information and one for item information, with the two dimensions given different weights, Neath (2010) was able to account for performance in the semantic memory task of recalling the chronological positions of the U.S. presidents. Presumably, by using a similar procedure that provides for variation in item, as well as order, distinctiveness, the SIMPLE model could also account for the data observed in the present Experiment 2, although the weight of the item dimension would undoubtedly be small in that case. Perhaps the best way to explain these findings, though, comes from the perturbation model (Estes, 1972; Nairne, 1990, 1991), in which the information at the intermediate positions is not actually lost because such positions are less distinct; rather, they are more likely to drift, or shift, in the memory representation, and thus, the observed primacy and recency effects result from the perturbation process. By this model, only order information, not item information, should yield a bow-shaped serial position function, as was found in Experiment 2 of the present study and in earlier studies of short-term episodic memory by Bjork and Healy (1974) and Healy (1974).

It should be noted that the "CU Fight Song" is mostly sung over the instrumentation of the school band. There is a specific melody and rhythm to the song, with a different melody for each line of the song (except that lines 2 and 6 have the same melody), which may be factors that affect one's memory. Perhaps having participants listen to the music while they perform the tasks would enhance their performance. The music that often accompanies singing of the lyrics should be taken into consideration as a factor that may influence memory. The item choices were designed to be reasonable alternatives and proved to yield difficult decisions. When 17 participants with no knowledge of the song were given the item selection task, they selected the correct word only 53.6% of the time, which is quite close to the chance level. This finding suggests that the foil items we offered were, on average, just as reasonable for the lines' context as were the original words used in the song.

In conclusion, the present study has demonstrated a bow-shaped serial position function in a semantic memory task. Unlike previous studies of semantic memory (e.g., Healy et al., 2000; Healy & Parker, 2001; Maylor, 2002), the bowed function in this case cannot be attributed to differential familiarity, because each line in the song had been exposed equally often. Also, unlike in previous studies, the bowed function in this case can be attributed to order, rather than item, information. Rather than an account either in terms of the distinctiveness of the positions (e.g., Brown et al., 2007; Murdock, 1960) or in terms of the relationship of the items to the start and end anchors (Henson, 1998), an adequate explanation seems to require a differentiation between item and order information, either as in a version of the SIMPLE model that includes separate item and order dimensions (Neath, 2010) or as in the perturbation model of Estes (1972; Nairne, 1990, 1991), which accounts for the bow-shaped function as a result of perturbations in the relative ordering of the items in semantic memory.

Appendix A

Lyrics to the "CU Fight Song"

1. Fight CU down the field
2. CU must win
3. Fight, fight for victory
4. CU knows no defeat
5. We'll roll up a mighty score
6. Never give in
7. Shoulder to shoulder
8. We will fight, fight
9. Fight, fight, fight!

Appendix B

Lyrics to the CU Fight Song with Choices for Item Selection Task in Experiment 2

1.
Fight
_____ CU down the field
Go

6.
                        in
Never give _____
                        up

2.
      must
CU _____ win
      will

7.
              to
Shoulder _____ shoulder
              by

3.
Fight
_____ fight for victory
Go

8.
            fight
We will _____ fight
            go

4.
   knows
CU _____ no defeat
   sees

9.
Fight
_____ fight fight
Go

5.
      roll
We'll _____ up a mighty score
      stack

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