

DIFFERENCES IN VISUAL AND AUDITORY SHORT-TERM MEMORY

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ABSTRACT

Short-term memory has always been thought of as an auditory process. However, short-term memory is considered a visual process as well. The purpose of this research was to discern whether auditory or visual short-term memory is held for a longer and more accurate duration. An analysis of variance indicated the visual presentation was recalled more accurately than the auditory presentation [$F(1,37)=69.07, p<0.01$]. The results also showed short words were recalled more accurately than the long words [$F(1,37)=22.02, p<0.01$]. The auditory condition seemed to be more mentally fatiguing for the participants as indicated by the amount of mistakes made in retention and the retrieval of the words.

Several studies have been done on the differences between visual and auditory short-term memory. Short-term memory has usually been thought of to be primarily an auditory process. Current evidence has shown that short-term memory has the tendency to be a visual procedure as well. In recent years there have been dissimilarities involving the amount of recall ability that visual and auditory short-term memory demonstrates.

Short-term memory is thought of to be the place new information is placed for later retrieval. Short-term memory is split into two different types of categories. New information can be taken into short-term memory either through a visual or auditory receptor (Ashcraft 112). The information is then placed into short-term memory to be retrieved, transferred into long-term memory or just simply forgotten. If the stimulus is placed into long-term memory, which can activate some other information in short-term memory, the item in long-term memory could be transferred back to short-term memory (Atkinson 112). This model is called the information flow, which was designed by Atkinson (112). This model works by collecting information through visual or auditory receptors and then placing it into the temporary working memory or short-term memory. While the information is in the temporary working memory, the process of rehearsal, coding, and retrieval is executed to allow for the correct response to occur. This is what has been referred to as the control process of short-term memory (Atkinson 112).

Short-term memory is an example of how the brain processes information differently when it is either received through visual stimuli or through auditory stimuli, which are both sensory processes. The auditory recoding is very different from visual recoding (Crowder 71). For example, the visual stimuli were seen and heard through rehearsal maintenance in the brain. However, the auditory stimuli were only heard, making that a more difficult process to perform. The brain is required to create images presented through a perceptual receptor, which is an image the brain creates through its sensory processes instead of seeing and then creating pictures in whatever form the stimuli were presented (Crowder 71).

The development of items in short-term memory contains more than just the arrangement and retention of sensory and perceptual stimuli. The brain functions cognitively to create what some psychologists have called making a 'mental image.' This is the ability to illustrate the retention of detailed visual information, even if the information is a list of words. The brain will create a picture to represent each word. A 'mental image' is a sensory episode that is produced by 'mental pictures' the brain already has stored to establish some type of recall. When the brain is processing a visual image, the cognitive functioning requires the discovery of a 'mental image,' but when the cognitive functioning is the process of an auditory stimuli, the brain needs to hear the word and then create a 'mental image' in order for a correct recall to take place. A possible problem could be the subject's perception, interpretation, or input problems like distractions from the

environment where the processing is taking place (Gregg 43-52).

A study was done to see if there are variations among visual and auditory short-term memory in the accuracy of correct recall. The duration capacity for a subject to hold either visual or auditory information was also observed. It is hypothesized that visual short-term memory will have a longer and more accurate duration than auditory short-term memory.

METHOD

Participants

Thirty-eight P103 male and female traditional psychology students (ages ranging between 18-22 years) at Indiana University South Bend volunteered to participate in this experiment for enrichment points. The volunteers were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association 1992).

Materials

Four lists of words were used for each condition for a total of 8 lists. The lists were comprised of words from a collection of nouns that reported imagery content. I picked words that had on average a 6.00 to a 7.99 imagery-content from an appendix that illustrated 925 nouns with various imagery-contents. The eight lists varied in syllables and lengths. Each list contained 10 words. There were 40 words used for the visual section and 40 words used in the auditory section. The lists were comprised of 10 short 1-syllable words, 10 short 2-syllable

words, 10 long 2-syllable words and 10 long 3-syllable words. A stopwatch was used to ensure proper exposure to each word.

Procedure

A between subjects experiment was conducted, which consists of two groups that were compared. The experiment consisted of two conditions: visual and auditory words with varying lengths and syllables. The lists were placed in a randomly selected order. The first nineteen participants, the control group, received the visual, then auditory lists. The second nineteen participants received the same lists, but the lists of words were in the direct opposite order. The words were given in accordance to the condition. The participants were shown a word for three seconds, then shown the next word. After each list was shown, the subjects were asked to recall the words they remembered. The same procedure was used for the auditory condition; the auditory condition consisted of reading words from a list to the participants instead of the words being shown. After the experimenter read each of the auditory lists, the subjects were asked to recall what they remembered. The participants had 3 seconds in which to process each word. The participants were asked to either look or listen to each word.

RESULTS

Table 1 shows the mean scores between groups. Table 2 shows a main effect between the visual or auditory presentation and the length of the word. The percent of mean scores between groups is presented in Figure 1. The percent of recall responses is present in Figure 2.

Table 1: Mean Scores Between Groups

	Short 1 Syllable	Short 2 Syllables	Long 2 Syllables	Long 3 Syllables	Mean
Visual	0.85	0.84	0.79	0.78	0.82
Auditory	0.74	0.72	0.63	0.67	0.69
Mean	0.80	0.78	0.71	0.73	

Table 2: Main Effect Between the Visual and Auditory Length of Words

	Short Words	Long Words	Mean
Visual	84%	78%	81%
Auditory	73%	65%	69%
Mean	79%	72%	

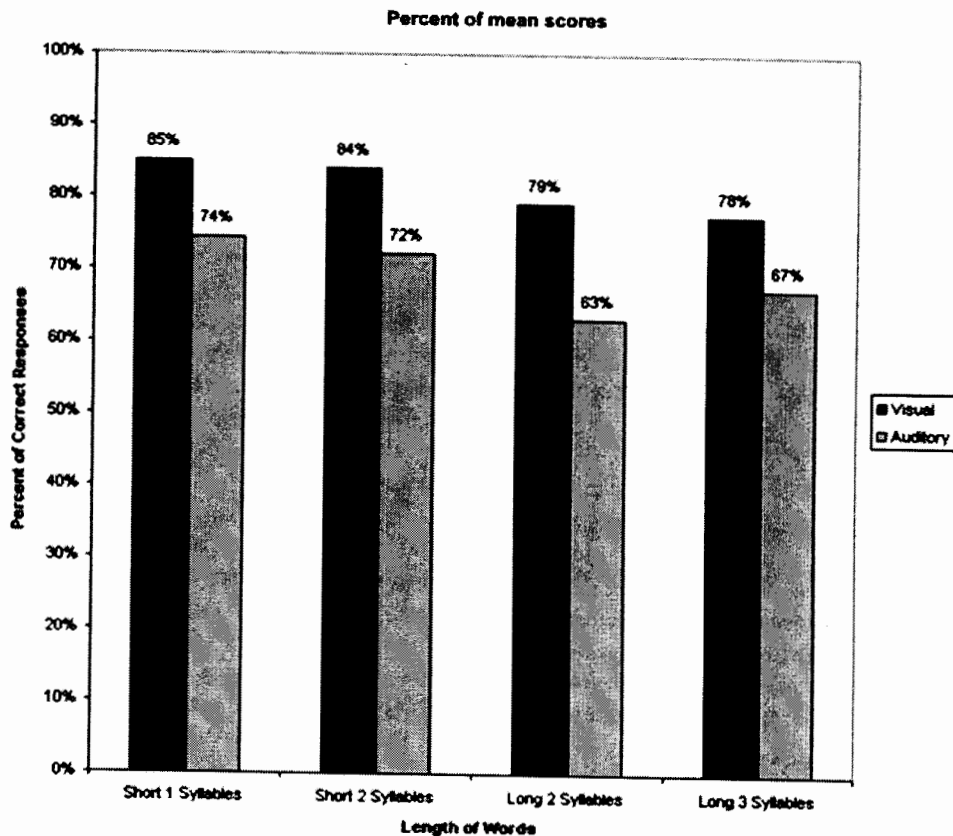


Figure 1: For each condition (Visual and Auditory), the percent of mean scores of correct responses from participants for the length of words is presented.

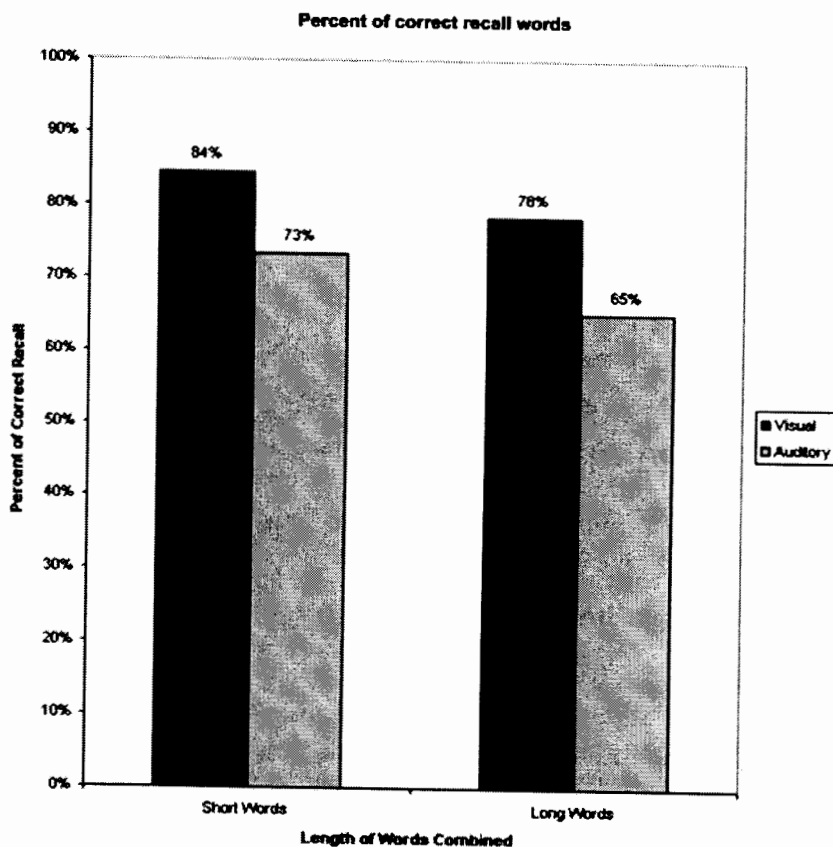


Figure 2: For each condition (Visual and Auditory), the percent of the correct recall of words from participants for short words and long words is presented.

I used a two factor repeated measures ANOVA for the analysis of variance. The inferential statistics showed a modality effect of the visual presentation was recalled more accurately than the auditory presentation, $F(1,37)=69.07$, $p<0.01$. The short one and two syllable words were recalled more accurately than the long two and three syllable words, $F(1,37)=22.02$, $p<0.01$. There was no interaction found between the visual and auditory conditions or the length of words. This shows that the length of word does have a main effect. The three syllable words were harder to remember than the shorter one and two syllable words. A serial-position effect was found in all of the eight lists that were presented.

DISCUSSION

The results of the data analysis reject the null hypothesis that there is no difference between visual and auditory short-term memory. As hypothesized, visual short-term memory will have a longer and more accurate duration than auditory short-term memory, because the item being presented is cognitively processed by two different brain functions within short-term memory. The item that is processed visually is digested by a visual receptor within the brain. When an item is presented through auditory receptors, the cognitive process is only thought of as being a form of repetition.

The length of word variable was statistically significant. The length of the words was instrumental in recall. This shows that the shorter words were held for a longer and more accurate capacity. Some interference was observed in the auditory word condition but not enough to cause significant results. This could have been caused by the amount of words the subjects were required to process. The brain will fatigue after an extended period of activity, which could be the cause of the interference that took place.

No difference was found in the order of presentation. I expected to find a difference in the order. I changed the order of conditions for that reason. Since no difference was found, the accuracy of recall and duration is not affected by the order of visual or auditory word arrangements.

There is a variation among the visual and auditory words. Since the words have a main effect, it appears to be easier for this group of subjects to recall the visual words with more accuracy. The same can be said about the length of words. It appears to be easier for this group of subjects to recall the shorter words with greater precision. There could be another reason why this group of subjects was more precise in the visual condition than the auditory condition. This group of 38 could have a tendency to be visual learners. If this study was repeated with auditory learners, I think the auditory condition

would have a higher percentage of correct answers in the auditory condition.

A serial-position effect was observed in all eight lists (a serial-position is when a subject will remember and retain the first and last couple of words with more accuracy than the words presented in the middle). The first 2 or 3 words and the last 2 or 3 words were retained longer and more accurately. Thus, a person has a tendency to remember the first and last few items being presented because the brain will start to rehearse the information that was presented first and last, and have an inclination to forget the middle items. There was also less interference detected with those first and last couple of words. There was a slight trend between the visual and auditory condition with the length. That interaction was not significant.

Several implications have been discovered by this experiment. Short-term memory has been thought to be an auditory process. After doing this study, it seems as though short-term memory can be thought of as a visual process as well. This becomes apparent because the visual condition recalled more words correctly. In fact, the visual condition did relatively better than the auditory condition. This could be due to the fact that these subjects were better at visual learning for the most part. For example, when subjects are given a series of pictures or lists of words, the brain begins to process that information by two different cognitive operations. After the operations are finished, the item(s) are placed into short-term memory. This allows the brain the ability to have two different forms, either through a mental image or repetition, from which to gather for recall. On the other hand, the group of 38 subjects could have been visual learners instead of auditory learners. Another implication that should be studied is why learning and short-term memory has previously been thought of as an auditory process. In future research, the experimenter should focus on why visual short-term memory learning seems to be more accurate than auditory short-term memory.

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ELIZABETH HILTON graduated in May 2001 with a degree in Psychology and a minor in Philosophy. This research paper was written for the Psychology Senior Lab.