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Development of Chunk Size and Capacity as a Predictor of Working Memory in Hindi Speaking Typically Developing Children

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Abstract

Enhancement in working memory capacity with increasing age may also be contributed to increase in speed and proficiency of covert verbal rehearsal skill. The major thrust of the present study is to investigate the development of working memory in children by measuring the chunk size and capacity in children. Sixty native Hindi speaking children (twenty each) in the age range of 3-4 years, 5-6 years and 18-20 years participated in this study. Twenty spoken sentences which includes four short, four long, eight short and four pseudo (random) sentences were used in this study. 'Words recalled for each sentence' and 'number of sentence completion' was measured in this study. Chunk size will be measured by the number of words recalled per sentence while number of sentence completion will estimate chunk capacity. It was observed that performance of group I (3-4yrs) and Group II (4-5yrs) improved with increasing age. There was significant effect of age on words recalled for each sentences type which means children with higher age group performed better than younger age group and poorer than adults. These findings suggest that chunk size of childhood working memory developed as per increasing age. Result also revealed that average sentence completion for short sentence was better across other sentence types. The evidence of the present study fosters that a population specific normative can be developed using a large population sample. Chunk size and capacity are two important predictors of working memory. These predictors may also comment on the potential growth of cognitive and communicative skills of the children.

Keywords: Working memory; Chunk size; Chunk capacity

Introduction

Working memory is a temporary information storage system which facilitates spontaneous retrieval of information for day-to-day usage. It has been also defined as the few temporarily active thoughts [1,2]. These thoughts are assumed to be controlling the behaviors through active memory representation. Working memory is used in mental tasks, such as language comprehension (for example, retaining ideas from early in a sentence to be combined with ideas later on), problem solving (in arithmetic, carrying a digit from the ones to the tens column while remembering the numbers), and planning (determining the best order in which to visit the bank, library and grocery). Working memory capacity has considered as outcome of storage and processing together [1-3]. Individual difference in WM capacity may be exhibited owing to developmental changes in processing ability and gradual increase in storage capacity. Apart from the global development during early childhood development of working memory is extremely crucial to ensure age appropriate cognitive-communicative growth. It is now well-known that the capacity of working memory broadly defined increases with age in childhood. Many studies indicate that working memory capacity varies among people, predicts individual differences in intellectual ability, and changes across the life span [4]. Enhancement in Wm capacity with increasing age may also be contributed to increase in speed and proficiency of covert verbal rehearsal skill [5-9]. It is not yet clear though which aspects of working memory account for this increasing capacity. Perhaps the most fundamental distinction that can be drawn is between the storage function of working memory and the processes that affect how working memory is used. Chunk of working memory has been defined as the number of meaningful units of information stored temporarily [10]. Words, numbers, events letters etc are examples of chunk. These chunks facilitate immediate and serial recall of words or events. Working memory in children can be investigated by measuring the number of specific information or chunks stored and the size or length of each chunk at a particular time [11]. The contextual knowledge of the person determines chunk size; it means whether the size of chunk is a novel word or a series of well rehearsed words. Refreshment of temporary representation through covert rehearsals controls chunk capacity. Review suggests that from two-three chunks to "magical number seven" as reported by Miller [10] is a wide range of chunk size variability. Similarly, based on the development of online rehearsal skill, chunk capacity varies across a range Miller [10] stated that estimation of chunk size and capacity can be indexed depending on performance on how stimuli are associated with one another to produce larger-sized chunks. For example, if the letter series R-B-I-S-B-I-P-N-B is coded as three acronyms of well-known government agencies RBI, SBI, and PNB, the load on working memory is reduced from 9 separate letters to 3 multi-letter chunks. Subsequent work confirmed that long-term associative knowledge is critically important in serial recall tasks [12,13] Cowan [11] suggested that the estimate of Miller [10] could result from the rapid on-line grouping of about seven random items to form about three or four multi-item chunks, which would fit within the basic capacity limit [11]. The typical presentation of telephone numbers in groups of three and four digits may serve the purpose of facilitating that on-line grouping. Working memory as defined is a temporary storage system which has limited capacity and information storage in it occurs in terms of the number of chunks [10,11]. Number and size of chunks may estimate the working memory capacity which can be indexed using specific task [14]. Based on this it is hypothesis that the number and size of working memory capacity increases with increasing age. Naveh-Benjamin et al. [15] recently provided evidence from the serial recall of word lists that the number of chunks that can be held in working memory decreases considerably in adult aging and that the ability to retain multi-word chunks also decreases somewhat. In this study an attempt had been made to investigate the pattern of chunk size and number development to index the working memory capacity in children. The amount of information stored in working memory has been an interesting issue. Researchers tried to explore how immediate, serial recall of word lists occurs? Miller [10] observed that the limit was not in the amount of information but in the number of meaningful units or chunks. For example, words are drawn from a much larger pool than digits and therefore contain much more information per item; nevertheless the lengths of word and digit lists that can be reproduced in immediate recall tasks are very similar. Words and numerals are examples of chunks, as are all of the words in an idiomatic expression if one knows it, or the letters within an acronym (e.g. IBM) if one knows it. Miller [10] observed that people can immediately recall lists with about 7 chunks. It may not really be magical, but it is a mystery. There are severe limits in how much can be kept in mind at once (~3–5 items). When how and why does the limit occur? Other research has yielded different results though. Young adults can recall only 3 or 4 longer verbal chunks, such as idioms or short sentences [16]. Some have shrugged their shoulders, concluding that the limit "just depends" on details of the memory task. Recent research however indicates when and how the limit is predictable. Many studies indicate that working memory capacity varies among people, predicts individual differences in intellectual ability and changes across the life span [4]. The major thrust of the present study is to investigate the development of working memory in children by measuring the chunk size and capacity in children. The underlying assumption behind the proposed study is that age appropriate working memory development will ensure cognitive-communicative growth of the child. Methodological robustness of this study will enable an effective ways of investigation of working memory. Aim of the present study is to know the pattern of chuck size and capacity development in Hindi speaking typically developing children.

Methods

Sixty native Hindi speaking children (twenty each) in the age range of 3-4 years, 5-6 years and 18-20 years participated in this study. It was ensured that these participants should have normal developmental and medical history. The socioeconomic, linguistic cultural academic background was controlled. Participants from nearby locations were randomly assigned in this study. Written consent was obtained from the participants and/or their parents. The test procedure was explained to the participants/parents. Parents were informed that the outcome of the test and its implication will be shared and explained to the parents. Gilchrist & Collegues's [16] spoke sentences for working memory assessment was used as stimuli in this study. Twenty sentences, four short, four long, eight short and four pseudo (random) sentences were used in this study. Short sentences were composed of three to five words (e.g. Thieves took the painting) while long sentences were of 8-11 words. Long sentences were such that it had two clauses of short sentences (e.g. our neighbors sells vegetables but he also makes fruit juice). These sentences were translated into Hindi by two Hindi teaching University Level academicians. A pilot on ten adult individuals was conduct to establish validity of the stimuli. All four types of sentences were recorded and presented to the participants using handheld tape recorders. A gap of 2000ms was inserted between presentations of two stimuli. Participants were instructed to repeat the heard sentences after a signal presented to repeat at a gap of 500ms. Two trials of each sentence were recorded. Younger participants were partially cued such as "please repeat" "listen carefully" "repeat completely" in case there was no response. Participants' response for each sentence type was recorded for offline measurement and analysis. Irrespective of partial correct or incorrect response the response was recorded for analysis and interpretation. The responses of participants were analyzed across three age groups.

Results

'Words recalled for each sentence' and 'number of sentence completion' was measured in this study. Chunk size will be

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measured by the number of words recalled per sentence while number of sentence completion will estimate chunk capacity. Response for words recall for each sentence was measured in binary fashion that is whether a word was recalled or not. Even recall with partial cue was considered as word recall. Repeated measures analysis of variance (ANOVA) across age group and sentence types was used in this study. Data were coded and analyzed using SPSS 17 statistical tool. Figure 1 represents average words recall across each sentence types. Figure 2 represents average sentence completion across sentence types.

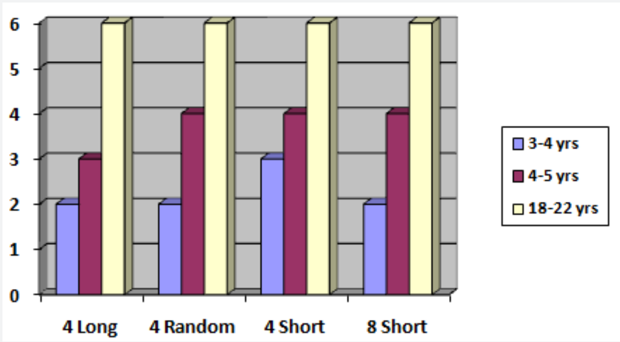

Figure 1: Average words recall across each sentence types.

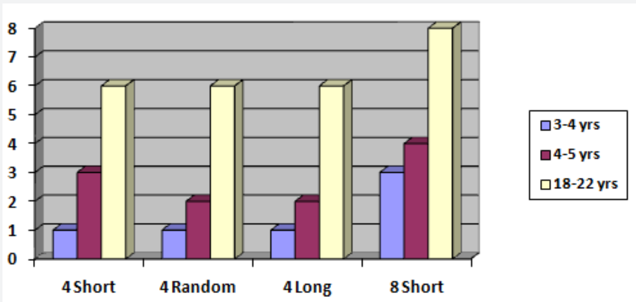

Figure 2: Average sentence completion across sentence types.

It was observed that performance of Group I (3-4 yrs) and Group II (4-5yrs) improved with increasing age. Out of four sentence types performance for 4 short sentences was better than other sentence group. There was significant effect of age on words recalled for each sentences type which means children with higher age group performed better than younger age group and poorer than adults. These findings suggest that chunk size of childhood working memory developed as per increasing age. Result revealed that average sentence completion for short sentence was better across other sentence types. The average sentence completion across each sentence type increased as per increase in age it means group II children (4-5yrs) performed better than group I (3-4 yrs) and group III (18-22yrs) adults performed better than the two group. There was significant effect of age on sentence completion across each sentence type which means children with higher age group performed better than younger age group and poorer than adults. These findings suggest that chunk capacity of childhood working memory developed as per increasing age.

Discussion

In this study we tried to investigate whether development of working memory is attributed by increase in number of chunks or by the size of chunks. The chunk capacity was measured by calculating the number of complete sentences recall by the participants. And, the size of chunk was measured by counting the number of words recalled in each sentences. The present finding suggests that chunk size and capacity both improves as per increasing age. Improved words and complete sentence recall with increasing age indicates that children take advantage of semantic and syntactic networks, as maturation of these networks occurs with prolonged exposure and rehearsal of language. Improvement in chunk size and capacity may also be contributed to development of better covert rehearsal skills. Based on these assumptions it is also hypothesized that chunk size and capacity may also be used as a predictor of language development.

Conclusion

The present study states that childhood working memory increases with increase in chronological age. The extent and nature of working memory development are indexed using chunk size and capacity. The evidence of the present study fosters that a population specific normative can be developed using a large population sample. Chunk size and capacity are two important predictors of working memory. These predictors may also comment on the potential growth of cognitive and communicative skills of the children.

References

1. Baddeley AD, Hitch G (1974) Working memory. Psychology of learning and motivation 8: 47-89.
2. Miller GA, Galanter E, Pribram KH (1960) Plans and the structure of behavior. The Journal of comparative Neurology 115(2): 217.
3. Daneman M, Carpenter PA (1980) Individual differences in working memory and reading. Journal of Verbal Learning and Verb al Behavior 19(4): 450-466.
4. Cowan N, Elliott EM, Scott Saults J (2005) On the capacity of attention: its estimation and its role in working memory and cognitive aptitudes. Cogn Psychol 51(1): 42-100.
5. Flavell JH, Beach DR, Chinsky JM (1966) Spontaneous verbal rehearsal in a memory task as a function of age. Child Dev 37(2): 283-299.
6. Henry LA (1991) The effects of word length and phonemic similarity in young children's short-term memory. The Quarterly Journal of Experimental Psychology 43(1): 35-52.
7. Hulme C, Tordoff V (1989) Working memory development: The effects of speech rate, word length, and acoustic similarity on serial recall. Journal of Experimental Child Psychology 47(1): 72-87.
8. Kail RV, Ferrer E (2007) Processing speed in childhood and adolescence: Longitudinal models for examining developmental change. Child development 78(6): 1760-1770.

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9. Ornstein PA, Naus MJ (1985) Effects of the knowledge base on children's memory strategies. Adv Child Dev Behav 19: 113-148.

10. Miller GA (1956) The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological review 63(2): 81-97.

11. Cowan N (2001) The magical number 4 in short-term memory: A reconsideration of mental storage capacity. Behavioral and Brain Sciences 24(1): 87-185.

12. Hulme C, Stuart G, Brown GD, Morin C (2003) High-and low-frequency words are recalled equally well in alternating lists: Evidence for associative effects in serial recall. Journal of Memory and Language 49(4): 500-518.

13. Saint-Aubin J, Poirier M (1999) Semantic similarity and immediate serial recall: Is there a detrimental effect on order information? The Quarterly Journal of Experimental Psychology 52(2): 367-394.

14. Cowan N, Chen Z, Rouder JN (2004) Constant capacity in an immediate serial-recall task a logical sequel to miller (1956). Psychological Science 15(9): 634-640.

15. Naveh-Benjamin M, Cowan N, Kilb A, Chen Z (2007) Age-related differences in immediate serial recall: Dissociating chunk formation and capacity. Mem cognit 35(4): 724-737.

16. Gilchrist AL, Cowan N, Naveh-Benjamin M (2008) Working memory capacity for spoken sentences decreases with adult ageing: Recall of fewer but not smaller chunks in older adults. Memory 16(7): 773-787.

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