Original Research Article

The significance of mode of presentation on the serial position effect : an exploratory study

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ABSTRACT

Background: Memory is the maintenance of material over time, which can be tested using various methods. Most of the study of memory and research focuses on the ability to retrieve stored information by means of free recall. The objective of this experiment was to show serial position effects (primacy/effect) in free recall.
Methodology: This experiment also aimed to look at the significance of mode of presentation (auditory, visual printed and visual pictures) on serial position effects. Participants in this experiment were tested with different treatment conditions. With the auditory group, participants were asked to recall the words by writing them down after the experimenter read out the list of 21 common-concrete nouns at the rate of 1 second per word. With the visual printed and visual pictures group, the participants were asked to recall the words by writing them down after the experimenter presented the stimuli on a PowerPoint presentation.
Results: The results indicated that there was a significant main effect of serial position. However, a significant main effect of mode of presentation and the interaction between the mode of presentation and serial position wasn't found.
Conclusion: Mode of presentation as a variable that affects the serial position effects needs further investigation in larger studies and future research.

Keywords: memory,, recall, serial position effect, visual stimuli, auditory stimuli, recency effect.

(Paper received –7th August 2016, Peer review completed – 29th August 2016, Accepted – 5th September 2016)

INTRODUCTION

Memory is a process by which material can become accessible given a period of time through stages such as encoding, storage and retrieval [1]. There are various methods that are used to test it. Free call is a method that involves studying a list of items and recalling them in any order depending on the items one retrieves from their memory. It offers a beneficial paradigm for investigation into memory processes. The data stemming from free call experiments are often used to develop models of storage and retrieval [2]. Ebbinghaus was the first one to describe the serial position curve, which uncovers the primacy effect and recency effect. Primacy effect is seen when recall is greater for the items present in the beginning of the list as compared to the middle of the list. Recency effect is seen when recall is greater for the items present at the end of the list as compared to the middle of the list. These effects have been looked and examined at in two opposing ways: dual store approach & the single store approach [3].

Atkinson and Shiffrin propose the dual store model of memory and explain these effects with reference to the short term and long term stores. The implicit material from the sensory register and copies of material from the long-term store is sent to the short-term store. The recency effect is explained in terms of the involvement of the short-term store as the last few items of the list enter this store and can be easily

accessible to the mind and are more likely to remain activated because this store is a working memory store and provides an account of immediate access to memory. Nevertheless, the primacy effect is explained in terms of the involvement of the long-term store as the items present in the beginning of the list are rehearsed, studied and well consolidated [4]. On the other hand, the single store approach assumes that retrieval processes for the primacy and recency effects are alike but that the items present in the beginning of the list are challenging to differentiate than the ones at the end of the list or the contextual cues that overlap between study and test [5]. The significance of contextual information in the distinctiveness effect has been seen in many explanations of serial position effects. The contextual retrieval hypothesis postulates that the efficacy of recall is dependent on the efficacy of the reactivation of the encoding context of the items by the test context [6].

Murdock [7] provided evidence to support the presence of the two separate memory stores as proposed in the dual store approach. Participants were presented with a list of words to be learned and then recall them. The serial position effect (primacy and recency) was found through the study. It was suggested that the items at the end of the list transfer over to the store term short-term buffer as it is viewed as a momentary holding mechanism and the items at the beginning of the list, by means of rehearsal, transfer over to the long-term store. Glanzer and Cunitz [8] also provided evidence for the short term and long term storage devices by manipulating the rate of presentation and repetition of individual words in order to affect the items present in the beginning of the list thereby focusing on long-term storage. On the other hand, manipulating the time delay between the end of the list and recall resulted in affecting the items present at the end of the list and focused on short-term storage.

Research in the field of short-term retention has led to the fact that modality of presentation is highly important. Experiments showed that short-term memory for digit lists was dependent on the mode of presentation: auditory or visual. The retention was greater with the auditory presentation as compared to the visual presentation. This result suggests that the input of modality is vital for short-term retention [9]. Experiments have compared auditory mode of presentation and visual mode of presentation and found an interaction between modality and recall with a superior recency effect with auditory presentation and primacy effect with visual presentation [10]. This modality difference that has been seen in literature can be examined in innumerous ways. From the evidence it seems that auditory signals are critical for short-term retention therefore the access to these signals may be influenced by mode of presentation. By obvious means, there is less access to auditory signals when it comes to visual presentation as opposed to auditory presentation, which may result in the modality difference [11]. It has been argued that the memory trace persistence in both the echoic and iconic memory stores varies. Due to the trace persistence in the echoic memory store being greater than the iconic memory, the auditory presentation of information leads to the last few items on the list being present in the echoic memory and only the first items are available for visual presentation. This therefore provides an explanation for the superiority recency effect for auditory presentation than visual [12].

Several researchers have found differences in recall and recognition within the visual modalities concerning the format of the visual presentation. The likelihood of greater retention and recognition for visual pictures over visual printed words is the picture-superiority effect that has been observed by various investigators [13]. Mayer [14] also provides a framework that explained the differences between the formats. He argued that there are different processing channels associated with pictorial and auditory stimuli for working memory. The routes for the processing of pictorial and auditory stimuli appear to be direct but the processing of printed words is far more complex that involves both the channels.

The purpose of the current study is to confirm the significance of modality and format of the presentation on serial position effect. This study aims at looking at the recall performance with regards to different modes of presentation and whether they produce a serial position effect (primacy and recency). This study focuses on two variables, one of them being the mode of presentation: auditory, visual printed and visual words and the other one being the serial position: beginning, middle or end. Based on previous research

discussed earlier, it is predicted that there will be a serial position effect, which implies that the words at the beginning and the end of the list type will be recalled significantly greater than the words present in the middle of the list type. It is also predicted that there will be a modality effect: (1) Auditory mode of presentation will produce higher recall than visual presentation (2) Within the visual modality, it is hypothesized that there will be a superior recall for visual pictures than visual printed words. Lastly, it is hypothesized that there will be an interaction between the mode of presentation and the serial position. Looking at the previous studies, auditory presentation would lead to a greater recency effect than visual presentation and visual pictures would lead to a greater recency effect than visual printed words.

METHODOLOGY

Design

A mixed factorial design was used in this experiment. There were two independent variables with 3 levels each: one was the mode of presentation (auditory, visual printed, visual pictures) and the other one was the serial position (beginning, middle or end). It used a between-groups design to test the first independent variable (mode of presentation). It also made use of a within-subjects design to test the serial position effect (primacy/recency) within the conditions. The dependent variable was the recall performance, which was operationalized by noting down the number of correctly recalled words.

Participants

The total participant sample number was 60, aged between 16-65 years (M= 23.5, SD= 10.62). There were 30 females and 30 males. There were 20 participants in each condition. The sampling method used to recruit was opportunity sampling. The participants were naïve to the experiment.

Apparatus/Materials

The stimuli consisted of a list of 21 common two-syllable words, concrete nouns presented in different ways (auditory, visual printed and visual words) obtained from MRC Psycholinguistic Database V2. Participants that underwent the visual printed and visual pictures condition were presented with a PowerPoint slideshow running on a Macintosh computer with the stimuli timed to 1 second per word. The size of the picture stimuli was 7×10 cm. The example of the stimuli can be seen in Figure 1. The list of words can be seen in Appendix 1. The participants were provided with a pen and paper to free recall. Furthermore, the data analysis was done by the means of the software named SPSS on a Macintosh computer.

Figure 1 – example of stimuli figure (coffee)

Procedure

All participants were firstly provided with a consent form to be signed and were informed about the study. They were then provided with the instructions sheet depending on the condition that they were tested in which can be found in Appendix 2,3 and 4 respectively. Participants details such as their age and gender was collected. The participants that were tested in the auditory condition were presented with the stimuli by reading aloud the list of words at the rate of one word per second and were asked to recall as many words as they could in any order. The participants that were tested in the visual printed and the visual

words condition were presented with the stimuli at the rate of one second per word/picture on a PowerPoint and were asked to do the same.

STATISTICAL ANALYSIS

Following the collection of the data, it was all compiled and organized into an Excel Spreadsheet and transferred over onto SPSS version 19.0 in order to carry out the statistical tests. A 3× 3 repeated measures ANOVA was carried out to test the effect and the interaction of the variables.

RESULTS

The mean number of words recalled by the participants with regards to the condition they were tested in and the serial position effect is shown in Figure 2.

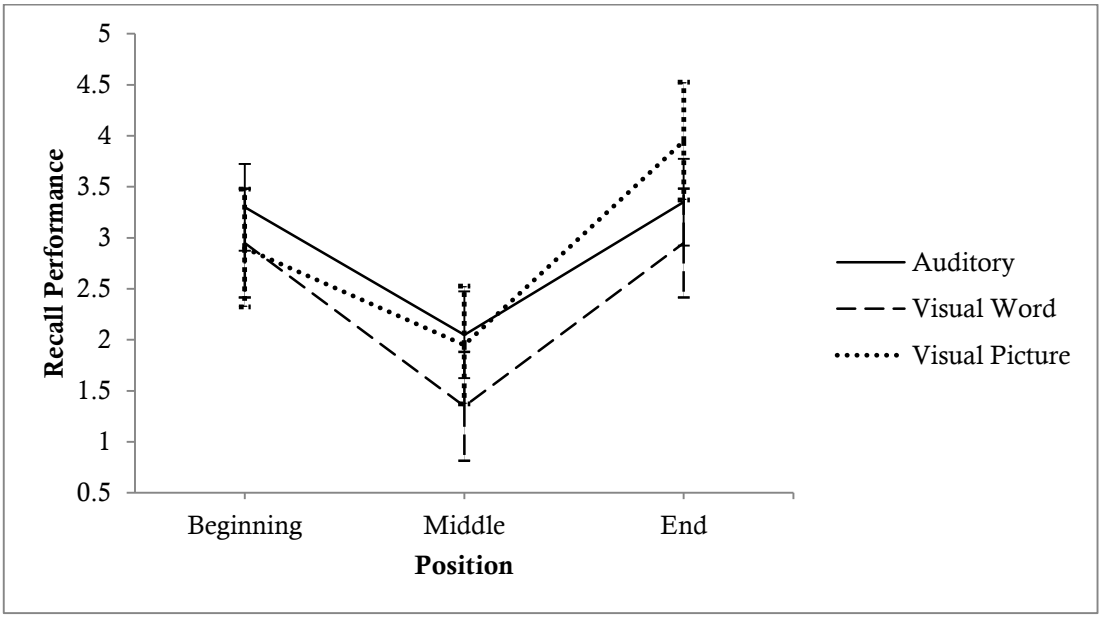

Figure 2: Graph demonstrating the mean number of words recalled by the participants.

For the within subjects effects, there was a significant main effect of serial position (beginning, middle, end) of the words in the list on the number of words recalled [F (2,114)= 28.31, MSE=1.56, $p < 0.001$]. Bonferroni corrected comparisons showed a significant difference between words present in the beginning (*M*=3.05, SE= .150) and middle (*M*= 1.78, SE= .170) and a significant difference between words present at the end (*M*= 3.42, SE= .176) and the middle. For the between subjects effects, there was no significant main effect of mode of presentation [F (2,57)= 2.74, MSE= 1.83, $p = 0.07$]. There was no significant interaction between the mode of presentation and the serial position of the words, [F (4,114)= 1.24, MSE= 1.93, $p = 0.30$].

DISCUSSION

As outlined previously, in free recall tasks, there is a probability to recall the items that are present in the beginning of the list (primacy) and items present at the end of the list (recency) than those present in the middle of the list. The results of this current study did support the first hypothesis of participants exhibiting a primacy and a recency effect. The results of this hypothesis are in line with previous research. Proactive inhibition and preceding words are positively correlated: greater preceding words results in greater short-term proactive inhibition. On the other hand, retroactive inhibition and succeeding words are positively correlated: greater succeeding words results in greater retroactive inhibition. This explanation for the serial

position effects has gained support from studies on short-term retention of individual items that exhibit the proactive and retroactive inhibition [15].

The second hypothesis postulated that there would be a modality effect wherein auditory presentation of words would produce greater recall than visual presentation and within visual modality; the format of visual pictures would produce a greater recall than printed words. The results of the present study didn't support this hypothesis, as there was no significant difference found between the three conditions (auditory, visual printed words and visual pictures). This finding is inconsistent with previous studies that have indicated these tendencies. The third hypothesis stated that there would be an interaction between the mode of presentation and serial position. This also hasn't been supported in the current study. Since there was no significant interaction, the existence of the two storage mechanisms also cannot be verified.

Nilsson [16] discussed the locus of the modality effect in free recall. It is suggested that, the interaction between word-length and word frequency needs to be taken into account while looking at the locus of modality effects. If the current study took these factors into greater consideration, the results could have shown a significant modality effect. One of the reasons why the hypothesized significant modality effects were not seen could be due to the experimental design of the present study being between-subjects to test that aspect. Researchers [17] made use of a within-subjects design wherein participants underwent each of the treatments, which may have resulted in more precise assessments. Individual differences wherein some participants might be poor at recall tasks overall. Future research can look into these effects with a within-subjects design in order to rule out whether this was the potential problem.

Another potential reason for why the modality effects were not seen could be due to the kind of stimuli used in the current experiment. Scientists have found a main effect of modality input with a superior recall in visual images. They made use of picture stimuli from a collection of 100's of clip art pictures. They made 40 participants from the sample population name the pictures and the pictures that were named consistently for more than 90% of the time were used in their experiment. In the case of our experiment, the images were only tested upon 4 people within the group, which could have hampered the efficacy of the image stimuli. Assessing more images would have resulted in a main effect [18].

Lastly, increasing sample size and would have yielded significant effects and obtained a greater power. Looking at the partial eta squared as a measure of effect size for our experiment (0.088) suggests a weak/small effect size, which could have been the reason of no main effect of modality and interaction between serial position and modality. Conducting a power analysis beforehand instead of estimating from the sample sizes used in previous studies would have provided us with the amount of participants required to detect an effect that could have been essential.
The serial position effects can be applied in public speaking where one tries to remember a speech or a script for a play. The serial position (primacy/recency) effects have important implications for advertising such as television ad placement. It has been indicated that television audiences have a superior recall of ads at the end of the commercial break suggesting a greater recency effect than primacy effect. A review of the serial position effect has suggested that primacy and recency effects also have been seen in website link placement wherein the links at the top and the bottom of the page on a website gained the most clicks [19].

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Acknowledgements – Nil
Source of Funding – Nil
Conflict of Interest – Nil

APPENDIX 1

LIST OF WORDS

Coffee
Baby
Pillow
Whistle
Table
Butter
Window
Towel
Money
Balloon
Rabbit
Carrot
Spider
Kettle
Magnet
Necklace
Mountain
Candle
Ruler
Scissors
Chicken

APPENDIX 2 – AUDITORY STIMULI

Instructions

The experimenter will read aloud a list of 20 words, at a steady pace.
When the list is complete, the experimenter will say 'recall'.
Please then recall aloud as many words from the list as you can. You can recall in any order you wish.

APPENDIX 3 - VISUAL PRINTED

Instructions

The powerpoint presentation will present 20 printed words, at a steady pace.
When the list is complete, 'recall' will be written in red font.
Please then recall aloud as many words from the list as you can. You can recall in any order you wish.

APPENDIX 5- VISUAL PICTURES

Instructions

The powerpoint presentation will present 20 images, at a steady pace.
When the list is complete, 'recall' will be written in red font.
Please then recall aloud as many words from the list as you can. You can recall in any order you wish.