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Research Paper

A Comparative Study on the Immediate Memory Span of the Students Studying at Six and Eleven Grades

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ABSTRACT

The present study was carried on to examine whether immediate memory span varied in terms of ages.196 students aged 11-16 studying at six and eleven grades participated in the experiment where they have presented three lists of numbers containing ten numbers each verbally one after another with five minutes intervals among each of the lists. Written recalls from the subjects were received after each number of the list had been presented. A two-tail t-test found significant differences between the immediate memory span of the six and eleven-grade students. Furthermore, some differences in cognitive behavior such as in recalling the larger size of numbers were observed among the two groups. Factors that facilitated immediate memory span were discussed.

Keywords: *Immediate Memory Span, Short-Term Memory, Primacy Effect, Chunking Of Information.*

Memory developmental studies are considered the most studied topics of all cognitive development. Simply, memory is the sum total of what we remember. In a broad sense, memory is an ability to encode, store and to retain information and subsequently to recall this one from past experiences with an aim to influence current behavior (e.g., adaptation, building relationship) and future planning and goals. Among the types of memory (e.g., sensory memory, short-term memory, and long-term memory) short-term memory has a major implication on memory development.

Immediate memory span, the main research topic of the present study, measures the capacity of one's short-term memory that holds but not manipulates a small amount of information in the active or readily available state for a short period of time typically 10 to 15 seconds or sometimes up to a minute. It consists of the lists of items that a person is able to repeat back correctly after the presentation of all trials. The list of items may include numbers, words or

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letters. These tasks turn in to the digit when the number is used for participants to be repeated in correct order. From publications of Jacob's pioneer study (1887), experimental psychologists have paid their efforts almost exclusively upon the use of digit. Herman Ebbinghaus was considered the founder of the Experimental Psychology of Memory. His studies focused on the capacity of memory span of the children and young adults of different age levels with a particular interest in identifying the developmental memory span curves for various types of materials (e.g., meaningless words and syllables). His findings indicated that considerable age effects could be observed across various materials. Subsequently (1885/1913**),** he discovered that he could reliably learn to repeat in order list of seven nonsense syllables after only a single study period.

Regarding the capacity of immediate memory span, George A. Miller (1956) provided particular information in his famous article that was considered one of the most highly cited papers in Psychology titled "The magical number seven plus minus two: some limits on our capacity for processing information". He administered an experiment (1956) with an aim to examine the capacity of the digit memory span of young adults who were asked to repeat back the digits in a correct order it was presented to them earlier. This study revealed that subjects were able to retain seven items plus minus two in their short-term memory. These findings were supported by Jacob's study (1887) where 443 female students (8-19) appeared at digit span test, the aim of which, was to measure the capacity of the short-term memory for digits and letters.

Students were asked to repeat back of a string of numbers or letters in the same order presented and the numbers of digits or letters were gradually increased (e.g., 123, 4974, 57891). The findings of this study provided an empirical evidence that students could retain an average span of 7.3 letters and 9.3 digits. One concern for Miller's theory is that Miller did not take in to account other factors, for example, an age that affects memory capacity. Jacob's study (1887) made clear that short-term memory gradually improves with ages. Subsequent researches (e.g., Lobsien, 1902; Netschajeff, 1900) confirmed the effect of age on the immediate memory capacity. Buhler (1930) assumed that developmental gains are most pronounced in 10 to 12-year-old children and then again after puberty. This assumption was further strengthened by Bourdon's (1894) and Chamberlain's (1915) studies where they suggested a considerable increase in memory capacity during the late elementary school years, with only minor further improvements until early adulthood (see also Nagy, 1930). Conversely, there are some reports that contradict Bourdon's (1894) and Chamberlain's (1915) findings. Meumann's (1907) studies involving children and adults showed rather slow improvements in immediate memory until the age of 13 followed by rapid improvements between the ages of 13 and 16. Peak performance was observed by the age of 25. It's a short step to conclude that memory tends to change with age and few experimental psychologists would dispute. But we do want to refine this type of global statement by measuring the memory span of the students of different ages. The main aim of the present study is to examine the immediate memory span of the students studying at six and eleven grades. In particular, we would like to confirm whether the capacity of the immediate memory span differs in terms of ages. In the present study, we use three lists involving 30 numbers in total as used by Jacob's study (1887). The order of digits in the lists was set randomly thus nullifying the possibility of a serial effect. The present study involves students of six and eleven grade because although they are physically and mentally mature enough to acquire immediate memory, it is hypothesized that older (aged 16) might show better performance than the younger ones (aged 11) due to the farmers' having many experiences in education or in the daily life that might make them more aware or attentive to tackle the new situation that is evidenced by Neumann's study (1907).

METHOD

Subjects

196 subjects aged between11-16 participated in the experiment. They were from different high schools and colleges located in urban areas.

Materials

Three sets of stimuli (lists of numbers) were used in three phases. Each list of numbers contained ten numbers in which the lists of digits began at length three and increased to length ten. Digit was less repeated more than once in a number of a list. The numbers of digits were gradually increased in the lists.

Procedure

Subjects are individually tested in a classroom where three lists of numbers are verbally presented one after another with five minutes interval among each of the lists. More clearly, a number (e.g., 345) securing the first position in the list from the last one is presented to the subjects. Then the next number (e.g., 2987) securing the second position in the list from the list one is presented to the subjects. In such a manner, ten numbers from the list one are presented. After five minutes interval, ten numbers from the list two are presented to the subjects in a similar manner as that of the list one. The same procedures are applicable to the list three. Subjects are instructed to recall the digits in the order it is presented or as many digits from the list as they could remember. Written responses from the subjects are received after each number of the list had been presented. Subjects' correct and incorrect responses are marked with a tick (√) and cross (x) symbols respectively. The performances of the subjects are assessed by the method recommended by Woodworth and Schlosberg (1954). Subjects are verbally presented three lists of the number. If, for example, a subject correctly recalls all the lists up to and including five digits, a basal value of five is allotted. If above that value, the subject scores twice with six-digit lists, once with seven, not at all with eight and none further, his total score will be 5+3/3=5 (basal value+ additional correct responses/3), since equal credit is given for each correct recall above the basal level.

RESULTS AND DISCUSSION

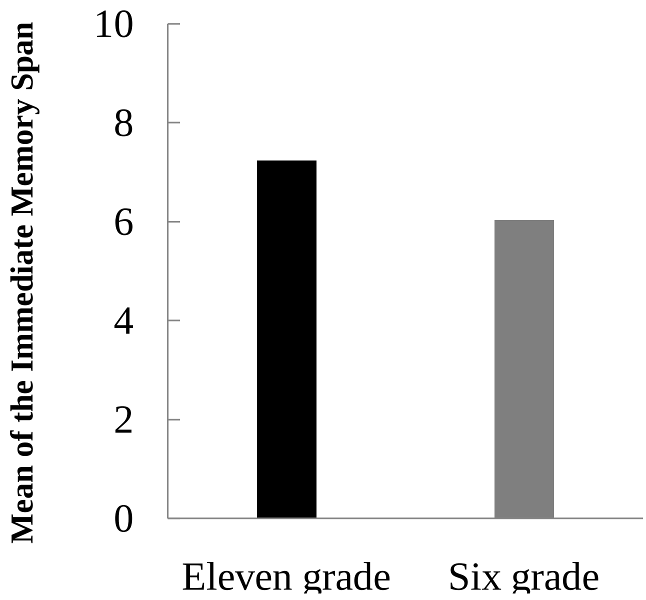
The means and standard scores including the *t*-calculated and *t*-table value of eleven and six grade students on immediate memory span tasks are shown in table 1 (insert table 1 here).

Table 1 Mean, standard deviation, t-test score and t-table value on immediate memory span of tasks performed by eleven grade and six grade students.

Group	No. of Participants	Mean	Standard deviation	*t*-score	*t*-table value
Eleven grade students	98	7.23	1.12	8	1.96
Six grade students	98	6.03	1.12		

Although the mean scores of both groups showed a little difference (mean scores are 7.23 and 6.03 for eleven and six grade students respectively), this one was stronger by two-tail *t*-test (*t*=8; *df*=194; level of significance=.05 where *t*-table value was 1.96) suggesting a significant difference between the immediate memory span of both groups that supported our hypothesis that immediate memory span might differ in terms of ages.

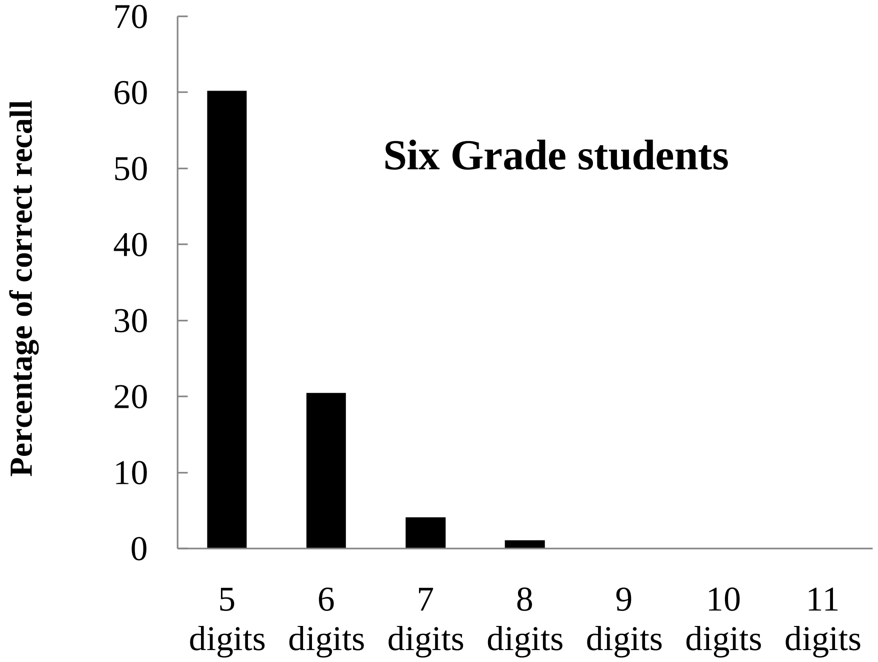
Figure 1 Mean of the immediate memory span of eleven grade and six grade students

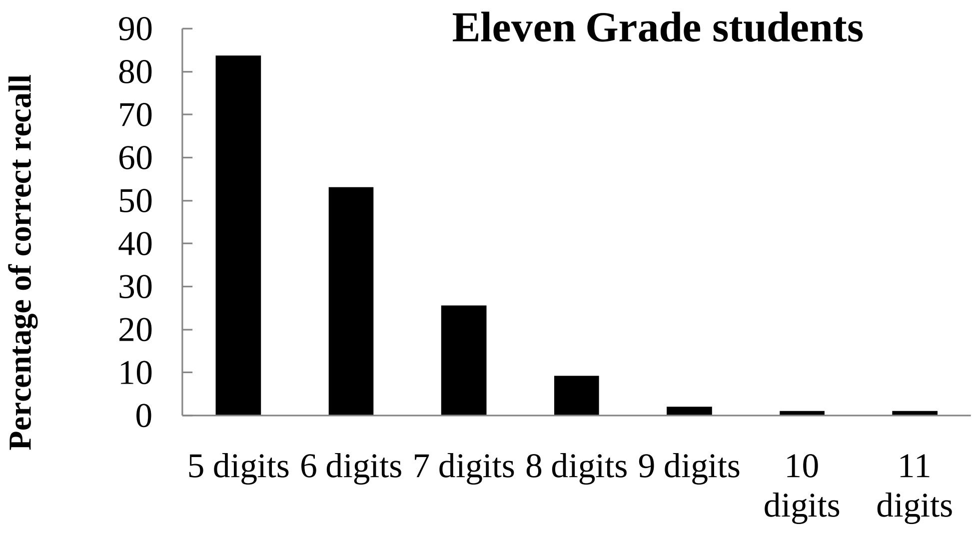


But the individual immediate memory span of both groups fell between seven plus minus two. These results add to the accumulating evidence (e.g., Millers, 1956) that humans can retain digits seven plus minus two irrespective of different ages, cultures, and nationalities. Students studying at eleven grade showed better immediate memory span in the larger size of items (e.g., 1342749) than that of six graders (although both groups showed better recall in the lists comprising smaller items e.g. 328, 6702, 83295). More specifically, it was observed that they made a better recall in the list of items comprising 6 digits (e.g., 469231), 7 digits (e.g., 5279821), and 8 digits (e.g., 157812453).

Conversely, six grade students made the opposite phenomena. For example, they easily retained the list of items comprising 3 digits (e.g., 261), four digits (e.g., 4903), and 5 digits (e.g., 53928) in their short-term memory and could recall these ones at a later period. But their correct recalls were interrupted when a number of digits began to be more than 5 digits **(**see figure 2**).**

Figure 2 Percentage of the correct recalls of eleven graders and six graders in terms of the number of digits belonging to three lists of numbers. Correct recall that fell between basal value and its prior correct responses were taken in to account in the graph.





During experimentation, there was a noteworthy observation that when six grade students have verbally presented the lists of digits, restlessness or hastiness prevailed in most of them. In some cases, they had begun recalling before all the digits in a number were presented. This scenario might occur due to one possible factor, that is, an immature emotional development and this one might be a possible factor behind six grade students' showing the comparative poor performances than that of eleven students. Interestingly, such emotional overexpression was not observed in eleven grade students. Thus, it is hypothesized that social, emotional maturity develops along with increasing ages. One similarity was observed between six and eleven grade students, that is, all of them had a tendency correctly recalled the first three or four digits in the lists comprising of larger items. As for instances, when 14567389 was presented, subjects of both groups correctly recalled the first three or four digits (e.g., 145 or 1456). Such responding tendency is known as primacy effect where early items have an advantage (Crowder, 1976). This one is produced from the first items having less competition from other items for limited memory capacity (Waugh & Norman, 1965).

A major line of thinking about Human cognitive development is that it is driven by learning and maturation that are obtained through ages, daily life experiences, education and so forth. As for instances, a complex task that a child can not do at the age of five may solve this one at the age of eight. An intellectual ability, patience, emotional balance, discretion, integrity and so on that are required for responding to a stimulus, problem-solving, decision making, and attention develops along with increasing ages (Jacobs, 1987). Because the more a child becomes old, the more experiences, education, learning he obtains that will contribute to his intellectual ability, or to forming strategies to remember more materials such as chunking by reorganizing information into smaller groups or clusters. This assumption is supported by a famous developmental psychologist named Jean Piaget who stated that the cognitive development of children occurred through a succession of stages the first stage of which is a sensory-motor stage (0-2 years) where a child learn the relationship between their bodies and the environment through the sense. In the pre-operational stage (2-7 years), children learn to form concept and to use symbols but have difficulty in classifying information.

The third stage called the concrete operational stage (7-12 years) produces logical thinking in children. The most notable feature of this stage is that children acquire the concept of conservation, implying a notion that quantity does not change despite changes in spatial arrangement or form. Abstract thinking, hypothesis, analogy begins to develop at the formal operational stage (12-adult). Summarily, Piaget's cognitive development theory indicates that human's cognition gradually develops from the tasks of simple to complex nature in terms of the increase of ages. The short-term memory works in line with the complex biological processes. The prefrontal cortex located at the front of the brain plays a vital role to maintain the normalcy of the short-term memory. It was evidenced (Jacobsen, 1935) that damages to the prefrontal cortex in primates linked to the deficits of short-term memory. The short-term memory contains two neural loops, one for visual data which activates areas near the visual cortex of the brain and another one for language, the phonological loop which uses broad areas that repeat word sound to keep them in mind.

There are some effective ways to demonstrate better immediate memory span. The first one might be that if subjects retained the items of the lists by a chunk of digits, their results might be better than what they demonstrated. In particular, if subjects memorized the digits from the lists (e.g., 14358910) in the manner of 143-589-10, their results could have been better (Miller, 1956). But the subjects participated in the present study had the tendency to recall the single long number at a time. Chunking of information facilitates the short-term memory to be broader in capacity. It provides an advantage to the information to be organized into shorter meaningful groups to make them more manageable. As for instance, a phone number (e.g., 01712627897) split into groups of three or four digits (e.g., 0171-262-7897), tends to be easier to remember than a single long number (e.g., 9583894878). It was evidenced (Simon, 1974) that the number of letters or digits should be three (e.g., 365) for chunking that makes a robust recall.

In short-term memory, items/events are being stored one after another. Many items are stored in the short-term memory within a very short time. When information is stored in the memory one after another, the first one takes a position below that of the second one. In such a manner, the old information is suppressed by the new one. Therefore, it is assumed that the storage capacity is dependent on the information being stored. For instance, the span is lower for long words than it is for short words. The other one might be that if the subjects were presented the lists of numbers both verbally and visually, their immediate memory span could have been better. Bisensory (auditory and visual condition) presentation might produce higher recall than single-mode (auditory) that was adopted in the presented study. One justification of this assumption might be that usage of two modalities (e.g. auditory and visual) provides the subjects more information (an e.g. wider aspect of learning tasks) than one modality (e.g. pure auditory condition) thus contributing much retention to the short-term memory. For example, the visual presentation might offer different perceptual features (e.g. size, color, shape) of the stimuli. Similarly, the verbal presentation might provide auditory information thus increasing the amount of memory in the short-term memory. Short-term memory spontaneously decays in 10-15 seconds if it is not retained by repetition or rehearsal. When much information (e.g., words, number, pictures) are stored in short-term memory at a time, this one effectively competes with each other for recall. New contents try to push out older ones unless the latter one is actively protected against interference by rehearsal or by directing attention to it. When something in short-term memory is forgotten, a nerve impulse is ceased being transmitted through a particular neural network. Without an impulses reactivation, it stops flowing through a network after a few seconds.

Earlier, it is mentioned that experimenters verbally presented the lists of digits to all the subjects (one by one) in the present study. In this case, despite experimenters' having sincere efforts to maintain the same level of sound they made to verbally present the digits to the subjects, they could not do it for all the subjects at a similar rate. Therefore, we can not rule out the possibility, despite our best effort, of the effect of the degree of sound experimenters made for the subjects. Of course, this limitation is true for the vast majority of the immediate memory span experiments with an auditory condition involving human subjects.

A better design for future studies might use the techniques of employing recorded presentation of the lists of digits in which experimenters or a professional presenter will record his verbal presentation of the lists of digits maintaining the same level of sound (as much as possible) for all the lists of digits and play the same record for all the subjects. This procedure might lessen the effect of sound experimenters makes during a verbal presentation to some extent. Another problem introduced by the use of the classroom as an experimental one is that it might potentially affect the cognitive behavior (e.g. recalling) of the subjects as it was not free from an extraneous variable (e.g. noise).The present study revealed that although there are no significant differences between the immediate memory span of the eleven grade and six grade students, learning abilities of complex problems (e.g., lists of items comprising larger digits), emotional stability found in much quantity in eleven grade students than six grade students suggesting that cognitive functions of humans varies with the span of ages. Thus, it appears advisable to test this suggestion further by examining the immediate memory span of a wider range of ages (e.g., 16-30, 30-45, 45- 55 years old) that could provide us a better understanding on the capacity of the short-term memory of human beings. An interesting and curious research may results from this study, that is, to examine whether humans' backward memory span, where subjects are required to recall the items in reverse order of presentation, varies in terms of ages. Immediate memory span has major implications on the mental development or intelligence. Poor immediate memory span might have adverse effects. A 2010 University of Stirling found a possible link between poor short-term memory and depression. On the contrary, Individuals with larger memory span have an advantage for a wide variety of cognitive tasks (e.g., intelligence test, problem-solving, and reasoning) and are more likely to be optimistic and self-assured thus contributing to their happy and successful life.

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Conflict of Interest

The authors colorfully declare this paper to bear not conflict of interests

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