

The Effects of Simultaneous Pairing of Auditory and Visual Stimuli And Visual Stimuli in Short-term Memory

Jonathon Wood and Emmalee Eriksen

Undergraduate Students, Psychology

Key Words: memory recall, audio, visual

Abstract: *The current study looked at the effects of the simultaneous pairing of auditory and visual stimuli in short-term memory recall. The study contained three conditions; visual stimuli only, auditory stimuli only, and the two stimuli simultaneously combined. The participants were a sample of 60 undergraduate students at the University of Wisconsin-Stout, which consisted of 30 males and 30 females. A 3x2 factorial design was used divided by sex and the stimulus condition. Each participant was presented with a slide show and later asked to free recall. Results showed that simultaneous pairing significantly yielded more items recalled than both of the isolated stimuli. Therefore, it can be concluded that the combination of auditory and visual cues can lead to improved short-term memory storage and retrieval. Significance in the classroom and work training sessions are discussed.*

Introduction

A person's short-term memory is in constant use in his or her everyday life. It is used to remember what has just been read in the last sentence, or even to remember where something was placed a moment ago. It is difficult to find a life task that does not require the use of short-term memory storage and encoding. One situation in which short-term memory is in constant use is in the school setting. In fact, traditional education has focused on memorization for centuries. Even the task of remembering what was written on the board, long enough to write it in a notebook, is a function of the short-term memory. Since this function of the brain is so commonly used, there has been much research regarding short-term memory. If, through research, one could find a way to improve short-term memory, or at least better understand it, it could have implications in every aspect of many individual's daily lives. This is why the topic of memory is so common in psychological research.

Short-term memory plays a key role in the mundane functions of peoples' everyday lives. According to Shallice (1982), however, people also rely on short-term memory for higher order operations such as problem solving, troubleshooting, and developing plans. The involvement of short-term memory in these processes is known as the Supervisory Attentional System. With this in mind, it is apparent that short-term memory is an extremely important aspect in dealing with surroundings. Consequently, it is important to study implications of short-term memory in the realms of adjustment, adaptation, education, and development. Psychologists aim to understand what affects a human's abilities to process, store, and encode new information. The first step of gaining this understanding is to identify the key variables of short-term memory. The second step is to determine how the variables affect one another.

As noted before, it is difficult to avoid situations where we are presented with new information that is only relevant for a short time. When we take in this information we either soon forget it or we retrieve the information needed to process and perform the intended function. For example, when a person meets a new group of people in a temporary social or business setting, it is important to remember each of their names during the time spent with these people. After the group parts ways, there may no longer be a reason to remember the newly learned names, so the

names are forgotten. Human brains strive for efficiency, so information such as a temporary acquaintance's name becomes lost. This is due to the fact that it is no longer necessary to store that information.

For most, short-term memory operations, such as remembering a new acquaintance's name, comes naturally and is relatively easy. During the limited time spent with that person, recalling his or her name is second nature. Memory retrieval processes, that people do not realize are happening, are known as implicit memory. Information can become a part of implicit memory by way of familiarity or repetition, or by the level of processing involved in storing the information. In meeting an individual and recalling his or her name, people process the new information according to a variety of stimulus cues. One most likely looks at his or her face and stores a visual representation of the new acquaintance. The person then says his or her name, which gives a label to the visual representation and an auditory stimulation to store to other person's brain. Hearing the name not only labels the face in the brain, but also gains another identifying cue, that person's voice. A simple introduction offers a variety of information to be stored within short-term memory that, in turn, renders the task of remembering the person and the associated cues, for the brain. The question posed in this research is how strong of an effect pairing a visual stimulus with an auditory stimulus has on a human's short-term memories?

Although the relationship between visual imagery and memory has been studied quite thoroughly, auditory association has been less explored, especially auditory associated with visual words. A study by Haan et al.(2000), examined memory in four conditions including visual words combined with hearing an associated auditory, visual word with the subject repeating the word, visual word combined with subject writing the word down, and finally simply the visual presentation. "The results show a similar memory performance in all conditions in which subjects did not hear the words (either via auditory presentation or via their own vocalization), fewer words were remembered" (Haans et al., 2000, p. 577). In a related study by Sharps and Price (1991), the mnemonic value of auditory imagery is examined by comparing visual pictures linked with auditory to simply visual pictures alone. Findings showed, "Pictures and characteristic sounds were associated with significantly better recall than were verbal labels alone, indicating that auditory imagery has mnemonic value similar to that of visual imagery" (p.81). Burrows and Solomon (1975) conducted research that examined the reaction time of free recall under conditions of auditory and visual stimuli alone, as well as combined. Results showed "that the paired stimuli yielded shorter reaction times than isolated stimuli" (p. 416). These results appear to support the connection between auditory and visual stimuli and the increase of short-term memory. This study used reaction time as the dependant variable whereas the following study examines the dependant variable of number of words recalled in the same conditions.

The aim of this research is to determine if pairing visual and auditory stimuli will have an effect on short-term memory when compared to an isolated stimulus. It is hypothesized that the data will show the number of items recalled will significantly increase when auditory and visual stimuli are displayed simultaneously (compared to when each stimulus is isolated). It was also hypothesized that the isolated auditory condition will result in the lowest amount of memory recall. If the hypothesis is correct, the results could be generalized to many situations and disciplines. Some specific situations this research could impact are that of the classroom learning environment, work training situations, and general social encounters. If it is determined that auditory stimuli linked with visual stimuli significantly improves short-term memory, it could be a great tool for teachers and employers alike to use.

Method

Participants

Participants in this study consisted of a sample of 30 male and 30 female undergraduate students from the University of Wisconsin-Stout (UW-Stout). There were 20 participants, 10 male and 10 female, in each condition. The participants were solicited from an online study recruitment

program, as well as directly from two general psychology classes at UW-Stout.

Materials

The experiment was administered in several private rooms containing one participant each. Each room contained a computer on which the stimulus was presented on a time controlled Microsoft® PowerPoint® presentation. Each condition had its own PowerPoint presentation. The auditory stimulus was administered via headphones that were connected to the computers. Images used in the slide shows were attained through Google® image searches (Internet search engine). These images were manipulated to have white backgrounds with the use of Adobe® Photoshop®. The auditory stimuli were attained through free sound effect download websites. Each participant was given a sheet of paper that contained a numbered list for recall. The other side was blank and was used for the retention interval (that was presented through the slide show). The participants' gender and number were also recorded on this sheet.

Procedure

A pilot study was conducted that recruited 20 colleagues to ensure that all stimuli were easily identifiable and that the sounds, which accompanied images, were accurate representations of the image. This consisted of 20 slides with only auditory stimuli to validate recognition and clarity of the stimuli. Participants were asked to identify the object, as well as rate how confident they felt that they were correctly identifying the object. The rating for this was a scale from 1 to 5, 5 being the highest. Any auditory stimulus that was identified incorrectly by more than 3 colleagues, or received consistently low confidence ratings, was discarded from the experiment.

The experiment used a 3x2 factorial design. Groups were separated based on gender and the type of stimulus administered. Stimulus groups consist of visual only (V), audio only (A), and the simultaneous presentation of visual and audio (VA).

Upon arrival to the lab, each participant was assigned sequentially based on gender to one of the three conditions. The participants were then assigned to a room where they were presented with the visual stimuli from a computer slide show and the auditory stimuli through headphones. Each participant was alone in the room during the test. The participants were given simple directions by the experimenter, which were also displayed at the beginning of the slide show. The experimenter then left the room and the participant could begin the slide show, by pushing the space bar, when ready. The stimuli consisted of 15 slides that were preset to intervals of four seconds between transitions. Participants saw only a white screen in the auditory condition and were issued auditory stimulus via time controlled PowerPoint slides.

Following the presentation of the stimuli, the participants were given instructions to complete two minutes of math problems, displayed on the screen, to reduce rehearsal methods. They were told to use the blank side of the paper provided at the beginning of the experiment.

Following the two minute retention interval, participants were then given two minutes for free recall of the presented stimuli on the front side of the paper provided. The amount of words recalled during the free recall period was the dependent variable of this experiment. Following the experiment, the participants were debriefed and informed that the study had nothing to do with their mental capacity or intelligence. Also, the type of results that were expected from each of the three conditions were discussed. They were also told that their recall scores would be kept anonymous.

Results

A one-way analysis of variance (ANOVA) was conducted to examine the differences in means between the three groups. The number of words recalled was the dependent variable and the three conditions were the independent variable. The results of the ANOVA were significant, $F(2, 19) = 11.921, p = .000$. As hypothesized, the group that received simultaneous audio and visual stimuli had the highest mean ($M = 9.4, SD = 1.903$), followed by the visual group ($M =$

7.95, SD = 2.231) and the audio group had the lowest mean (M = 6.60, SD = 1.142). No significant differences were found at any level between males and females.

A Scheffe Multiple Comparisons post-hoc analysis was conducted as well to understand the specific differences between the groups. The results showed that the simultaneous stimuli group had significant differences at the 1-tailed level with both the audio group ($p = .000$) and the visual group ($p = .033$). The audio group and the visual group, however, did not have significant differences ($p = .103$).

Discussion

This study has displayed the positive effects of linking visual and auditory stimuli in short-term memory recall. Therefore, it can be concluded that the combination of simultaneous and related stimuli can enhance memory recall.

The results of this study could have an impact on education in the classroom and work settings. It has been established that short-term memory recall is necessary for one to truly grasp the information presented in situations. It is effective in places such as classroom lectures and work training programs because information can often be fleeting. Educators often have to be brief with some of the more detailed information because time constraints require them to focus on main points. These details, which are often only highlighted in a lecture or training session, are usually ignored. In order to get the full impact of an educational program, the minute details must be retained. It is common for educators to use an only auditory lecture with few visual stimuli, which typically consists of written words on a projector. The results of this study indicate that this is not the most effective way to fully convey information.

Combining vivid visual stimuli with auditory stimuli is shown to significantly yield better short-term memory recall. It can be concluded that changes to enhance education must occur to implement more interactive styles of learning.

There are some changes that could be considered for next time. Future research should look at the effects of an auditory stimulus of the word being pronounced. Also, a larger sample size could make the research more conclusive. It may develop some significant differences between males and females, or between the two isolated stimuli.

References

- Burrows, D. & Solomon, B. A. (1975). Parallel scanning of auditory and visual information. *Memory and Cognition*, 3(4), 416-420. Retrieved September 22, 2004, from EBSCOhost database.
- Haan, E.H.F., Appels, B., Aleman, A. & Postma, A. (2000). Inter-and intra-modal encoding of auditory and visual presentation of material: Effects on memory performance. *The Psychological Record*, 50(3), 577-86. Retrieved September 22, 2004, from Wilson Web database.
- Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society London*, (B)298, 199-209.
- Sharps, M. J., & Price, J.L. (1991). Auditory imagery and free recall. *The Journal of General Psychology*, 119(1), 81-87. Retrieved September 12, 2004, from Wilson Web database.