

December 2021

## Primacy and Recency Effects on Position Error in Short-Term Memory Recall

Weerachet Sinlapanuntakul

*Embry-Riddle Aeronautical University, sinlapaw@my.erau.edu*

Kelly Harris

*Embry-Riddle Aeronautical University, harrik28@my.erau.edu*

Brittany S. Wesley

*Embry-Riddle Aeronautical University, wesleyb1@my.erau.edu*

Follow this and additional works at: <https://commons.erau.edu/beyond>



Part of the [Cognition and Perception Commons](#), [Cognitive Psychology Commons](#), and the [Human Factors Psychology Commons](#)

---

### Recommended Citation

Sinlapanuntakul, Weerachet; Harris, Kelly; and Wesley, Brittany S. (2021) "Primacy and Recency Effects on Position Error in Short-Term Memory Recall," *Beyond: Undergraduate Research Journal*: Vol. 5 , Article 2. Available at: <https://commons.erau.edu/beyond/vol5/iss1/2>

This Article is brought to you for free and open access by the Journals at Scholarly Commons. It has been accepted for inclusion in Beyond: Undergraduate Research Journal by an authorized administrator of Scholarly Commons. For more information, please contact [commons@erau.edu](mailto:commons@erau.edu).

# *Primacy and Recency Effects on Position Error in Short-Term Memory Recall*

Weerachet Sinlapanuntakul, Kelly Harris, & Brittany S. Wesley

## **Abstract**

Position error is the most common error in serial recall of short-term memory, especially when environment, language, or similarity factors are presented. Previous studies demonstrate some support for the serial recall resulting in less error-prone for the first and last positions than the middle positions. This study investigates the accuracy of recalling letters and their positions when given a random sequence with minimal to no external factors. The significant predictors influencing position error were the primacy and recency effects. Participants completed a 20-trial experiment on the CogLab Experimental Control Software, which presented a series of letters one at a time in order, but the order of letters varied in each trial. After displaying all the letters in each trial, participants were asked to select letters according to their original positions. The results from this study indicated that participants were most likely to recall the first letter, somewhat likely to recall the last letter, and least likely to recall the middle letters of a random sequence in their correct original positions.

## **Introduction**

The position error is ubiquitous in perception, memory, and action (Logan, 2021). However, it is often the result of a systematic error in memory recall. Position error challenges our ability to remember and recall sequences coherently, such as the numerical order of a zip code, phone number, or list of words. It can also be referred to as serial position effects or serial order, meaning the ability to remember information in the order it occurred. Previous research on serial order in spatial immediate memory has identified that transpositions are the most common error in memory recall. Smyth & Scholey (1996) suggested that there is often a tendency to recall the correct information but in the incorrect position. Other studies have also recognized that the first and last serial positions are the least likely error-prone than the middle position information (Wisewedeac et al., 2007). This trend results from the primacy and recency effects, contributing to the better recall of the first and last information items. Position error has many beneficial applications, ranging from cognitive psychology to abnormal psychology, mainly in healthcare. Howieson et al. (2011) used serial position error to examine the existence of mild cognitive impairments

in an individual, while Kloth et al. (2019) used the nature of serial position effects to differentiate between patients with Frontotemporal Dementia and Alzheimer's disease.

Previous studies have indicated multiple factors influencing the findings of position error associated with memory or recall task performance. Disruptive factors, such as location set and background noise, are considered unnecessary information that may lead to misleading results in serial position error, especially when presented simultaneously with sequential items of information (Dimsdale-Zucker et al., 2019). Furthermore, factors associated with language, including vocabulary knowledge, word frequency, and familiarity, can also impact the participant's recall performance tremendously (Poirier et al., 2015). In addition to these factors, incorporating too many items of information into the short-term memory, which only lasts for 15-30 seconds, puts a deficit on how much information can be retained and recalled in the correct order (Weinstein, 2017). Nonetheless, similarities between the items within a set of information, such as semantics and sound, play a role in reducing the error rate when recalling serial ordering. Some studies have also demonstrated that similarities in the temporal distance and edge principles are empirical for serial order control memory (Nakayama, 2014). Essentially, each item's

display time and the duration between items before displaying the next piece of information can influence the serial position recall.

Furthermore, De Belder et al. (2019) conducted a study to determine if the verbal serial order of letters would help retrieve those items from short-term memory, suggesting that the primacy and recency effects might not be as influential as proposed. On the other hand, a study using pictures of snowflakes has proved that varying the time intervals of the pictures shown to participants significantly impacted the primacy and recency effects (Derks, 1979). In the beginning, participants could recall better when shown the snowflake pictures at a longer time interval rather than at the end. This study supports the relevance of primacy and recency effects concerning serial position error in short-term memory recall.

Even though the primacy and recency effects have been studied for years, the results from the literature are inconclusive about their significance regarding short-term memory recall due to the disruptive and language-related factors presented in previous studies. Therefore, it is crucial to examine the primacy and recency effects on serial position error, specifically when unwanted factors are absent.

### **Current Study**

This research examines the primacy and recency effects in short-term memory recall as well as their contribution to position error. Participants were asked to recall a sequence of letters in the correct order for 20 trials. It is hypothesized that the primacy and recency effects would influence participants to correctly recall the positions of letters shown at the beginning and end of each trial than the middle ones.

## **Methods**

### **Participants**

Twenty participants (thirteen females and seven males) aged 20 to 29 ( $M = 21.20$ ,  $SD = 1.94$ ) participated in this study. All participants had self-reported normal or corrected to normal vision and were undergraduate students.

### **Materials**

Participants completed the experiment using the Position Error Effects simulation available

in the Short-Term Memory lab on the CogLab Experimental Control Software (Francis & Neath, 2007). A traditional desktop was used to run the CogLab software. The experiment was conducted in a classroom setting with a low background noise level, and the environment remained consistent for all participants.

### **Procedure**

At the start of each experimental session, a participant was presented with a sequence of seven letters, displayed one letter at a time, each for only one second. The set of letters remained unchanged throughout the experiment for all participants. The order of the sequence, however, varied in which the letters were displayed. In addition, the seven letters were visible to the participant in a randomized order while completing the trial, but they were not clickable. Once all seven letters had been presented to the participant one at a time, the randomized group of letters became clickable. Participants then had to do their best to click on the letters according to the original sequence of the letters. It was important to note that participants were unable to change their responses after clicking on a letter. Participants completed 20 trials with the same seven letters for each trial, and they must click on the Next Trial button after each trial to start the following sequence. The total estimated time was 30 minutes per participant.

### **Statistical Analysis**

Paired-samples t-tests were conducted with Bonferroni correction (.0025) to investigate the differences between the correct position recall in each letter or position. The averages of letters 1 and 4 (first and middle) were analyzed to identify the primacy effect. The averages of letters 4 and 7 (middle and last) were analyzed to identify the recency effect. The data analysis tools used included Microsoft Excel version 16.36 for macOS and IBM SPSS Statistics.

## **Results**

### **The Primacy Effect**

The first letter (1) presented in each trial ( $M = 89.25$ ,  $SD = 5.68$ ) was more likely to be recalled than the middle letter (4) presented ( $M = 62.25$ ,

$SD = 8.18$ ). The data depicted in Figure 1 shows a statistical significance in the data supporting the primacy effect,  $t(19) = 11.17, p < .001$ .

### The Recency Effect

The middle letter (4) presented in each trial ( $M = 62.25, SD = 8.18$ ) was less likely to be recalled compared to the last letter (7) presented ( $M = 80.25, SD = 6.58$ ). As shown in Figure 1, there is a significant difference between the two variables,  $t(19) = -6.60, p < .001$ , proving that the recency effect is relevant.

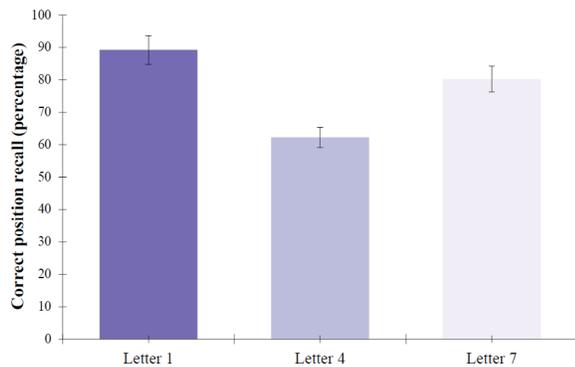


Figure 1  
Percentages for Correct Position Recall Between Letters 1, 4, and 7.

### The Primacy and Recency Effects

There was a significant difference between the first letter ( $M = 89.25, SD = 5.68$ ) and the last letter ( $M = 80.25, SD = 6.58$ ) with more accurate position recall on the first letter,  $t(19) = 4.56, p < .001$ .

### Discussion

The present study supports the hypothesis that the primacy and recency effects are significantly associated with serial position memory recall, otherwise known as position error. As hypothesized, the results of this study demonstrated statistically significant differences in primacy and recency effects, with higher percentages of correct order recall supporting the primacy effect. Out of seven letters presented in a random sequence, the first and last letters were less error-prone than the middle letters. In particular, participants were least likely to retain the middle letters, likely to correctly recall the last letter, and most likely to recall the first letter presented in the original sequence correctly.

The results replicated previous findings in support of the primacy and recency effects in position error (Wisewedeac et al., 2007). The middle information is most likely to be error-prone due to the displacement between short-term and long-term memory, unlike the first and last serial positions (Smyth & Scholey, 1996). Furthermore, findings from this study are similar to a research study on patients with amnesia; many conditions demonstrated that the recency was more likely to be retained than primacy items (Carlesimo et al., 1996).

This study corresponds to prior research on how presenting information simultaneously with other factors could affect the individual's memory serial recall (Dimsdale-Zucker et al., 2019; Poirier et al., 2015). Factors impacting a memory recall task, including interruptions and distractions in the participant's environment, were avoided. Each participant was in a controlled environment with no external interruptions, limiting the distractions in this study. According to Weinstein (2017), incorporating too much information into the short-term memory, particularly remembering 15-30 seconds worth of information, can impact the accuracy of memory recall. In the present study, participants were only asked to recall seven letters presented to them one after another in a sequence. Each letter appeared one second after the other, making it unlikely for them to be a deficit on the quantity of information recalled and in what order. This idea of memory recall supports prior research associated with the inefficaciousness of a person's short-term memory resulting in position error. As identified by the previous studies, significant support towards the primacy and recency effects notably contributed to position error. Besides, there is minimal prior research that does not support the findings in the present study.

## Limitation and Future Research

Limitations in this study included a small sample size, and that only college students were recruited for the study. Future research should examine whether the overall results would be conclusive or shifted when having a larger and more diverse sample size in a controlled environment as conducted in this study.

## References

- Carlesimo, G. A., Marfia, G. A., Loasses, A., & Caltagirone, C. (1996). Perceptual and conceptual components in implicit and explicit stem completion. *Neuropsychologia*, *34*(8), 785-792.
- De Belder, M., Abrahamse, E., Kerckhof, M., Fias, W., & van Dijck, J.-P. (2019). Serial position markers in space: Visuospatial priming of serial order working memory retrieval. *PLOS ONE*, *14*(3), 1-10.
- Derks, P. L. (1979). The length-difficulty relation in serial memorization of words, pictures, and snowflakes. *Bulletin of the Psychonomic Society*, *14*, 201–204.
- Dimsdale-Zucker, H. R., Flegal, K. E., Atkins, A. S., & Rutter-Lorenz, P. A. (2019). Serial position-dependent false memory effects. *Memory*, *27*(3), 397-409.
- Francis, G., & Neath, I. (2007). *CogLab online with access code, version 2.0*. Australia: Wadsworth Cengage Learning.
- Howieson, D. B., Mattek, N., Seecyle, A. M., Dodge, H. H., Wasserman, D., Zitzelberger, T., & Jeffrey, K. (2011). Serial position effects in mild cognitive impairment. *Journal of Clinical and Experimental Neuropsychology*, *33*(3), 292-299.
- Kloth, N., Lemke, J., Wiendl, H., Meuth, S. G., Duning, T., & Johnen, A. (2019). Serial position effects rapidly distinguish Alzheimer's from frontotemporal dementia. *Journal of Neurology*, *262*(5), 1-9.
- Logan, G. D. (2021). Serial order in perception, memory, and action. *Psychological Review*, *128*(1), 1.
- Nakayama, M., & Saito, S. (2014). Within-word serial order control: Adjacent mora exchange and serial position effects in repeated single-word production. *Cognition*, *131*(3), 415-430.
- Poirier, M., Saint-Aubin, J., Mair, A., Tehan, G., & Tolan, A. (2015). Order recall in verbal short-term memory: The role of semantic networks. *Memory & Cognition*, *43*(3), 489-499.
- Smyth, M. M., & Scholey, K. A. (1996). Serial order in spatial immediate memory. *Quarterly Journal of Experimental Psychology: Section A*, *49*(1), 159–177.
- Weinstein, Y. (2019). How long is short-term memory? Shorter than you might think. *The Learning Scientists*.
- Wiswedeac, D., Rüsselerab, J., & Müntea, T. F. (2007). Serial position effects in free memory recall—An ERP-study. *Biological Psychology*, *75*(2), 185- 193.