iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL
FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 Issue: VIII Month of publication: Aug 2023

DOI: https://doi.org/10.22214/ijraset.2023.55197

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

Role of Rehearsal Language in Working Memory of Tamil English Bilingual Children

Ms. Swetha S[1], Dr. Vini Abhijith Gupta[2]
Department Of Audiology And Speech Language Pathology, Dr. M.V. Shetty College Of Speech And Hearing, Mangalore, Karnataka, India

Abstract: Memory is the ability to retain information or a representation of past experience, based on the mental processes of learning or encoding, retention across some interval of time, and retrieval. The three major classifications of memory that deals with today are as follows: sensory memory, short-term memory, and long-term memory. Information from the world around an individual begins to be stored by sensory memory, making it possible for this information to be accessible in the future. Short-term memory refers to the information processed by the individual in a short period of time. Working memory (WM) performs this processing. Long-term memory allows to store information for long periods of time. WM is the retention of a small amount of information in a readily accessible form. It facilitates planning, comprehension, reasoning and problem solving. Therefore, the aim of the study was to analyse the role of rehearsal language in working memory in 60 Tamil English bilingual children which included 30 boys and 30 girls between the ages of 8.0 to 10.11 using Backward Digit (BD) span task in three rehearsal instructions such as no instruction on the language of rehearsal, rehearsal in Tamil followed by rehearsal in English to determine the working memory capacity and gender differences. The results suggested that BD span scores were significantly higher in Tamil rehearsal than the other rehearsal conditions, WM capacity increased as age increases and no gender differences were obtained across all the age groups in both boys and girls.
Keywords: working memory, rehearsal, Tamil English bilingual children, effect of age, gender difference.

I. INTRODUCTION

Memory is today defined in psychology as the faculty of encoding, storing, and retrieving information (Squire, 2009). Among the more frequently occurring meanings of memory are (1)memory as a neurocognitive capacity to encode, store and retrieve information ; (2) memory as a hypothetical store in which information is held (3) memory as the information in that store;(4) memory as some property of that information; (5) memory as a componential process of retrieval of that information; and (6) memory as an individual's phenomenal awareness of remembering something.

Memory is an adaptation to particular temporal properties of past events, such as the frequency of occurrence of a stimulus or the coincidence of multiple stimuli. In neurons, this adaptation can be understood in terms of a hierarchical system of molecular and cellular time windows, which collectively retain information from the past. From the coining of the term "memory" in the 1880's by Hermann Ebbinghaus, to the distinction made between primary and secondary memory by William James in 1890, and to the now widely accepted and used categorizations of memory that include: short-term memory (STM), long-term memory (LTM), and working memory (WM).

WM has been defined as ' a limited capacity system allowing the temporary storage and manipulation of information necessary for such complex tasks as comprehension, learning and reasoning'(Braddeley,2000). It is the "sketchpad of conscious thought." which hold and manipulate thoughts and is foundational to the organization of goal-directed behaviour (Chatham & Badre, 2015).

Baddeley & Hitch (1974) proposed a WM model that revolutionized the rigid and dichotomous view of memory as being short or long-term, although the term "WM model" was first introduced by Miller et al. (1960). The WM model posited that as opposed to the simplistic functions of STM in providing short-term storage of information, WM is a multicomponent system that manipulates information storage for greater and more complex cognitive utility (Baddeley, 1996, 2000b). The three subcomponents involved are phonological loop (or the verbal WM), visuospatial sketchpad (the visual-spatial WM), and the central executive which involves the attentional control system (Baddeley, 2000b).

It was not until 2000 that another component termed "episodic buffer" was introduced into this WM model (Baddeley, 2000a). Episodic buffer was regarded as a temporary storage system that modulates and integrates different sensory information (Baddeley, 2000a).

It is frequently defined as a versatile mental workspace which can store significant data while performing challenging mental tasks. Mental arithmetic is an excellent illustration of how WM is used in everyday situations. WM is essential because it supports skills in many domains, including comprehension, learning and reasoning.

Engle et al. (1999) argued that individual differences in performance on complex WM tasks are primarily due to differences in the central executive component of WM, whereas in the case of simple span task performance they are primarily due to differences in domain-specific abilities such as chunking and rehearsal (in particular, verbal span tasks).

Furthermore, neuroimaging studies have revealed that WM is particularly dependent on cells in the prefrontal cortex, a region of brain that traditionally has held a prominent status in high-order, complex goal-directed human behavior (Kane & Engle, 2002).

The WM tasks in individual's first language (LI) and second language (L2) drawn from a general system related to the executive functions found no significant difference between WM span scores in LI and L2, as well as a moderate, significant relationship between the two. Whereas monolingual and bilingual young adults had similar performance in both the digit span task and forward Corsi block test (Milner, 1971). They also found that bilingual men, but not women, displayed a verbal memory weakness. However, studies of multilingual adult participants (Papagno & Vallar, 1995) have found that they had better performance in verbal STM (auditory digit span and nonword repetition) but did not differ from monolinguals in visuospatial STM tasks.

There is evidence that 6- 10 year old, bilinguals outperformed monolinguals on a delayed recall test of everyday event stories. Recent study on monolingual and bilingual young adults, a bilingual advantage on the counting span task was found, together with a smaller build-up of proactive interference in a STM task.

The studies also determined that above 7 years of age, the efficiency of refreshing increases to reach a similar level at 14 as in young adults. This improvement in refreshing is a major determinant of the developmental increase in WM capacity observed in childhood (Gaillard et al., 2011)

Digit Span is a reliable measure to assess WM abilities. In Backward Digit (BD) Span the child is read a sequence of numbers and recalls the numbers in the reverse order. It involves WM, transformation of information, mental manipulation, and may involve visuo-spatial imaging (Wechsler, 2014). D'Esposito and Postle (2002a) reported that digit span were considered to exhibit greater dependence on the posterior cortex. When information has to be manipulated, however, increased prefrontal activity is found.

Kumar and Anoop (2021) studied Role of Rehearsal Language in WM in 24 individuals who were exposed to Kannada and English. Results indicated that rehearsal in English (shorter digit length) resulted in higher scores than the other two conditions. The results provide evidence to the existence of word-length effects even at the level of rehearsal strategies.

Tom and Gupta (2022) conducted a study on Role of Rehearsal Language in WM in Bilingual Children of age range 8.0-10:11years and indicated that Malayalam rehearsal produced substantially lower BD spans than English rehearsal condition. WM capacities increased with age in both boys and girls. And In terms of WM capacities, there were no appreciable variations between the genders across all age groups in the three rehearsal conditions.

Hence, it is important to consider the role of rehearsal language in WM for Tamil - English bilinguals, also the performance of WM on the basis of age and gender is necessary to be assessed.

II. REVIEW OF LITERATURE

Memory is the ability to retain information or a representation of past experience, based on the mental processes of learning or encoding. Further categorizations of LTM include several categories: (1) episodic; (2) semantic; (3) Pavlovian and (4) procedural memory (Humphreys et al., 1989). Meanwhile, STM was defined as temporarily accessible information that has a limited storage time (Cowan, 2008). WM refers to a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning. The three subcomponents involved are phonological loop, visuospatial sketchpad , and the central executive (Baddeley, 2000b).

The introduction of episodic buffer of WM (Baddeley, 2000) was proposed as a limited capacity storage system responsible for integrating information from several sources to create a unified memory, sometimes referred to as a single 'episode'. Several domains of WM such as the focus of attention inhibitory controls, maintenance, manipulation, and updating of information, capacity limits (Cowan, 2005), and episodic buffer were executive processes that relied on executive control efficacy.

The model of the phonological loop comprises a phonological store associated with left parietal activation, which can hold memory traces for a few seconds before they fade, and an articulatory rehearsal process associated with activation in Broca's area. That is analogous to subvocal speech and memory traces can be refreshed by being retrieved and re-articulated. Immediate memory has a limited span because articulation takes place in real time — as the number of items rehearsed increases, it reaches a point at which the first item will have faded before it can be rehearsed.

Thus, it is particularly suited to the retention of sequential information, and its function is reflected most clearly in the memory span task, whereby a sequence of items such as digits must be repeated back immediately in the order of presentation. Digit span, the maximum number of digits that can be retained perfectly on 50% of occasions (typically about seven), is assumed to be determined jointly by the durability of the memory trace, and the time required to refresh the trace by subvocal rehearsal.

Evidence for the importance of rehearsal comes from the word length effect, whereby immediate recall of long is much more error-prone than for short words (Baddeley et al 1975).

The visuospatial sketchpad refers to the ability to temporarily hold visual and spatial information, such as the location of a parked car, or the route from home to a grocery store. The visuospatial sketchpad and the verbal rehearsal component of the functional framework involves mental capacities which are used to remember such as new words, new faces, spatial information and so on.

The episodic buffer of WM (Baddeley, 2000) is proposed as a limited capacity storage system responsible for integrating information from several sources to create a unified memory, sometimes referred to as a single 'episode'. The episodic buffer does this by "binding" information from the various systems of WM.

The study of the lesion pattern of STM patients has also contributed converging evidence on the multi-component nature of verbal WM. Meta-analysis of brain lesions in patients with deficits of the STM suggested that a crucial lesion site may be in the left inferior parietal cortex in the perisylvian region (Baldo & Dronkers, 2006)

The studies also determined that an articulatory rehearsal mechanism that would recursively reactivate verbal memories within a phonological loop (Baddeley 1986), while Logie (1995) has suggested the existence of an inner scribe that would fulfill the same function for maintenance of visuospatial information within the visuospatial sketchpad. Subsequently, the existence of a refreshing mechanism through attentional focusing and covert retrieval assumed to counteract the decay of memory traces Cowan (1992). Raye et al., (2007) identified the neural substrates of this mechanism as being distinct from the neural areas involved in verbal rehearsal. These different mechanisms are assumed to reactivate and strengthen WM traces in the face of decay and interference resulting from concurrent processing.

The ability to engage with verbal rehearsal strategies is evident by 7 years of age, and this ability improves over middle childhood. Research investigating the ability to follow spoken instructions in a WM paradigm suggests that adults rely on multiple components of WM when performing the task (Yang et al., 2016), whereas children's performance is primarily linked to their verbal WM ability (Jaroslawska et al., 2015). Bilingualism is concerned with the coexistence of more than one language system within an individual (Hakuta, 2009). Messer et al., (2010) reported that sequences of words in the rememberer's first language are recalled better than those from the second language.

Digit span is the standard test to assess the core systems of verbal WM performance that is routinely used (Elliot & Smith, 2011). The fact that span size for digit stimuli is consistently greater than span size for other stimuli such as words or letters digit span increases with age providing a foundation for theorists to incorporate STM capacity as a mechanism of development (Bronik, & Fry 1997).

A. Western Studies

Cowan(2017) reported that WM subsumes STM storage, and additionally includes complex processing functions (e.g., immediate processing, manipulation of information).

Jarrold et al., (1999) described the hypothesis of the preservation of phonological loop coexisting with impaired visuo-spatial sketchpad in WS in short-term verbal memory (Digit Span) and short-term visuo-spatial memory (Corsi Blocks). The results revealed that WS had the lowest score in short-term visuo-spatial memory contrasting with a superior Digit Span performance proving dissociation in WM components (between phonological loop and visuo-spatial sketchpad).

When rehearsal aloud is required, the result suggest that the most recently rehearsed items are recalled best (Tan & Ward, 2000).Among other WM tasks (phonological STM, visuospatial STM, and central executive tasks), the BD span task was the one that consistently differentiated between children with and without special educational needs at 7 and 8 years of age. The BD span is a task that particularly loads the central executive, and possibly the extremely effective discriminating capacity of the task arises from its sensitivity to the function of the central executive. (Gathercole & Pickering, 2001)

Chen and Cowan (2005) found a greater contribution of phonological processes for serial recall as opposed to free recall or free scoring of serial recall.

Gilchrist et al., (2009) reported that the digits were attended only occasionally, when a recall cue was presented about 1 s after the last digit and the performance increase with age throughout the elementary school years was just as big for small digits (1, 2, 3), which are likely to be familiar, as for large digits (7, 8, 9), which are less familiar .

Barrouillet et al., (2011) emphasized that the process of using attention to refresh items, no matter whether verbal or nonverbal in nature, takes time and counteracts decay and also found that children who are too young (about 4 years of age and younger) do not seem to use attention to refresh items. For them, the limit in performance depends on the duration of the retention interval. For older children and adults, who are able to refresh, it is not the absolute duration but the cognitive load that determines performance.

Hill et al., (2014) compared gender differences in WM networks by a BrainMap meta-analysis and results demonstrate consistent WM networks across genders, but also provide evidence for gender-specific networks whereby females consistently activate more limbic (e.g., amygdala and hippocampus) and prefrontal structures (e.g., right inferior frontal gyrus), and males activate a distributed network inclusive of more parietal regions.

Ershova1 and Tarnow (2017) found WM capacity & gender differences in 400 young adults and observed small differences in WM capacity between the genders and males are more common than females among low and high WM capacity.

Elosua et al., (2017) found gender differences in verbal and visuospatial wm tasks in patients with Mild Cognitive Impairment (MCI) and Alzheimer Disease (AD) results revealed no significant differences between men and women with AD in visuospatial tasks, whereas these differences were found within the MCI group, with the average of men achieving significantly higher results than women. In verbal tasks, there were no differences between sexes for any of the groups.

Gibson et al (2018) examined phonological and visuospatial immediate free recall (IFR) tasks, and scored children's recall based on established primacy and recency effects, to differentiate between performance attributed to STM and WM. Consistent with regression-based methods, they found that children with ADHD displayed large magnitude impairments in WM.

Lehtonen et al. (2018) compared bilinguals and monolinguals performance in six cognitive control dimensions by using effect sizes from 152 previous studies on adults. They concluded that their analyses revealed only a small bilingual advantage in dimensions of inhibition, shifting and WM, but no bilingual advantage in monitoring or attention.

Rindermann et al., (2020) found the relation between visual impairment and WM in 6-16years with and without visual impairment at different development levels in WM capacity and verbal comprehension. Using the WISC-IV and found that blind and visually impaired children showed higher WM capacity than children without visual impairment. On the other hand, visually impaired children showed a weakness in verbal comprehension .

Giannouli (2023) examined the gender differences in self-estimated intelligence by exploring the role of WM, creativity, and other psychological correlates in a total of 159 young and 152 older adults assessed by the Digit Span Forward and Verbal Fluency and results suggested that Young males rated their intelligence quotient (IQ) and emotional quotient (EQ) higher than young females and Older women reported higher IQ and EQ than older men.

B. Indian Literature

Jagadeesh and Uppunda (2020) found role of rehearsal in WM in 24 bilinguals (Kannada – English) adults by measuring BD span and results indicated that rehearsal in English (shorter digit length) leading with higher scores than Kannada digits .

Gupta and Sharma (2017) reported that children with LD frequently struggle to study because the high WM demands of the learning activity frequently surpass their WM capacity. These children academic performance can also be enhanced by remedial training, teaching proper WM strategies, and other measures.

Prathap and Singh (2021) concluded from their investigation on college students that the deterioration in student's prospective memory was correlated with how dependent they were on their digital devices and how much cognitive offloading they were doing.

lyer & Venkatesan (2021) revealed that bilingual children outperform trilingual children on WM tasks that included verbal and visuospatial components among 6 to 8-year-old children. Little studies have been conducted on WM abilities in children using BD span in Indian conext .

C. Need For The Study

WM is a critical aspect of our cognitive capacity because it provides the ability to retain task-relevant information in a highly activated and accessible state over time (Hambrick, Zane, & Engle, 2005). WM is responsible for monitoring ongoing cognitive processes and actions, engaging selective attention to relevant representations and procedures, and suppressing irrelevant, distracting ones (Oberauer et al.,2003). WM skills are specifically impaired in children with Autism, Attention Deficit Hyperactive Disorder and Dyslexia. The operational effectiveness of WM is a key predictor of a child's school achievement in the areas of literacy and numeracy. Also the important role that WM plays in speech perception, particularly in difficult auditory environments such as in the presence of background noise, it is likely that variations in WM function and capacity will make it more difficult for hearing aid users to understand speech in noisy environments (Javanbakht, Moosavi and Vahedi, 2021).

Poor WM abilities can be addressed by Speech Language Pathologists (SLP) by taking into account both changes to the environment and child-enacted knowledge and skills, which may help to lessen their negative effects on learning and academic achievement (Boudreau and Costanza-Smith, 2011).

Mora & Camos (2015) found Dissociating Rehearsal and Refreshing in the Maintenance of Verbal Information in 8-Year-Old Children who performed complex span tasks in which the availability of either the rehearsal or the refreshing was impeded by a concurrent articulation or an attention-demanding task, respectively and results revealed that the two maintenance mechanisms are independent in 8-year-old children as they are in adults .

A study done by Tom, Gupta (2022) on the impact of rehearsal language on WM spans in 60 bilingual children between the age of 8-10 years found that there were word length effects at the level of rehearsal strategies. As a result, Malayalam rehearsal produced substantially lower BD spans than English rehearsal condition, In all three rehearsal conditions. WM capacities increased with age in both boys and girls and in terms of WM capacities, there were no appreciable variations between the genders across all age groups in the three rehearsal conditions.

However, compared to girls, boys made fewer errors in the incorrect BD span with rehearsal in English (short digit span) leading with high scores. The results revealed highly significant differences between all age group. In summary, previous literature indicate the importance of role of language rehearsal in WM.

A few or limited research has been done to support the efficacy in Tamil Language. Therefore, the current aim of the study was to access the role of rehearsal language in WM in bilingual children (Tamil-English) between the ages of 8.0 to 10.11, in order to explain effects of age and gender on WM capacity. It is essential to analyse TD children as they will serve as a baseline for the purpose of applying rehearsal techniques to help children with developmental delays improve their WM. Therefore, it is said to believe that results of the present study will provide new and important information that will help identify and design interventions for children with poor WM.

III.METHODOLOGY

A. AIM

The purpose of the present study is to determine whether rehearsal language affects the performance of WM in TD children aged through 8.0 to 10.11 years. Age related and gender differences in WM capacities were also assessed.

B. Participants With Inclusive And Exclusive Criteria

Participants included 60 (30 girls and 30 boys) TD sequential bilingual children in fourth through sixth grades who spoke Tamil as their first language and the medium of instruction in the classroom was English. Age of the children ranged from 8.0 to 10.11 years. This age range was chosen because, according to Dehn (2008), spontaneous rehearsal does not begin until age 7 and the majority of children have normal articulation abilities by the time they are 8 years old (Farquharson et al.,2018).

Children with a history of speech and language disorders, reading and writing disorders, hearing disorders, neurological issues and cognitive issues such as poor attention, memory were excluded. Children performing above average in academics chosen by the teachers were taken for the study.

C. Materials Used

Digits between zero to nine which were bisyllabic were presented in Tamil language for all three rehearsal conditions of the experiment. The stimuli were spoken by a native female speaker.

D. Procedure

Through teacher interviews, potential participants were identified from the classroom. All participants had their BD spans assessed. A random number sequence was presented with a one-second gap between each stimulus. The allotted time to rehearse the sequence aloud was 30 seconds after the last digit in the series was presented. The participant wrote the numbers backward. Additionally, they were told to substitute '_' for any missing digits in the sequence. The allotted time for participants to record their responses was 30 seconds. The number of digits in the next sequence (span length) increased by one for each correct response or sequence, whereas the span length decreased by one for each incorrect response. Six reversals were performed in total (from correct to wrong and vice-versa) for each participant. The last four reversal's means were used to determine the BD spans after the initial two reversals were eliminated. Feedbacks were provided for correct responses.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

Three different rehearsal instructions were used to measure verbalization of BD
1) No instruction on the language of rehearsal (NI),
2) Instructed to rehearse in Tamil (RT), and
3) Instructed to rehearse in English (RE).

All participants were tested initially in the NI condition, which serves as the control condition. No directions were offered on the rehearsal language for this condition. To prevent participants from becoming biased in favour of/against rehearsal in either Tamil or English, the NI condition was carried out first.

To become accustomed to the task, all participants underwent a practice trial first. This was not included for calculating the BD span scores.

A. Scoring

The total number of digits written correctly during each of the three conditions was calculated. For the scoring purpose, the raw score of the total number of correct digit spans obtained was retained and subjected for statistical analysis. For example, if the child repeats digits backward in NI condition as "753", the number of correct digits was considered as three.

B. Statistical Analysis

The significance of BD span score were obtained using Repeated measures ANOVA , Bonferroni test and one way ANOVA for the pair wise and multiple comparisons comparison of BD span score according to each age group. The Independent sample "t" test, Repeated measures ANOVA along with Bonferroni test was performed to determine statistically significant variations in pair wise comparison of backward digit span score within and across gender.

IV. RESULTS AND DISCUSSION

In spite, of presenting the digits only in Tamil language, the results of the study aim to assess the variations in BD span scores with rehearsal in Tamil versus English. The ability to use WM in 60 TD children of different age group and gender by presenting digits in Tamil in all the language of rehearsal condition were assessed. The children practiced in Tamil under the No instruction on the language of rehearsal condition. The results of the study are discussed below.

Table 4.1
Showing the mean scores of BD span in language of rehearsal conditions in bilingual children. (In NI, RT and RE).

Backward digit span score	Mean	S.D.	"F"	p value	Significance
No instruction (NI)	4.08	0.72	13.58	< 0.001*	S
Rehearsal in Tamil (RT)	4.02	0.65			
Rehearsal in English (RE)	4.50	0.65			

*S – Significant

The mean scores of BD span in comparison across the language of rehearsal are shown in Table 4.1 for bilingual children. It can be inferred that the mean scores of BD span across all the language of rehearsal were significant in bilingual children and rehearsal in the Tamil (RT) condition was lower than both the English (RE) and 'No Instruction' (NI) conditions.

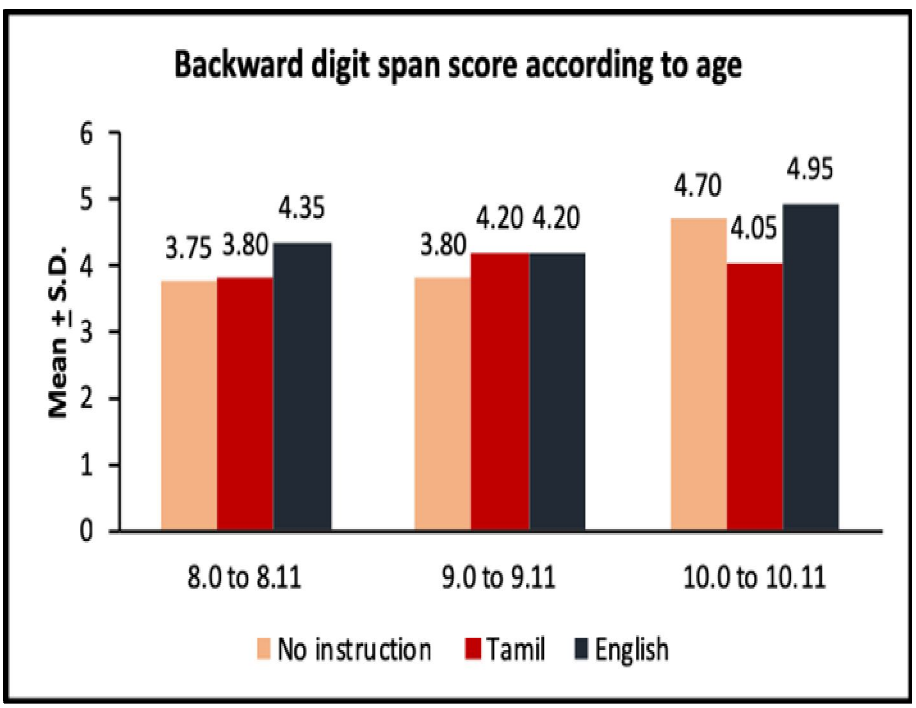
International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

Table 4.2: Comparison of backward digit span score between the age groups
Showing the mean and SD scores of BD span across the language of rehearsal conditions in bilingual children between the age groups.

Backward digit span score		Mean	S.D.	"F"	p value	Significance
8.0 to 8.11	No instruction	3.75	0.79	5.92	0.006	S
	Tamil	3.80	0.77			
	English	4.35	0.67			
9.0 to 9.11	No instruction	3.80	0.41	7.80	0.001	S
	Tamil	4.20	0.41			
	English	4.20	0.62			
10.0 to 10.11	No instruction	4.70	0.47	17.51	< 0.001	S
	Tamil	4.05	0.69			
	English	4.95	0.39			

*S – Significant ,

Fig. 4.1
Showing the graphical representation of the mean scores of BD span in language of rehearsal conditions across the age groups (8.0-8.11, 9.0-9.11 and 10.0-10.11 years)



The BD span results for the three rehearsal instructions (in NI, RT & RE) in age ranges of 8.0–8.11 years, 9.0–9.11 years, and 10.0–10.11 years are shown in Table 4.2 and Fig 4.1. Results of the statistical analysis revealed a significant difference ($p < 0.05$) in all the three condition between all age groups (p=0.00).Thereby, suggesting that WM performance gets better with age.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

A. Comparison Between the Gender

Table 4.3
Showing the gender comparison of BD span scores in rehearsal conditions across the age groups (8.0-8.11, 9.0-9.11 and 10.0-10.11 years).

Backward digit span score	Gender	Age groups	N	Mean	S. D.	"F"	p value
No instruction (NI)	Boys	8.0 to 8.11	10	3.7	0.7	8.11	0.002 (S)
		9.0 to 9.11	10	3.8	0.4		
		10.0 to 10.11	10	4.6	0.5		
	Girls	8.0 to 8.11	10	3.8	0.9	8.33	0.002 (S)
		9.0 to 9.11	10	3.8	0.4		
		10.0 to 10.11	10	4.8	0.4		
Tamil (RT)	Boys	8.0 to 8.11	10	3.4	0.8	4.24	0.025 (S)
		9.0 to 9.11	10	4.2	0.4		
		10.0 to 10.11	10	4.2	0.8		
	Girls	8.0 to 8.11	10	4.2	0.4	1.33	0.282 (NS)
		9.0 to 9.11	10	4.2	0.4		
		10.0 to 10.11	10	3.9	0.6		
English (RE)	Boys	8.0 to 8.11	10	4.2	0.8	6.26	0.006 (S)
		9.0 to 9.11	10	4.2	0.4		
		10.0 to 10.11	10	5.0	0.5		
	Girls	8.0 to 8.11	10	4.5	0.5	3.70	0.038 (S)
		9.0 to 9.11	10	4.2	0.8		
		10.0 to 10.11	10	4.9	0.3		

*S- Significance, NS- No Significance

The BD span results for the three rehearsal instructions (in NI, RT & RE) in age ranges of 8.0–8.11 years, 9.0–9.11 years, and 10.0–10.11 years are shown in Table 4.3. From the table 4.3, it is evident that significant differences were obtained for all three rehearsal across age group except for girls in RT condition.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

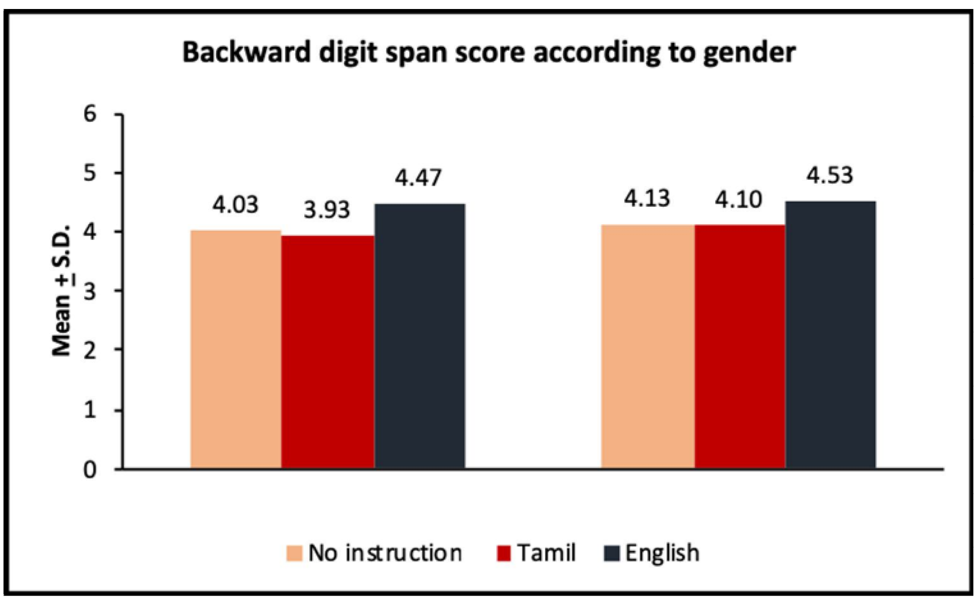
B. Comparison of BD Span Across Gender

Table 4.4
Showing the mean and S.D scores of BD span in rehearsal conditions in boys and girls.

Backward digit span score		Mean	S.D.	"t"	p value	Significance
No instruction	Boys	4.03	0.67	-0.54	0.595	NS
	Girls	4.13	0.78			
Tamil	Boy	3.93	0.79	-0.99	0.325	NS
	Girls	4.10	0.48			
English	Boys	4.47	0.68	-0.39	0.695	NS
	Girls	4.53	0.63			

*NS-No Significance.

Fig 4.2
Showing the graphical representation of the mean scores of BD span across rehearsal conditions in boys and girls. X-axis represents boys/ girls (gender) and Y-axis represents the mean of BD span scores obtained.



The BD span scores for boys and girls under three rehearsal conditions are shown in Fig 4.2 and Table 4.4. In all three conditions, there was no significant difference ($p > 0.05$) in the findings between boys and girls across age groups. From the results, it can be concluded that no gender differences can be seen in terms of their WM capacities across the age groups in the three rehearsal conditions.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VIII Aug 2023- Available at www.ijraset.com

C. Comparison Between the Rehearsal Conditions among Age Groups and Gender

Table4.5:
Showing the mean and SD scores of BD spans across the language of rehearsal conditions in bilingual children between age groups and gender.

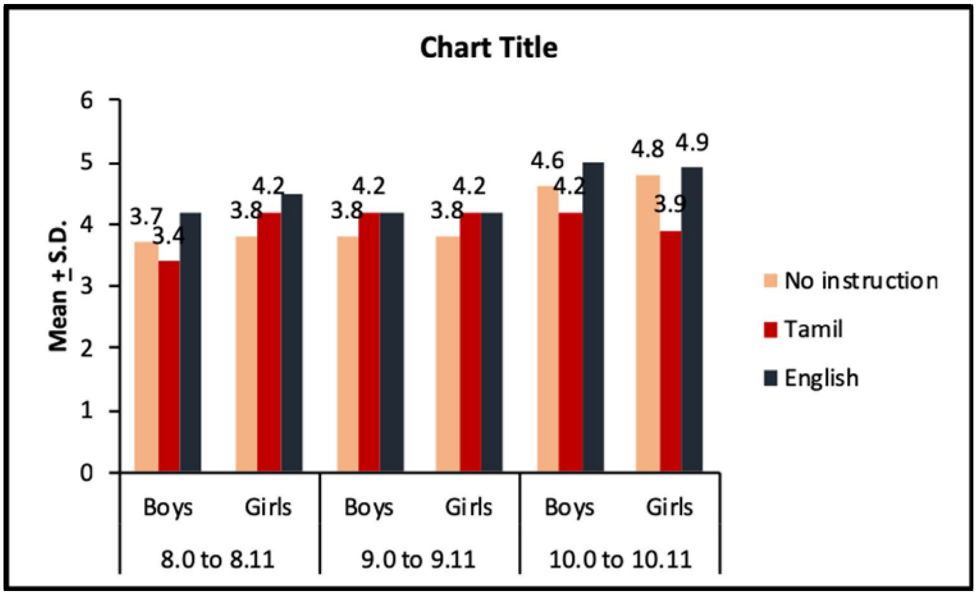
Age group	Gender	BD span score in rehearsal condition	n	Mean	S.D.	Repeated measures ANOA		Post hoc analysis (Bonferroni test)					
						"F"	p value	No instruction vs Tamil		No instruction vs English		Tamil vs English	
								Mean	p value	Mean	p value	Mean	p value
8.0 to 8.11	Boys	No instruction	10	3.7	0.7	3.97	0.048 (S)	0.3	0.193 (NS)	-0.5	0.138 (NS)	-0.8	0.037 (S)
		Tamil	10	3.4	0.8								
		English	10	4.2	0.8								
	Girls	No instruction	10	3.8	0.9	4.01	0.050 (S)	-0.4	0.223 (NS)	-0.7	0.010 (S)	-0.3	0.193 (NS)
		Tamil	10	4.2	0.4								
		English	10	4.5	0.5								
9.0 to 9.11	Boys	No instruction	10	3.8	0.4	6.00	0.037 (S)	-0.4	0.037 (S)	-0.4	0.037 (S)	0.0	--
		Tamil	10	4.2	0.4								
		English	10	4.2	0.4								
	Girls	No instruction	10	3.8	0.4	2.67	0.104 (NS)	-0.4	0.037 (S)	-0.4	0.104 (NS)	0.0	1 (NS)
		Tamil	10	4.2	0.4								
		English	10	4.2	0.8								
10.0 to 10.11	Boys	No instruction	10	4.6	0.5	4.70	0.041 (S)	0.9	0.004 (S)	-0.1	0.343 (NS)	-1.0	< 0.001 (S)
		Tamil	10	4.2	0.8								
		English	10	5.0	0.5								
	Girls	No instruction	10	4.8	0.4	21.00	0.001 (S)	0.4	0.168 (NS)	-0.4	0.037 (S)	-0.8	0.037 (S)
		Tamil	10	3.9	0.6								
		English	10	4.9	0.3								

*S- Significance, NS- No Significance

Table 4.5 displays the overall BD span results for the three different rehearsal instructions (no instruction, rehearsal in Tamil and rehearsal in English) and gender across age group.

The mean BD span scores for boys and girls across all age groups and rehearsal conditions are shown in the table 4.5 and the findings of the statistical analysis revealed a significant difference for boys and girls in all rehearsal except for 9.0-9.11 age group girls . Significant differences were noted for BD span in RT vs RE for boys and NI vs RE for girls in 8.0-8.11 age group ; NI vs RT for both boys and girls and NI vs RE for boys in 9.0 to 9.11 age group and RT vs RE for girls and boys , NI vs RE for girls and NI vs RT for boys in 10.0 to 10.11 age group .

Fig 4.3:
Showing the graphical representation of comparison of the mean scores of BD span across the language of rehearsal conditions in bilingual children between age groups and gender. X- axis represents the age groups and gender of bilingual children and Y-axis represents the mean scores of BD span scores across the rehearsal conditions (Rehearsal in NI, RT and RE).



In Fig 4.3, it is clear that BD span scores were higher in RE condition than the other two conditions (NI & RT) across all age groups.

From the above results, it can be inferred that Tamil rehearsal produced substantially lower BD spans than English rehearsal condition. Higher BD span was observed in English rehearsal condition among both boys and girls across age group. In all three rehearsal conditions, WM capacities increased with age in both boys and girls. In terms of WM capacities, there were no differences between the genders across all age groups in the three rehearsal conditions.

V. DISCUSSION

The aim of the current study was to determine whether differences in role of rehearsal language can arise changes in WM capacities related to age and gender across the conditions. 60 Tamil-English bilingual children of 8.0 - 10.11 years were chosen as participants for the study. They were asked to listen to a span of digits presented in Tamil and were asked to rehearse according to the instruction provided such as in NI where the participants have to rehearse either in English or Tamil , rehearse in Tamil followed by English for 30 seconds respectively and to write the rehearsed digit span in reverse manner on instruction. The results of the present study revealed that rehearsal in English to obtain higher BD span than compared to rehearsal in No Instruction and rehearsal in Tamil among both boys and girls across age group . Also found that WM capacity increases as age increases and no differences in WM capacity was noticed with respect to gender. The results of the current study is in accordance with the study in Malayalam language (Tom & Gupta ;2022) and in Kannada language (Jagadeesh & Uppunda ;2020) who reported similar findings that BD span was higher when English was used as rehearsal since better WM scores were obtained when practising in a language with shorter word lengths. The results of the current study also revealed that as age progressed, WM capacities showed improvements, but no variations were observed within gender. The results also provided evidences to the existence of word-length effects even at the level of rehearsal strategies. The findings of the present study reported WM capacity increases as age increases which is supported by Gilchrist et al., (2009). Also results of the current study revealed that in all age groups and the three rehearsal strategies, there were no gender biased differences in WM skills between boys and girls which correlated with the western study by Harness et al.,(2008) on gender differences in working memory who found that performance of men and women were not significantly different in the no-distraction condition.

The outcomes of the current study are advantageous for a SLPs. Therefore , by using a rehearsal technique tailored to the language chosen for rehearsal the current study provides a baseline for SLPs to employ this technique in assessment and intervention for children with special needs to improve their WM skills.

VI. SUMMARY CONCLUSION

The short-term mental storage and manipulation operations are collectively called working memory which functions as a workspace that provides a temporary holding store so that relevant information is highly accessible and available for inspection and computation. When cognitive tasks are accomplished, the information can be easily erased, and the process can begin again with other information.

WM provides also an interface to LTM (Atkinson and Shiffrin,1968), that is instead responsible for the "passive" storage of information for longer periods of time: WM can "upload" and "download" information to and from LTM.

Despite its limited capacity, WM is an essential memory mechanism related to processing linguistic tasks including, overall language proficiency (van den Noort, Bosch & Hugdahl 2006), vocabulary development (Daneman & Green,1986), grammar learning (Williams & Lovatt 2003), reasoning (Baddeley & Logie 1999), note taking (Kiewra & Benton, 1988), writing (Kellog, 2016), sentence processing (Felser & Roberts, 2007), speaking (O'Brien et al. 2006), listening comprehension (Juffs & Harrington, 2011), reading comprehension (Kane et al., 2004; Alptekin & Ercetin, 2009), inferential understanding (Alptekin & Erçetin, 2010; 2011), second language aptitude (Dornyei & Skehan; 2003).

The aim of the current study was to was to determine whether differences in role of rehearsal language can arise changes in WM capacities related to age and gender across the conditions. 60 Tamil-English bilingual children of 8.0 - 10.11 years were chosen as participants for the study . They were asked to listen to a span of digits presented in Tamil and were asked to rehearse according to the instruction provided such as in NI where the participants have to rehearse either in English or Tamil , rehearse in Tamil followed by English for 30 seconds respectively and to write the rehearsed digit span in reverse manner on instruction. The results of the present study revealed that rehearsal in English to obtain higher BD span than compared to rehearsal in No Instruction and rehearsal in Tamil among both boys and girls across age group. Also found that WM capacity increases as age increases and no differences in WM capacity was noticed with respect to gender. The results of the current study strongly agree with the findings of previous western and Indian literature that working memory is crucial for optimal learning and development. Therefore, a child's WM can be improved by using a rehearsal technique to the language chosen for rehearsal. Also, to employ this technique the current study will serve as a baseline for SLP'S in assessment and intervention purposes for children with special needs to improve their WM skills.

A. Limitations of the Study

1) Limited sample size.
2) The samples were exclusively collected from Cuddalore district in Tamil Nadu.

B. Future Directions

1) Sample size can be increased.
2) The study can be done in other districts inTamil Nadu.
3) Study can be carried out in other Indian languages.
4) Can be Tamil-English bilingual adults in different age groups.
5) Further studies can be done to comprehend how these cross-linguistic rehearsal techniques are used in conjunction with other, more challenging WM tasks like listening span, operation span, reading span etc.

REFERENCES

[1] Archibald L.M.D, (2017) "Working Memory and Language Learning: A Review"Child Language Teaching and Therapy, 33(1), 5–17 https://doi.org/10.1177/0265659016654206
[2] Baars J.B,Gage M.N,(2010) COGNITION, BRAIN, AND CONSCIOUSNESS Introduction to Cognitive Neuroscience Second Edition 2010, 35.
[3] Baddeley A, (1992) Working Memory. Vol 255, Issue 5044,556-559 https://doi.org/10.1126/science.1736359
[4] Baddeley A, (2000)The episodic buffer: a new component of working memory? VOLUME 4, ISSUE 11, P417-423. DOI:https://doi.org/10.1016/S1364-6613(00)01538-2
[5] Baddeley A, (2003)WORKING MEMORY: LOOKING BACK AND LOOKING FORWARD Volume 4, 829-839 .
[6] Baddeley A, Hitch G.J, (2010)Working memory http://dx.doi.org/10.4249/scholarpedia.3015
[7] Chai , Hamid ,Abdullah (2018) Working Memory From the Psychological and Neurosciences Perspectives: A Review. https://doi.org/10.3389/fpsyg.2018.00401
[8] Cowan(2013) Working Memory Underpins Cognitive Development, Learning, and Education https://doi.org/10.1007%2Fs10648-013-9246-y
[9] Demir, Bora. "Working Memory Model and Language Learning." Shanlax International Journal of Education, vol. 9, no. S2, 2021, pp. 1–8. DOI: https://doi.org/10.34293/ education.v9iS2-Sep.4366

[10] Dong, Li(2019)(Bilingualism: Language and Cognition） Attentional control in interpreting: A model of language control and processing control. Bilingualism: Language and Cognition 23(4) DOI:10.1017/S1366728919000786

[11] Elosua; Ciudad and Contreras (2017)Gender Differences in Verbal and Visuospatial Working Memory Tasks in Patients with Mild Cognitive Impairment and Alzheimer Disease https://doi.org/10.1159/000466689

[12] Ershova1 and Tarnow (2017)Working Memory Capacity & Gender: Small Overall Differences between Genders, U-Shaped Curve for Male/Female Ratio.

[13] G. Weiss, Saklofske, Holdnack, Prifitera (2019) WISC-V Clinical Use and Interpretation,9.

[14] Giannouli (2023)Are sex differences in self-estimated intelligence an elusive phenomenon? Exploring the role of working memory, creativity, and other psychological correlates in young and older adults . https://doi.org/10.1002/brb3.2857

[15] Gilchrist, Cowan, and Benjamin(2009) Investigating the Childhood Development of Working Memory Using Sentences: New Evidence for the Growth of Chunk Capacity doi: 10.1016/j.jecp.2009.05.006

[16] Harness ,Jacot, Scherf, White, Warnick(2008) Sex differences in working memory DOI: 10.2466/pr0.103.1.214-218

[17] Henry(2010) The episodic buffer in children with intellectual disabilities: An exploratory studydoi: 10.1016/j.ridd.2010.04.025

[18] Hill, A. C., et al. Gender differences in working memory networks: A BrainMap meta-analysis. Biol. Psychol. (2014), http://dx.doi.org/10.1016/j.biopsycho.2014.06.008

[19] Jagadeesh and Uppunda (2020) Role of Rehearsal Language in Working Memory.

[20] Jones,Macken(2015)Questioning short-term memory and its measurement: Why digit span measures long-term associative learning http://dx.doi.org/10.1016/j.cognition.2015.07.009

[21] Kukushkin Carew(2017) Memory Takes Time . https://doi.org/10.1016/j.neuron.2017.05.029

[22] Lucidi ,Langerock,Hoareau,Lemaire, Camos, Barrouillet(2015)Working memory still needs verbal rehearsal DOI: https://doi.org/10.3758/s13421-015-0561-z

[23] Masoura .V.E, (2006) Establishing the Link Between Working Memory Function and Learning Disabilities . Learning Disabilities: A Contemporary Journal 4(2), 29–41.

[24] Miller, Lundqvist, Bastos (2018) Working Memory 2.0 https://doi.org/10.1016/j.neuron.2018.09.023

[25] Paulesu,Shallice,Danelli,Sberna,Frackowik and Frith(2017) Anatomical Modularity of Verbal Working Memory? Functional Anatomical Evidence from a Famous Patient with Short-Term Memory Deficits Volume 11 – 2017 https://doi.org/10.3389/fnhum.2017.00231

[26] Pezzulo(2007) Working Memory.

[27] Pham, (2021)"The Role Of Working Memory And Linguistic Knowledge On Language Performance" Electronic Thesis and Dissertation Repository, 2-7.

[28] Rindermann, Ackermann & Nijenhuis (2020)Does Blindness Boost Working Memory? A Natural Experiment and Cross-Cultural Study. https://doi.org/10.3389/fpsyg.2020.01571

[29] Routledge(2023)The Routledge Handbook of Translation, Interpreting and Bilingualism,3. Chapter 1: Interfaces of translation, interpreting, and bilingualism from cognitive perspectives DOI: 10.4324/9781003109020-2

[30] Sampaioa, Sousab, Fernandeza, Henriquesc, Goncalves(2007) Memory abilities in Williams syndrome: Dissociationor developmental delay hypothesis? Sampaio et al.Brain and Cognition 66 (2008) 290–297 doi:10.1016/j.bandc.2007.09.005

[31] Tom, Gupta (2022)Role of Rehearsal Language in Working Memory in Bilingual Children.

[32] Tulving ,Craik (2000)The Oxford Handbook of Memory , 36 .

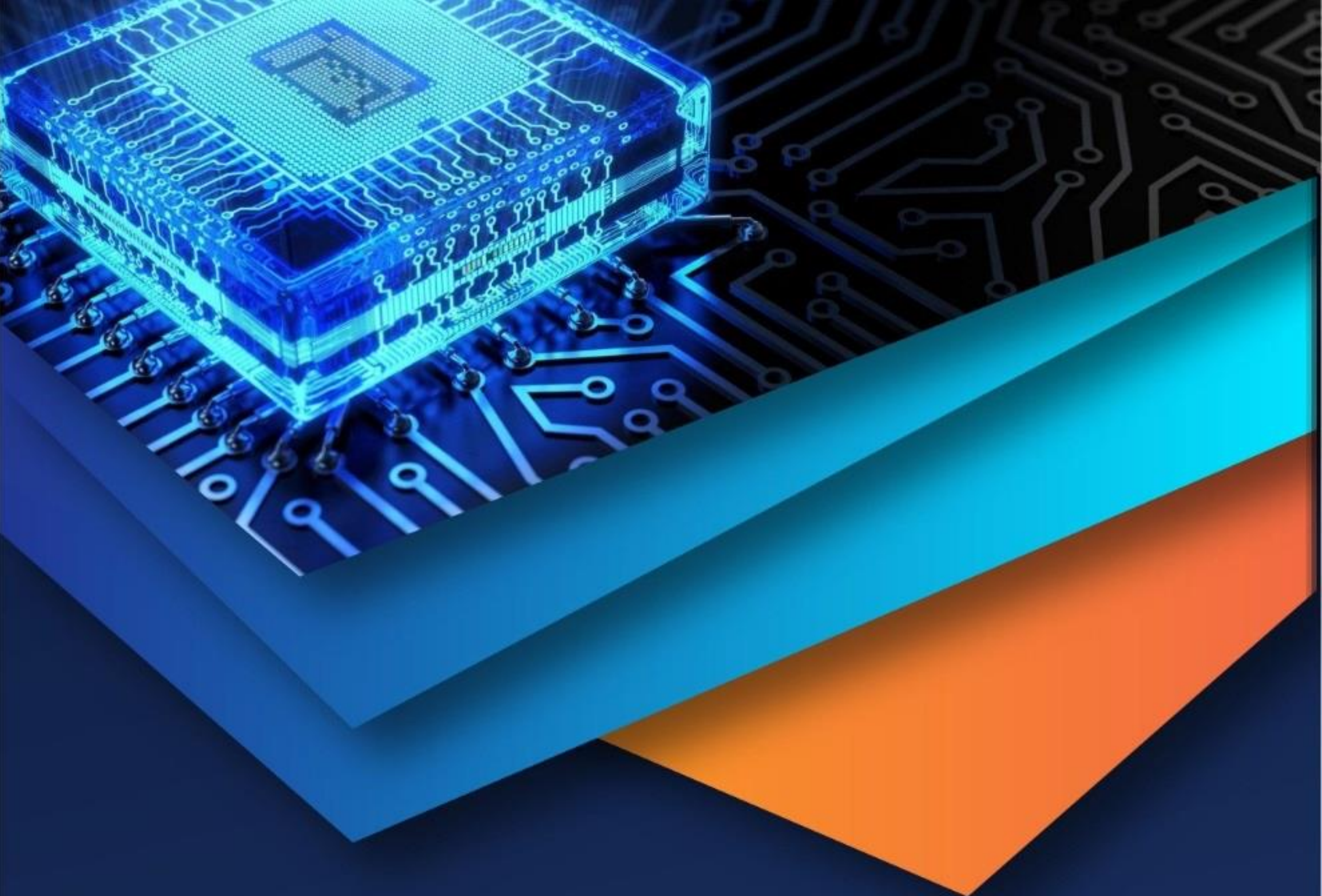
[33] Vecchi,Gatti (2020) Memory as Prediction From Looking Back to Looking Forward,7.

[34] WORKING MEMORY AND BILINGUALISM: AN INVESTIGATION OF EXECUTIVE CONTROL AND PROCESSING SPEED , XIAOJIA FENG 2008 ,20-38.

[35] Xie, Zhou (2020) Bilingualism, Demographics, and Cognitive Control: A Within-Group Approach. doi: 10.3389/fpsyg.2020.00094

[36] Yang , Allen, Waterman, Zhang, Su, Chan(2021) Comparing motor imagery and verbal rehearsal strategies in children’s ability to follow spoken instructions. Journal of Experimental Child Psychology https://doi.org/10.1016/j.jecp.2020.105033

[37] Zlotnik ,Vansintjan (2019)Memory: An Extended Definition. doi: 10.3389/fpsyg.2019.02523



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY