

# Development of Working Memory: The Relevance of Academic Achievement Motivation

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## ABSTRACT

The study intended to analyze the influence of academic achievement motivation, age and gender on development of working memory. A total of 200 students participated in the present study. A 2x2x2 factorial design with two age groups i.e., (Children, 8-12 yrs. & Adolescents, 13-16 yrs.) x gender (Boys & Girls) X two level of academic achievement motivation (High & Low) was used in present study. Academic Achievement Motivation Test (T.R. Sharma;1984) was applied to identify the level of motivation in students. Working Memory Tasks (S. Pandey & P.Tamta;2014) were used to assess three components of working memory i.e. phonological loop, visuo-spatial sketch pad and central executive. Data analysis was done using univariate and multivariate analysis techniques.

ANOVA results proved the significant effects of age and academic achievement motivation on working memory. However, the role of gender in working memory is partially supported. More specifically, adolescents performed better on different components of working memory as compared to children. Moreover, high academic achievement motivation in students enhanced the capacity of working memory as compared with low academic achievement motivated counterparts. Regression results proved the positive contributing role of academic achievement motivation and age in working memory. Findings are discussed.

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## 1. Introduction

Working memory is the ability to keep information current in mind for a short period, while using this information for the task at hand. It is the 'workbench' the 'screen' of computer where current thinking takes place. Working memory is essential for classroom learning and academic achievement. Students with working memory difficulties take a much longer time to process information. They are unable to cope with timed activities and fast presentation of information. Working memory grew out of dissatisfaction in the early 1970s with the idea of a single short-term storage and processing system, characterized most notably in the Atkinson and Shiffrin (1968) model. This led Baddeley and Hitch (1974) to propose a model of Working Memory (WM) which comprised of a number of components. One component, the central executive, was proposed as the system responsible for reasoning, decision making, and coordinating the operation of subsidiary specialised "slave" systems. Initially, two slave systems were proposed, namely the visuo-spatial sketch-pad, or VSSP, and the articulatory loop. The visuo-spatial sketch-pad was considered to be responsible for the temporary storage and manipulation of visuo-spatial material, while the articulatory loop provided a similar function for verbal material. Later Baddeley (2000) developed a model of working memory which suggested that WM is a domain-general component responsible for the control of attention and processing that is involved in a range of regulatory functions, including the retrieval of information from long-term memory. This model also includes two domain-specific stores responsible for the temporary storage of verbal and visuo-spatial information and has been supported in studies of Children, (Alloway, Gathercole, & Pickering, 2006; Bayliss et al., 2003), Adults,

(Kane et al., 2004), and Neuron Imaging Research (Jonides et al. 2005).

Working memory can be tested reliably from as young as 4 years of age, yet performance on working memory tasks is subject to large degrees of individual variation (Alloway & Gathercole, 2006). Individual differences in working memory capacity have important consequences for children's ability to acquire knowledge and new skills (Cowan & Alloway, 2008). In typically developing children, scores on working memory tasks predict reading achievement independent of measures of phonological skills. Working memory is also linked to math outcomes; low working memory scores are closely related to poor performance on arithmetic, word problems and poor computational skills (Bull & Scerif, 2001). In addition, Working Memory is related to academic achievement in the domain of reading (Daneman & Tardif, 1987), writing (Abu-Rabia, 2003), mathematics, and science (Gathercole, et.al; 2004). As Working Memory (WM) plays an important role in cognitive activity, researchers are exploring ways of applying WM research to improve abilities such as fluid intelligence – the ability to understand complex relationships and solve new problems and science achievement (Martinez, 2000).

Working memory develops with increasing age. It develops steeply up to eight years of age thereafter shows more gradual improvement (Gathercole,1993). The development pattern with increasing age is found in entire components of working memory. One year old children typically have small capacities that increase gradually until the teenage years, when adult capacities are reached that are more than double that of 4 year old children.

The neural processes sub-serving working memory and brain structures underlying this system continue to develop during childhood. The prefrontal cortex is one of the last brain regions to mature and it has been suggested that developmental changes in this brain area parallel the cognitive development during childhood (Luna et al; 2004). Researchers have evinced that the development of working memory processes is tied to the maturation of the frontal lobes in childhood years. Developmental studies conducted with the n-back task have shown that visuo-spatial working memory (VSWM) performance improves throughout childhood and adolescence into young adulthood (Kane et al; 2004). Reiss and Menon (2002) studied three age groups of participants ( i.e., 7-12yrs., 13-17 and 18-22yrs.) who performed a 2-back task. The result showed that accuracy and response latency on this visuo-spatial working memory (VSWM) task improve gradually extending into young adulthood. Developmental changes in knowledge and strategy use are very complex and must involve the acquisition of additional information in older children.

Previous studies document gender and age differences in the profile of cognitive abilities, especially among children and adolescents (Hyde & Linn 1988). Men outperformed women on space and number factor, whereas, women did better than men on verbal fluency (Pandey, 2007 Pandey & Tamta, 2013). Several studies have demonstrated greater performance in women in certain tasks that involve verbal memory tasks of verbal learning, associated verbal pairs or logical memory (Lewin et al; 2001). Nilsson and Backman (1997) found that women's higher performance in episodic memory tasks may be related to higher verbal abilities because reports of memory performance employ verbal tasks. Other studies indicate that women and men rely on different strategies when learning a route on map (Dabbs et al., 1998). Gron et al. (2000) reported that men were faster than women in finding their way out of virtual maze. One working memory task that has shown sex differences favouring women is the Digit Symbol subtest from the Wechsler Adult Intelligence Scales (WAIS) battery. Research has shown that from a behavioural performance perspective, males demonstrate greater mathematical (Lynn & Irwing, 2008), spatial (Lejbak, et al; 2011), and object working memory (Lejbak et al., 2011) compared to females, and females display greater verbal (Lewin, et al; 2001) and writing skills than males (Bae, et. al; 2000).

Working memory is required whenever anything must be learned because learning requires manipulation of information, interaction with long-term memory, and simultaneous storage and processing of information. Long-term memory, the vast storehouse of knowledge and experience, is also necessary for learning, but is able to acquire very little knowledge and skills without support from short-term and working memory. Clearly, working memory plays a critical role in learning; it is where knowledge is constructed and modified and where information is processed for semantic encoding. Nearly all of what must be learned and remembered must pass through working memory.

There are wide ranging individual differences in children's academic achievement. Variations in academic skill such as reading and math performance between children with and

without learning difficulties are quite apparent to classroom teachers and parents alike. Even in typically developing children with no learning difficulties, individual differences in reading and math performance can be readily observed ( Hecht, Torgesen, Wagner, & Rashotte, 2001). Researchers have reported various distal contributors to these performance level differences such as, family socio-economic status (Aikens & Barbarin, 2008;), parental interaction style (Mattanah, Pratt, Cowan, & Cowan, 2005;), classroom instruction technique (Kilbanoff, Levine, Huttenlocker, Vasilyeva, & Hedges, 2006) and level of academic achievement motivation. In many studies it was found that children with high academic achievement have better cognitive skills such as reasoning, comprehension and problem solving as compare to children with low level of academic achievement motivation.

Psychologists have noted that motivation should be taken into account in education because of its effective relationship with new learning, abilities, strategies and behaviors (Shahraray, 2007), and they have presented motivation for academic achievement as one of the preliminary constructs for defining such type of motivation. Motivation for academic achievement is attributed to behaviors which lead to learning and achievement (Masaali, 2007). In other words, academic achievement motivation is such a pervasive inclination towards doing a task successfully in a particular context and assessing the performance spontaneously. The bulk of behaviors indicating the academic achievement motivation involve insisting on doing difficult assignments, hardworking or effort into learning to reach mastery and choosing assignments which need great effort (Abedi, 2008). Working memory is a necessary cognitive ability for academic performance. Classroom performance and the development of verbal and academic skills, such as reading decoding, reading comprehension, mathematics, and written expression, depends heavily on the adequate functioning of working memory. Academic motivation plays an important role in students' life to achieve their academic goal. Broussard and Garrison (2004) found positive relationship between motivation and academic performance. According to them students with high levels of motivation consistently exhibit higher achievement and class grades than students with low motivation. Arbabisarjou et al. (2016) found that there was a significant relationship between academic achievement motivation and academic performance among medical students. Korantwi-Barimah et al. (2017) study amongst university students demonstrated positive significant correlations between academic self-concept, motivation and academic performance.

Review of studies indicates that working memory is critically involved in academic achievement goal pursuit. However, a number of studies identified role of cognitive-motivational factors in working memory. This study seeks to enrich the understanding of development of working memory in children by selecting an important factor i.e., academic achievement motivation, which may facilitate the desirable pattern of development in working memory.

## 2. Objective & Hypothesis

Against this backdrop, present study was planned to investigate the influence of academic achievement motivation, age and gender on working memory and its components. Following hypotheses were made; It was hypothesized that:

1. Academic achievement motivation would exert positive impact on the development of working memory. Therefore, participants with high academic achievement motivation would show superior working memory as compared to low academic achievement motivation group.
2. A developmental pattern in different components of working memory would be found. Therefore, Adolescents would perform better on working memory and its domains as compared to children.
3. Male and female would differ on experience of working memory as a whole and its domains.
4. Age and academic achievement motivation would contribute favorably in working memory and its domains.

### 3. Method

**Design:** Present study is based on a 2x2x2 factorial design with two age groups i.e., (Children, 8-12 yrs. & Adolescents, 13-16 yrs.) x gender (Boys & Girls) X two level of academic achievement motivation (High & Low).

**Participants:** A total of 200 participants, age ranged with the 8-16 yrs. and grade 6 to 12<sup>th</sup> standard, enrolled in different schools of Gorakhpur City, participated in present study. Stratified random sampling technique was used for sample selection.

#### Measuring Tools:-

**Personal Data Sheet (P.D.S):-** In order to determine the personal and school background of students, Personal Data Sheet was used.

**Academic Achievement Motivation Test:** - To assess level of academic achievement motivation in children, Academic Achievement Test, (by Dr. T. R. Sharma, 1984) was used. The test provided a direct numerical score indicating how much an individual (a boy or girl) is motivated in the field of academic achievement. The test contains a total of 38 items. The reliability (test-retest=.795 for girls sample & .807 for boys sample) and validity (construct validity) of the test are reported fairly high.

**Working Memory Task:** Three sets of working memory tasks were devised. These tasks were used to assess the level and form of working memory.

- a) **Reading Span Task (RSPAN):** Based on Reading Span Task (Chiappe, Hasher & Siegel 2000), the RSPAN was designed to measure the combined processing and storage capacity of working memory. Reading span task contains 30 sentences each one written on a separate card. These cards were categorized under five sets based on increasing the number of sentences. The length of each sentence given in card is 8 to 12 words. Every card is

presented for 0.5 second. Respondent read each sentences aloud and determined whether it made sense or not, and at the same time remembering the Red word (as one word was written with red color) of that sentence. After the presentation of each set, respondents were asked to recall the red word in correct order. Aggregate of correctly recalled items denoted the level of memory span (RSPAN) in adolescents.

- b) **Visual Pattern Recall (VSPAN):** The Visual Pattern Recall Task includes 25 Geometric designs. The participant was instructed to look carefully at the pattern and try to remember where the blank parts were. The design was presented on the card and there was a half second delay before presentation of an empty geometric design of the same size of recall. The participants were asked to correctly recall the pattern by putting (✓) mark at the same part. After the presentation of card assigned immediate memory test was done. The correct responses on geometric design were added together, which denoted the level of VSPAN.

- c) **Operation Span Task (OSPAN):** The formation of OSPAN is based on Operation Span Task (Turner & Engle 1989). OSPAN task consisted of 30 math equations. Each card contained one word. These cards were categorized under five sets based on increasing the number of Math equation with words. For instances, 1<sup>st</sup> set of the task includes 2 cards sets and 2<sup>nd</sup> set of task contains 4 cards and so on. Immediate memory test was done. The participants were given a set of equation and accompanying with words. They read the equation aloud as soon as it appeared. Then, were asked to solve a series of math equations while, trying to remember sets of unrelated words. Lastly, they were asked to recall all words in the proper order. The total of correctly recalled items denoted the level of memory span (OSPAN). Finally on the basis of total scores obtained on three types of task, the level of overall working memory in children was determined.

### 4. Results

Obtained scores were treated statistically in term of both Univariate (ANOVA) and Multivariate analysis. ANOVA results have been reported first then; findings obtained from bivariate and multivariate analysis have been reported and interpreted.

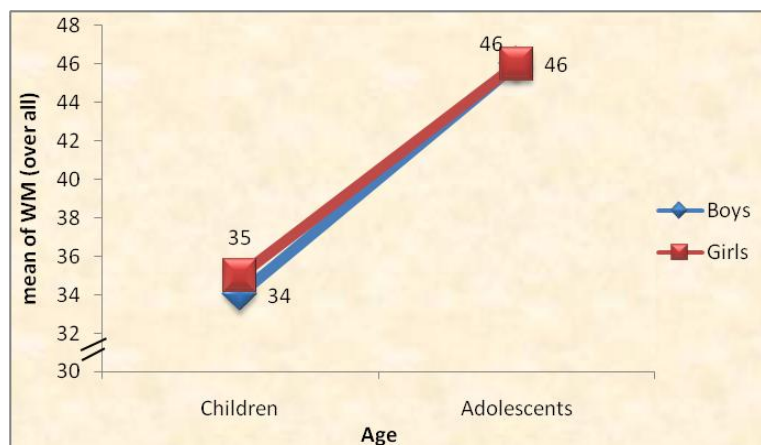
**ANOVA Results:** In order to assess the effect of academic achievement motivation, age and gender on working memory and its components, 2x2x2 factorial analysis of variance was computed. Results displayed in Table-1 shows Mean, S.D. and significant F values for overall working memory and its components (i.e. phonological working memory, visuo-spatial working memory and central executive working memory) by age, gender and level of academic achievement motivation.

**Table- 1 Mean, S.D. and significant F values of various components of Working Memory by Age, Gender and Academic Achievement Motivation**

Working Memory		Children				Adolescents				Significant F-Values A= Age B= Gender C= Academic achievement motivation
		High Academic achievement motivation		Low Academic achievement motivation		High Academic achievement motivation		Low Academic achievement motivation		
		Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Working Memory (as a whole)	Mean	38.555	40.400	31.769	29.33	52.533	52.700	33.363	41.444	AXB=2.828*
	(S.D.)	8.819	5.504	10.401	7.499	9.553	8.246	9.800	8.048	AXBXC=6.090**
Phonological Working Memory	Mean	12.55	14.20	11.07	10.00	16.80	16.80	11.36	15.55	A= 23.221**
	(S.D.)	4.06	2.94	3.17	3.38	4.09	3.39	3.34	3.12	C=9.323**
Visuo-spatial working memory	Mean	14.778	15.200	11.00	11.333	18.200	17.400	12.454	11.133	A= 13.084** C= 16.908** BXC= 3.604*
	(S.D.)	5.166	2.280	4.178	3.661	3.075	3.025	3.958	3.64	
Central Executive Working Memory	Mean	11.22	11.00	9.69	8.200	17.53	18.500	9.545	12.555	AXC=4.936* AxBxC=6.678**
	(S.D.)	2.27	1.87	3.838	2.305	3.77	3.171	4.251	4.275	

\*\*P<.01, \*P<.05

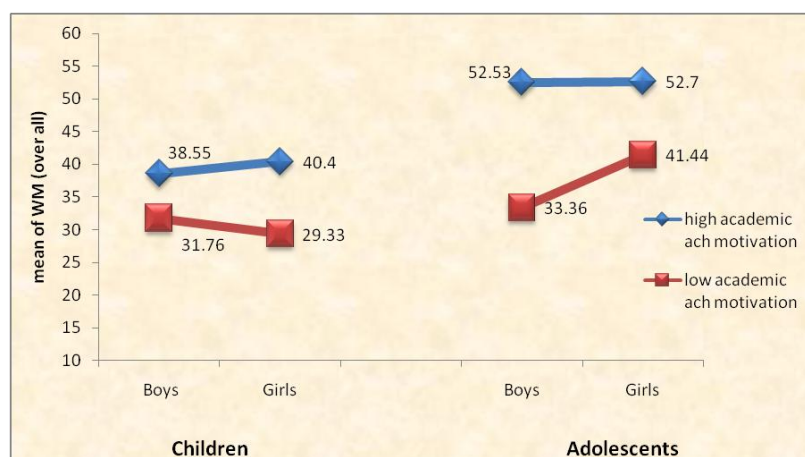
Results (Table-1) indicate that interaction effect of age X gender was found significant on overall working memory.



**Fig-1 Working memory (over all) as a function of gender and age.**

As above graph ( Fig-1) indicates in the case of children, girls performed slightly better than their boys counterparts on overall working memory. However, in the case of adolescents there was no any difference between boys and girls.

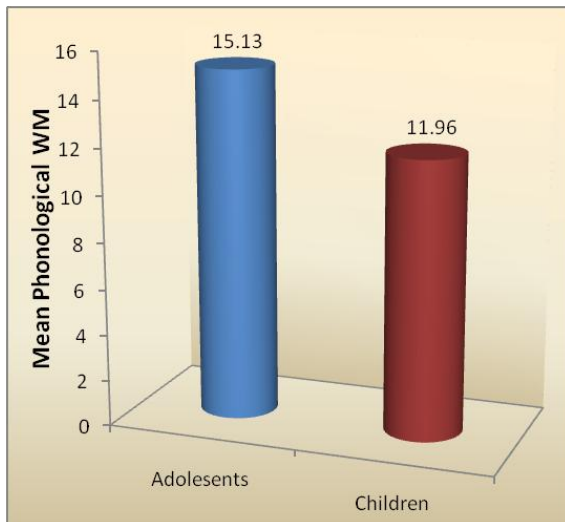
Moreover, interaction effect of age X gender X level of academic achievement motivation was found significant on overall working memory.



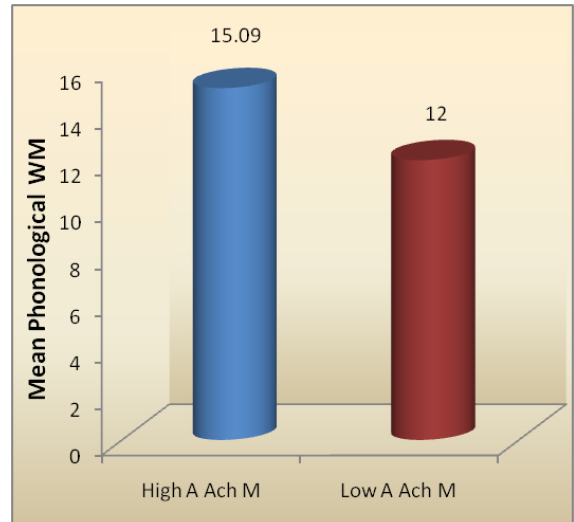
**Fig-2: Working memory (over all) as a function of interaction of academic achievement motivation, gender and age.**

As interaction graph (Fig-2) shows in the case of children, boys with high academic achievement motive performed inferior than their girl counterparts. Contrary to this, boys with low academic achievement motive, performed better than their girl counterparts.

However, in the case of adolescent group, both boys and girls of high academic achievement motive scored equally higher on working memory. Whereas, case of low academic achievement group, adolescent girls performed far better on overall working memory as compared to adolescent boys.



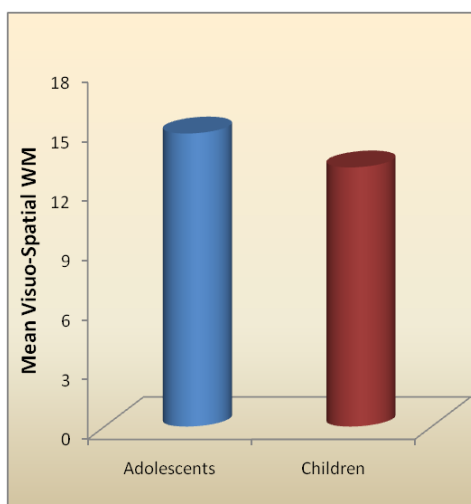
**Fig: 3 -Phonological WM as a function of Age**



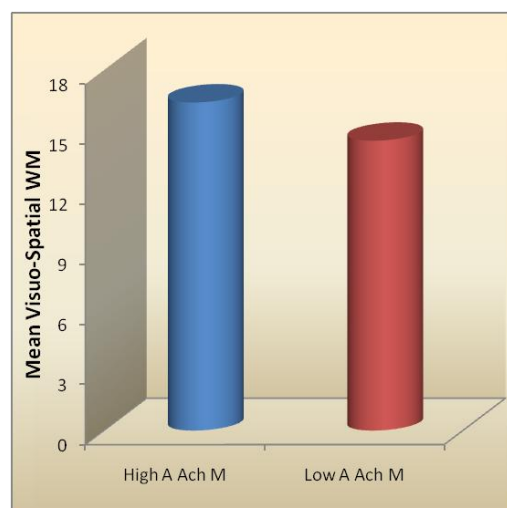
**Fig:4- Phonological WM as a function of Academic Achievement Motivation**

Further, Table-1 & Fig-3 indicate that main effect of age on Phonological Working Memory was found significant which suggests that adolescents performed better on phonological component of working memory as compared to children. Further, significant main effect of academic achievement

motivation reveals that students with high academic achievement motivation were performed far better on phonological working memory than low academic achievement motivation group ( Table-1& Fig-4).



**Fig: 3 -Phonological WM as a function of Age**



**Fig:4- Phonological WM as a function of Academic Achievement Motivation**

Again, on visuo-spatial component of working memory, main effect of age was found significant (table-1, fig-5 )which revealed that adolescents performed better on visuo-spatial working memory as compared to children. Further, significant

main effect of level of academic achievement motivation revealed high academic achievement motivated group performed superior on visuo-spatial working memory than low academic achievement motivated group (table-1, fig-6).

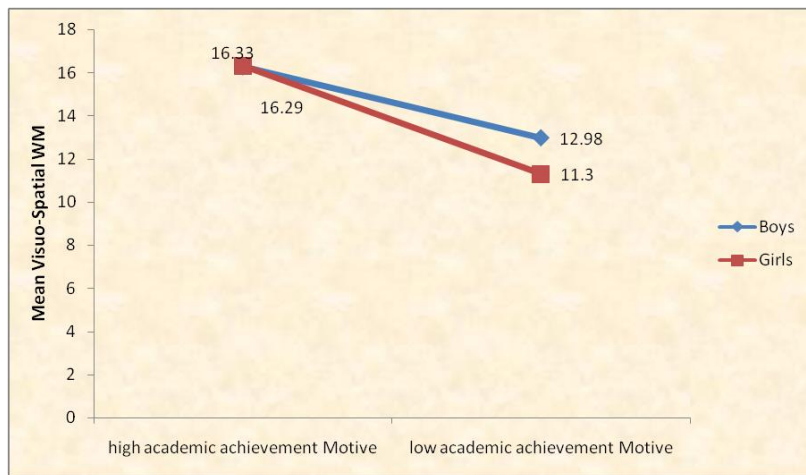


Fig-7. Visuo-spatial working memory as a function of academic achievement motivation and gender

The interaction effect of level of academic achievement motivation and gender on visuo-spatial working memory was found significant. As interaction graph (Fig-7) shows that in the case of high achievement motive group, very little difference between boys and girls were found. Whereas, girls with low

academic achievement motivation, performed inferior on visual spatial working memory as compared to boys.

The **Central Executive** domain of WM was significantly influenced by interaction of age, gender and level of academic achievement motivation of students.

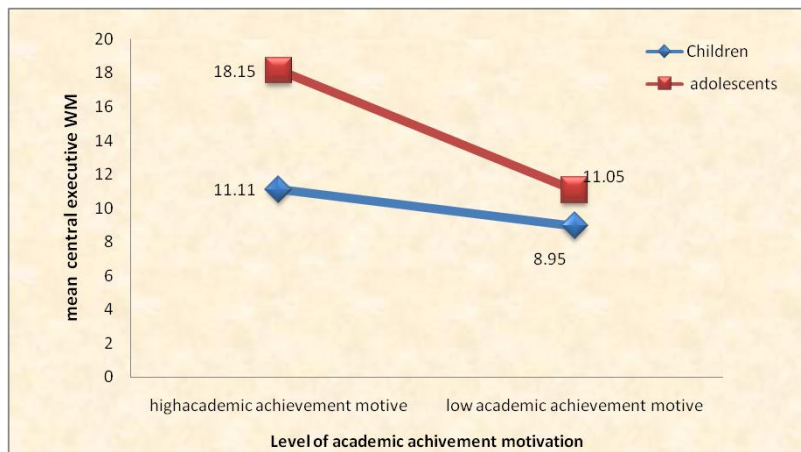


Fig-8: Central executive working memory as a function of interaction of academic achievement academic achievement motivation & age

As interaction graph (Fig-8) shows, adolescents with high academic achievement motivation performed far better on central executive WM as compared to children. Similarly, in case of low academic achievement motivation again

adolescents performed superior on central executive WM as compared to children.

Further, interaction effect of age X gender X Level of academic achievement motivation (Table-1 & fig.-9) was also found significant on central executive working memory.



Fig-9: Central executive working memory as a function of interaction of age, gender and academic achievement motivation

As interaction graph (Fig-9) displays, in the case of children very little difference found between boys and girls with high achievement motivation. Whereas, in case of low academic achievement motive group, boys performed far better than girls on central executive working memory. Further, in case of adolescents with high academic achievement motive girls were found superior than boys on central executive working memory. Whereas, in the case of low academic

achievement motive group adolescent girls performed far better than boys.

**Bivariate Analysis:** Further, to determine the association between academic achievement motivation, age and working memory and its components, correlations were computed. Results are displayed in Table-2.

**Table-2: Relationship between age, gender, academic achievement motivation and component of working memory**

Variable	Working Memory Component			
	Over all working memory	Phonological working memory	Visuo-spatial working memory	Central executive working memory
Age	.307**	.289**	.290**	.220**
Academic Achievement Motivation	.457**	.364**	.433**	.388**

\*\*P<.01, \*P<.05

Correlation results (table-2) indicate strong positive association between age, academic achievement motivation and working memory. More specifically, age positively correlated with overall working memory, phonological WM as followed by visuo spatial WM and central executive WM. Further, academic achievement motivation was found positively correlated with working memory (over all) and its components. More specifically, academic achievement motivation was found positively correlated with working memory (as a whole). Similarly, academic achievement

motivation was also found positively correlated with phonological working memory, visuo-spatial working memory and central executive working memory.

Significant correlation results suggest to exercise step wise multiple regression analysis (SMRA), to determine the predicting roles of academic achievement motivation and age in working memory and its domains. Summary of regression results are displayed in table-3.

**Table-3: Step Wise multiple regression analysis for Working Memory and its Components on to the Age, Gender and Academic Achievement Motivation**

Predictor Variables	Criterion variable				
	R	R2	R2 Change	(Beta)	F
( over all Working Memory)					
Age	.570	.325	.325	.576	95.26**
Academic Achievement Motivation	.690	.476	.151	.392	84.49**
( Phonological Working Memory)					
Predictor Variables	R	R2	R2 Change	(Beta)	F
Age	.525	.276	.276	.525	75.29**
Academic Achievement Motivation	.605	.366	.091	.304	56.92**
( Visuo spatial Working Memory)					
Predictor Variables	R	R2	R2 Change	(Beta)	F
Academic Achievement Motivation	.433	.188	.188	.433	45.732**
Age	.564	.318	.130	.262	45.86**
( Central Executive Working Memory)					
Predictor Variables	R	R2	R2 Change	(Beta)	F
Age	.530	.281	.281	.530	61.95**
Academic Achievement Motivation	.661	.386	.105	.327	22.797**

Results displays in table 3 denoted that over all working memory was predicted by two factors. Level of age has contributed maximum positively ( $\beta=.576$ ,  $R^2=.325$ ) followed by academic achievement motivation ( $\beta=.392$ ,  $R^2=.476$ ). Though, independently age has contributed 32.5% and academic achievement motivation contributed 15.1%, but the composite contributions of these factors were found 47.6 % variance in the working memory.

Further, phonological working memory was predicted by two factors. Age explained maximum positively ( $\beta=.525$ ,  $R^2=.276$ ) and academic achievement motivation also contributed positively ( $\beta=.304$ ,  $R^2=.366$ ). Though, independently age has contribution 27.6% and academic achievement motivation 9.1% but composite contribution of level of academic achievement motivation and age as a whole were 36.6% variance in the phonological working memory.

Likewise, visuo-spatial working memory was predicted maximum positively by level of academic achievement motivation ( $\beta=.433$ ,  $R^2=.188$ ), and age which also contributed positively ( $\beta=.262$ ,  $R^2=.318$ ). Though, independently academic achievement motivation has contributed 18.8% and age 13% but the composite contribution of these factors were found 31.8% variance in the visuo-spatial working memory.

Further, table-1 indicates that central executive working memory was predicated by two factors, level of age was found strongest predictor of central executive memory, which explained maximum positively ( $\beta=.530$ ,  $R^2=.281$ ), followed by academic achievement motivation ( $\beta=.327$ ,  $R^2=.386$ ) which also explained positively. Though, independently age contributed 28.00% variance, and academic achievement motivation has contributed 10.5%, but the composite contribution of these factors was found 38.6% variance in the central executive working memory.

## 5. Discussion

Present findings have proved that age and academic achievement motivation exerted pervasive and positive impact on development of working memory. Gender difference in working memory is partially supported. More specifically, adolescents performed better on working memory and its components as compared to children. Further, results revealed that high academic achievement motivation made children more capable for storing and maintaining information. Specifically, high academic achievement motive group showed higher WM capacity, better phonological working memory and central executive WM than low academic achievement motive group. Regression results have also proved the positive contribution of academic achievement motive in the proper development of working memory.

Present results have strongly proved the hypothesis that working memory increased with growing age from childhood to adolescence. Both univariate and multivariate analysis supported that working memory capacity increases with growing age. These results have strong empirical support. Gathercole et al. (1994) reported that the developmental increase in memory capacity appear to be due to increase in

speed and efficiency of the sub vocal rehearsal process. There is close association between the speed with which children and adults can articulate words and their phonological loop capacity (Baddeley et al., 1974). This association is thought to reflect the fact that the faster articulation allows faster sub-vocal rehearsal. Thus, as children grow older and their rate of speaking increases, their sub-vocal rehearsal rate also increases allowing more material to be continuously recycled without decay, resulting in greater phonological loop capacity (Roodenrys et al., 1993). Present findings have also been supported by a number of researches related to neuroscience. In a study, Kwon, et al. (2002) reported age related increases in prefrontal cortical activation associated with visuo-spatial two-back task performance in 7 to 22 year olds. Whereas, other researchers have indicated that children working memory span increases steadily between 3-15 years of age (Gathercole & Baddeley, 1990).

Present findings have partially proved the hypothesis that male and female differ on working memory. However, main effect of gender on overall and domains of working memory were found non- significant. A few studies have identified gender differences on cognitive task. Harness et al. (2008) found that on verbal working memory task men and women were not significantly different but on visual working memory task, women showed better performance than men. Whereas, Minor and Park (1999) found no gender differences in spatial working memory function. Contrary to this, subsequent research has elucidated that sex difference in cognition are well established, with a male advantage found for spatial measures (Voyer & Bryden, 1995) and a female advantage found for many verbal measures (Weiss et al., 2006) and object location memory measures (Silverman & Eals, 1992). Researchers have identified gender differences in verbal memory and visuo-spatial memory (Lewin et al., 2001) and central executive working memory (Pandey, Tamta & Tripathi 2015). In present study children girls with high verbal ability outperformed boys on central executive working memory. Thus, the role of gender in working memory is also supported by a number of studies.

Present findings have also proved another hypothesis that academic achievement motivation of children exercised positive impact on the development of working memory. As findings of this study indicates that students with high level of academic achievement motivation showed better phonological working memory and visuo-spatial working memory than low academic achievement motivated group. Although once controversial, the premise that motivation has an important affect on cognitive processing is now widely accepted in scientific psychology (Kunda, 1990). Numerous investigators using a variety of paradigms across multiple disciplines have documented motivational influences on perception, attention, memory, decision making, and problem solving (Dunning, 1999; Proffitt, 2006). Of these foci, research on motivation and memory has received a relative dearth of empirical attention, and the literature at present remains at a nascent level of development. Achievement motivation represents the energization and direction of competence-relevant behavior (McClelland, 1985). This competence plays an inherent and

integral role in the storage, retention, and retrieval of information and it seems likely that the type of competence that one pursues during task engagement influences these competence-based memory processes.

Apart from empirical validations, the present findings are theoretically explained on the basis of Baddeley (1990) model of working memory. This model suggests that the central executive is a limited capacity supervisory system that provides the interface with information stored in long-term memory, which also controls the processing of two slave systems: the phonological loop and the visuo-spatial sketchpad. Unlike the central executive that extends its influence across different modalities, these two subcomponents are dedicated to specific information processing domains, namely verbal information (the phonological loop or phonological memory) and visuo-spatial information (the visuo-spatial sketchpad). The findings of present study proved that age exercised strong positive impact on development of working memory. These Findings can also

be supported by Neo Piagetian views that egocentric ability develops steadily through growing age.

## 6. Conclusion

Findings of the present study have proved the effect of age and academic achievement motivation on working memory. However, the role of gender in working memory is partially accepted. Findings of the study confirm the hypothesis that working memory and its components are strongly influenced by academic achievement motivation. More specifically, students with high academic achievement motivation showed superior working memory than low academic achievement motivation group. A developmental trend with growing age was found. Adolescents performed better on working memory than children. However, there are few limitations of this study. Generalization of the results from this study is limited as the sample size is small and also limited to one region (Gorakhpur) of Uttar Pradesh.

## References

1. Abedi, J. (2008). Measuring students' level of English proficiency: Educational significance and assessment requirements. *Educational Assessment*, 193–214.
2. Abu-Rabia, S. (2003). The Influence of working memory on reading and creative writing processes in a second language. *Educational Psychology*, 23, 209–222.
3. Aikens, N. L., & Barbarin, O. (2008). Socioeconomic differences in reading trajectories: The contribution of family, neighbourhood, and school contexts. *Journal of Educational Psychology*, 100, 235-251.
4. Alloway, T. P., & Gathercole, S. E. (2006). How does working memory work in the classroom? *Educational Research and Reviews*, 1, 134–139.
5. Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2006). Verbal and visuo-spatial short-term and working memory in children: Are they separable? *Child Development*, 77, 1698–1716.
6. Arbabisarjou, A., Zare, S., Shahrakipour, M. and Ghoreishinia, G. (2016). The relationship between academic achievement motivation and academic performance among medical students. *International Journal of Pharmacy & Technology*, 8(2), 12272-12280.
7. Atkinson, R.C., & Shiffrin, R.M. (1986). Human memory: A proposed system and its control processes. In K.W. Spence & J.T. Spence (Eds.), *The psychology of learning and motivation: Advance in research and theory* (Vol.2, pp. 89-195). New York: Academic press.
8. Baddeley, A.D. (1990). Human memory: Theory and practice. Botson: Allyn and Bacon.
9. Baddeley, A. D., & Hitch, G. J. (1974). Working memory. In G. H. Bower (Ed.), *Recent The psychology of learning and motivation: Advance in research and theory* (Vol. 8, pp. 47–89). New York: Academic Press.
10. Baddely, A.D. (2000). The episodic buffer: A new component of working memory? *Trends in cognitive sciences*, 4, 417-423.
11. Bae, Y., Choy, S., Gedder, C., Sable, J., and Snyder, T. (2000), *Trends in education equity for girls and women*. Washington DC; U.S Government Printing Office.
12. Bayliss, D.M., Jarrold, C, Gunn, M.D., & Baddeley, A.D. (2003). The Complexities of complex Span: Explaining individual differences in working memory in children and adults. *Journal of Experimental Psychology: General* 132, 71-92.
13. Broussard, S. C., & Garrison, M. E. B. (2004). The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family and Consumer Sciences Research Journal*, 33, 106-120.
14. Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Shifting, inhibition, and Working memory. *Developmental Neuropsychology*, 19, 273–293.
15. Cowan, N, and Alloway, T.P. (2008). The development of Working Memory . In N. Cowan (Ed.), *Development of memory in childhood (2<sup>nd</sup> ed., P. 303-342)*. Hove, UK: Psychology Press.
16. Dabbs, J.M., Chang, E., Strong, R.A., & Milun, R. (1998). Spatial working memory task in humans. *Brain and Cognition*, 47, 470-493.
17. Daneman, M., & Tardif, T. (1987). Working memory and reading skill re-examined. In M. Coltheart (Ed.), *Attention and performance: Vol. 7*, (pp.491–508). London: Erlbaum.
18. Dunning, D. (1999). A newer look: Motivated social cognition and the schematic representation of social concepts. *Psychological Inquiry*, 10, 1-11.
19. Gathercole, S.E., & Adams, A. M., (1993). Phonological working memory and very young children. *Developmental Psychology*, 29, 770-778.
20. Gathercole, S.E., & Adams, A. M., (1994). Children's phonological working memory: Contribution of long term knowledge and rehearsal. *Journal of Memory and Language*, 33, 672-688.
21. Gathercole, S.E. & Baddeley, A.D. (1990). Phonological memory deficits in language disordered children: Is there a causal connection? *Journal of Memory and Language*, 29, 336-360.
22. Gathercole, S. E., Pickering, S. J., Knight, C., & Stegmann, Z. (2004). Working memory skills and educational attainment: Evidence from national curriculum assessments at 7 and 14 years of age. *Applied Cognitive Psychology*, 18, 1–16.

23. Gron G, Wunderlich AP, Spitzer M, Tomczak R, Riepe MW. 2000. Brain activation during human navigation: Gender-different neural networks as substrate of performance. *Nat Neuroscience* 3,404–408.
24. Harness, A., L. Jacot, S. Scherf, A. White and J.E. Warnick, 2008. Sex differences in working memory. *Psychological Reporters*, 103: 214-218
25. Hecht, S. A., Torgesen, J.K., & Rashotte, C.A. (2001). The Relations between Phonological Processing Abilities and Emerging Individual Differences in Mathematical Computation Skills: A Longitudinal Study from Second to Fifth Grades. *Journal of Experimental Child Psychology*, Vol79, Issue 2, 192-227
26. Hyde, J.S., Linn, H.C., (1988). Gender differences in verbal ability; a meta analysis. *Psychol.Bull.* 104, 53-69.
27. Jonides , J. Lacey, S.C. , & Nee D.E. , (2005). Process of Working Memory in Mind and Brain. *Current Direction in Psychological Science*, 14, 2-5.
28. Kane, M.J. Hambrick, D.Z., Tuholski, S.W., Wilhelm, O., Payne, T.W. & Engle, R.W. (2004) . The generality of Working Memory Capacity: A latent variable approach to verbal and visuo-spatial memory span and reasoning. *Journal of Experimental Psychology: General*, 133, 189-217.
29. Klibanoff RS<sup>1</sup>, Levine SC, Huttenlocher J, Vasilyeva M, Hedges LV. (2006). Preschool Children's Mathematical Knowledge: The Effect of Teacher "Math Talk". *Developmental Psychology* Vol. 42, 59 – 69.
30. Korantwi-Barimah, J.S., Ofori, A., Nsiah-Gyabaah, E. and Sekyere, A.M. (2017). Relationship between motivation, academic self-concept and academic achievement amongst students at a Ghanaian Technical University. *International Journal of Human Resource Studies*, 7(1), 61 – 73.
31. Kunda, Z. (1990) The case of motivated reasoning. *Psychological Bulletin*, 108, 480-498.
32. Kwon H, Reiss AL, Menon V. Neural basis of protracted developmental changes in visuo-spatial working memory. *Proceedings of the National Academy of Sciences*, 13336–13341.
33. Lejbak, I, Crossley, M., and Vrbancic, M.(2011). A male advantage for spatial and object but not verbal working memory using the n-back task. *Brain and Cognition*, 76, 191-196.
34. Lewin,C., Wolgers, G., and Herlitz, A.(2001), Sex differences favouring women in verbal but not in visuo-spatial episodic memory. *Neuropsychology* 15, 165-173.
35. Luna, B., Garver, K.E. Urban, T.A., Lazar, N.A. , & Sweeney, J.A. (2004). Maturation of cognitive processes from late childhood to adulthood. *Child Development*. 75, 1357-1372.
36. Lynn, R.,and Irwing,P(2008). Sex differences in mental arithmetic, digit span, and g as defined as working memory capacity. *Intelligence*, 36,226-235.
37. Martinez, M. E. (2000). *Education as the cultivation of intelligence*. Mahwah, New Jersey: Lawrence Erlbaum Associates.
38. Masaali S. [Relationship between reading study and academic achievement among students in IU]. [dissertation]. Isfahan: Khorasgan Slamic Azad University. 2007. [Persian]
39. Mattanah, J., Pratt, M., Cowan, P., & Cowan, C. (2005). Authoritative parenting, parental scaffolding of long-division mathematics, and children's academic competence in fourth grade. *Journal of Applied Developmental Psychology*, 26, 85-106.
40. McClelland, D. (1985). Human motivation. Glenview, IL: Scott, Foresman.
41. Minor, K.,park, S. (1999). Spatial Working Memory: Absence of gender difference in Schizophrenia Patients and Healthy control Subjects. *Society of Biological Psychiatry*, 46, 1003-1005.
42. Nilsson, L.G. & Backman, L. (1997). The Betula prospective cohort study: Memory, health, and aging. *Aging, Neuropsychology, & Cognition*, 1–32
43. Reiss A. L. & Menon, V. (2002) Neural basis of protracted developmental changes in visuo-spatial working memory. *Proceeding of the National Academy of Science of the United States of America (PNAS)* October. 99 (20) 13336-13341
44. Pandey, S.(2007). *Psychological consequences of Child Abuse*. New Delhi: Concept Publishing Company.
45. Pandey, S. & Tamta, P. (2013), Dose Child Abuse Impede Development of Working Memory in Children. *Journal of Psychological Issues* (Vol. 21) 16-31.
46. Pandey, S., Tamta, P. & Tripathi, N. (2015). Does verbal ability facilitate the development of working memory? *Journal of Psychological Researches: An international Journal*, 59, 2, 12-22, 0022-3972.
47. Proffitt, D. R. (2006). Embodied perception and the economy of action. *Perspectives on Psychological Science*, 1, 110-122.
48. Roodenrys, S., Hulme, C, and Brown, G.(1993). The development of short term memory span: seperable effects of speech rate and long term memory. *Journal of Experimental Child Psychology* 56, 431-442.
49. Shahraray M, (Translator). [Angizesh dar taalim va tarbieyat]. Pintrich P, Shonk D (Author). Tehran: Elm, 2007,[Persian].
50. Silverman, I., & Eals, M. (1992). Sex differences in spatial abilities: Evolutionary theory and data. In J. Barkow, I. Cosmides, and J. Tooby (Eds.) *The adapted mind:evolutionary psychology and generation of culture*. New York: Oxford University Press.
51. Voyer, D., & Bryden, M.P.(1995). Gender level of spatial ability, and lateralization of mental rotation. *Brain and Cognition*, 13, 18-29.