

A COMPARATIVE STUDY OF VISUAL & AUDITORY SHORT TERM MEMORY IN CHILDREN & TO EVALUATE RECALLING.

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Abstracts: Background and Objectives: The process of retention and storage of any kind of information is known as Memory. In this study we are trying to find out which form of memory is accurate and can be recalled best; hence present study was conducted to compare the Visual & Auditory Short term memory (STM) in children and to evaluate the rapidity and specificity of response of children to both Visual and Auditory inputs (assessing Working memory status). **Materials and Methods:** After appropriate consent from parents and school teachers; the study comprised of 100 (50 boys, 50 girls) Healthy Children aged 11-15 years of National Higher Secondary School, Raipur (C.G.). Children having infirmities (Visual or Auditory) were excluded. Reaction time for audiovisual exposures to recalling is noted. **Results:** There is a strong difference between the retention and storing capacity of visual STM and auditory STM ($p < 0.001$). The mean reaction time is more for long words than short words. Short words are remembered more accurately than long words. **Interpretation and Conclusion:** The visual STM has a short mean reaction time and more accuracy than auditory STM. STM and working memory plays an important role in the learning processes of school children. **Keywords:** Auditory short-term memory, Visual short-term memory, Working memory.

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Introduction:

One of the higher functions of human beings is to recall the events which have occurred in the past. The storing and memorizing property of brain is termed as "Memory". So memory can be defined as "the process of retention and storage of any kind of information for short or long periods." The purpose of present study is to compare the two categories of short term memory i.e. visual and auditory. Through our study we tried to find out which form of memory is accurate and can be recalled best. As the development of memory occurs mostly during the childhood, so the subjects included are school children. Several studies have been done on the differences between visual and auditory short-term memory^{1,2,3}. 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 well⁴. In recent years there have been dissimilarities involving the amount of recall ability that visual and auditory short-term memory demonstrates.

In view of above consideration, the present study is an attempt to compare the visual & auditory short term memory in children aged 11-15 years & to evaluate the rapidity and specificity of response of children to both visual and auditory inputs (assessing working memory status).

Materials and Methods:

The study (Cross-sectional) comprised of 100 students (aged 11 years to 15 years) from National Higher Secondary School, Kutchery Chowk, Raipur (C.G.) from January to April 2010. Out of 100 participants, 50 were boys and 50 were girls. The students were allowed to participate in the study after taking appropriate consent from parents and school teachers and ethical approval from college ethical committee. Mean age was 12.5 for all 100 students. The students were randomly selected and those having any infirmities were excluded.

Testing Memory – For comparing the visual and auditory short term memory two lists of words were used for each condition for a total of 4 lists. The lists were comprised of words from a collection of nouns and each list varied in syllable and lengths^{5,6,7,8}. Each list contained ten words. There were twenty words used for the visual section and twenty words used in the auditory section. The lists were comprised of ten short words and ten long words. A stopwatch was used to ensure proper exposure to each word. Before starting comparative study, all students were generally examined regarding height, weight, pulse, BP, pallor, edema, Cyanosis, clubbing, icterus, lymph node enlargements. Systemic examination was done to rule out any pathology.

Each child was tested individually. Testing was done in a well illuminated quiet room in school.

For visual section –Visual acuity was checked in each student. A list of 10 short words was shown by OHP; each word was exposed for 3 sec so total time is 30sec. In next 30sec. they were asked to recall and write the words remembered. The reaction time which is the time between the exposures to recalling was noted. After that a lists of 10 long words were shown for 30sec. each word exposed for 3sec. and next 30sec. were allowed to recall and write the words remembered.

The auditory section was tested in same manner by reading 10 short words and 10 long words lists in front of each student. After auditory exposure of each of the auditory lists, the subjects were asked to recall what they remembered. The procedure was repeated for each student. Tested students were placed in another room by the side of testing room. The data so collected was subjected to tabular analysis.

The result were analyzed by using various statistical techniques like percentage, mean, standard deviation, Z test, T test, Test of significance.

Table:1 –Mean reaction time visual and auditory

	Short words	Long words
	Mean/SD	Mean/SD
Visual	5.07±1.99	5.21±1.79
Auditory	6.02±2.59	8.32±3.00
Total Mean	5.54±2.29	6.76±2.39

According to above table the mean reaction time is less for short words than for long words in both visual and auditory task. It indicates that the short words are more accurately remembered than long words.

Table: 2 Comparison between visual and auditory short term memory

	Short words	Long words	p value
	Mean/SD	Mean/SD	
Visual	3.53±1.75	1.92±1.10	<0.001
Auditory	2.59±1.11	1.18±0.67	
Total	3.06±1.43	1.55±0.88	

A comparative study between visual and auditory short-term memory revealed that visual information are remembered and recalled more accurately than the auditory presented information(table no 2).

Table:3 Effect of age on short term memory

Age group	Visual	Auditory
	Mean/SD	Mean/SD
11-13yrs	54.21±26.74	37.63±14.95
>13-15yrs	55.41±26.37	37.91±15.59
Total	54.81±26.56	37.77±15.27

The table no 3 shows that the short-term memory storage capacity increases with age but not significant and a difference of 1.2 mean for visual short-term memory and 0.28 for auditory short-term memory.

Many studies found significant effect of increasing age on memory capacity^{9,10,11}.

Discussion:

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 receptor¹². 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 memory¹³. 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.

The auditory recoding is very different from visual recoding¹⁴. 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 perform¹⁴.

The result of present study shows that the reaction time, which is the time taken by students to recall and write their answers, is less for the short words as compared to long words means it is easier to remember the short words and they are recalled rapidly in case of both visual and auditory stimuli.

The analysis shows that visual short-term memory has a shorter reaction time and more accuracy than auditory short term memory and a strong difference between storing and recalling capacity of visual and auditory short term memory (table no 1 and 2). This is 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. (Table no.1)

Koppitz EM in a visual aural digit span test found better visual performance⁸.

John W and Hitch GJ concluded that mean addition span were higher for visual presentation than oral presentation¹⁵.

A significant difference between visual and auditory short term memory was also revealed by Elizabeth H ($F(1,37) = 69.07, p < 0.01$)³.

Alloway TP, Gathercole SE and Pickering SJ also found that the visual tasks had greater values in comparison to auditory task¹⁶.

Though the above researchers found that visual short term memory was better than auditory, some experiments presents better auditory scores than visual. Evan, Hilary and Fontana D and Shinrigaku K justified this & had observed a consistent superior aural/auditory short term memory^{1,2}.

The length of word variable was also significant and was instrumental in recall (Table no 2). Some interference was observed in the auditory word condition but not enough to cause significant results.

Since the words have a main effect, it appears to be easier for the included subjects to recall the visual words with more accuracy. The same can be said about the length of words. It was also found that recalling of shorter words is easier than longer words (table no 1,2,3). The reason for better visual STM in the participating students could be because of tendency to learn from visual stimulus.

The measurement of short term memory is done by several tasks, Daneman M and Carpenter PA invented the 1st version of 'reading span' task¹⁷. But earlier, Sperling G already had suggested a capacity limit for visual short term memory i.e. 2 to 6 words or digits¹⁸.

In present study, the students were able to recall maximum 3 words out of a list of 10 words. There are many factors which affect the capacity of short term memory like age, sex, performance

intelligence, etc. Table No.3 shows that the memory scores increases with increasing age.

Effect of age on memory had also been studied by John WA and Hitch GJ, Isabel PM and Alloway TP, Gathercole SE and Pickering SJ. They found that the task scores were increasing with age^{10,14,15,19}.

However, Ellis NR, Woodley ZA and Dulancy CL and Bjerklie GL and Harton A did not find any significant correlation between age and memory^{14,20}.

Several implications were discovered by different studies and were thought that STM was related to an auditory process²¹. After doing this study, it was found that short-term memory can be 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, which has the ability to recall two different forms of information either through a mental image or repetition, recall together. On the other hand, the group of 100 subjects could have been visual learners instead of auditory learners.

Conclusion:

- The mean reaction time is more for long words than short words, and it does not depend on mode of stimulus presentation. Means short words are remembered and recalled more rapidly than the long words.
- Visually presented stimuli are remembered and recalled more precisely and accurately than the auditory presented stimuli. There is a strong difference between visual short-term memory and auditory short term memory ($p < 0.001$).
- Short words are remembered more accurately than long words.
- The memory task performance increases with age. Elder children scores better than younger children but it is not very significant (p value is more than 0.05).

The present study concludes that the Short term memory and Working memory plays an important

role in the learning processes of school children. Impairments of memory are closely associated with learning deficits, as well as daily classroom activities. To improve the short term memory of school children visual things and activities can be preferred and thus classroom outcomes can be increased.

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