



## **Working Memory Performance In Multilinguals**

**Aiswarya Liz Varghese**

Assistant Professor

Department of Audiology and Speech Language Pathology.  
Kasturba Medical College, Mangalore, India

**Jojo Mathew**

Associate Professor

Department of Audiology and Speech Language Pathology.  
MAPS College, Mangalore, India

**Dr. Jayashree S. Bhat**

Professor and Head of the Department.

Department of Audiology and Speech Language Pathology.  
Kasturba Medical College, Mangalore, India

### **Abstract:**

*Memory and language in humans are two of the most important cognitive functions. Working memory is an active storage system which is crucial for Multilanguage learning. There are studies highlighting the importance of working memory in learning a second language (Ardila, 2003). The primacy and recency effect or the serial positions effects have often been incorporated to study working memory. The present study was aimed to evaluate the recalling abilities in multilinguals and the serial positioning effect in multilinguals. Fifteen multilinguals whose first, second and third languages which are Marathi, Hindi and English respectively were selected for the study. The stimuli consisted of six lists of non-standardized sentences, each list consisting of 10 Marathi sentences which were translated to English and Hindi languages. Participants were given 200 seconds to read the list and 300 seconds to retrieve it in the written mode. The results indicated multilinguals showing superior recency effect over primacy effect while retrieving the serially positioned multilanguage sentences in which they were proficient in. Since India is a multilingual and multicultural country, researches regarding multilingual performances across the languages would help speech language pathologists to better understand and thus to efficiently decide the treatment plans for their polyglot clients.*

**Keywords:** *Working memory, primacy effect, recency effect, serial position effect, multilinguals.*

## **1.Introduction**

Memory and language in humans are two of the most important cognitive functions. Working memory is an active storage system which is crucial for Multilanguage learning. Multilingual memories of a person are mainly dependent on the person's fluency in a particular language, proficiency of the languages and also age of acquisition of languages. High proficiency in two or three languages provides mental flexibility across all domains of thought and forces people to adopt strategies that accelerate cognitive development.

Many researchers have been exploring the importance of short term memory in performing various cognitive tasks including calculation, recalling, multiple task performances etc. To prove the existence and working principles of short term memory, many of them came out with various hypothetical models.

There are studies highlighting the importance of working memory in learning a second language (Ardila, 2003). The primacy and recency effect or the serial positions effect have often been incorporated to study working memory. A common explanation of the primacy and recency effects were introduced by Atkinson & Shiffrin (1968). In their opinion, primacy effect is the result of greater amount of attention and rehearsal allocated to the first few items on a list. These items after rehearsal are transferred to the long term memory store and thus can be retrieved easily. Thus the improved recall for the words at the beginning of the list is often referred to as the primacy effect.

Atkinson & Shiffrin (1968) attributed the recency effect to signify output from what they referred to as primary memory in the form of a short-term memory buffer. Thus, the most recent items viewed at the end of the list are still retained in short-term memory and are recalled there and hence this process is referred to as the recency effect. Welch & Burnett (1924) suggested that the primacy effect should be reduced or eliminated if all of the words on a list are rehearsed an equal number of times. Glanzer & Cunitz (1966) also showed that primacy effect is reduced when the items are presented at a faster rate, thus eliminating opportunity for extensive rehearsal by the participants.

Research has also been done to demonstrate the use of short-term memory in explaining the recency effect as it is explained by a retrieval of items from short-term memory. This

was demonstrated in experiments by both Postman & Phillips (1965) and Glanzer&Cunitz (1966), by providing evidences in support of the short-term memory account for the recency effect. Their studies indicate that the letters at the beginning and end of a sequence of letters would be more accurately recalled than those in the middle of the sequence.

Working memory has an impact on polyglotism. One such study was done to find out differences between English and Hungarian on working memory. The results clearly support the language specific effects of verbal working memory functions (Thorn and Gather Cole 1999). The results showed better performance accuracy when the sentences were short. There was no significant difference between the simple short and complex short sentences. Previous findings (Engle *et al.* 1999, Lustiget *al.* 2001, Miyake 2001) evidenced that working memory performance depends more on the ability to control attention, to suppress irrelevant information and to focus on task-relevant goal. Even though there are many studies on the impact of working memory in bilinguals, there is only a few on multilinguals, making the pressing context of the present study.

The present study was aimed to evaluate the

The recalling abilities in multilinguals.

The serial positioning effect in multilinguals.

## **2.Method**

Fifteen multilingual individuals (1 male and 14 females, age range 19 to 22 years, mean age of 20.40 years, standard deviation-0.91) whose first, second and third languages were Marathi, Hindi and English respectively, participated in the present study. They had their formal education in English and were using Marathi or Hindi for their day to day communication. All the participants were proficient in speaking, reading and writing in all three languages. All the participants were either undergraduates/graduates.

Materials:

The stimuli consisted of six lists of non-standardized sentences, each list consisting of 10 Marathi sentences which were translated to English and Hindi languages. That is, each list consisted of 30 sentences, 10 each in Marathi, Hindi and English. The 30 sentences used in individual lists were the same, but were used in different order and different

patterns. It was not possible to predict the words in the sentences. However all the sentences were grammatically correct and simple, so that retrieving them was not a difficult task.

The organization of the sentences in each list was as follows

- List 1 had Marathi sentences on the left hand side of the page, Hindi sentences on the right side of the page and English at the center.
- List 2 had Marathi sentences on the left hand side of the page, English sentences on the right side of the page and Hindi at the center.
- List 3 had Hindi sentences on the left hand side of the page, Marathi sentences on the right side of the page and English at the center.
- List 4 had Hindi sentences on the left hand side of the page, English sentences on the right side of the page and Marathi at the center.
- List 5 had English sentences on the left hand side of the page, Hindi sentences on the right side of the page and Marathi at the center.
- List 6 had English sentences on the left hand side of the page, Marathi sentences on the right side of the page and Hindi at the center.

### *2.1.Procedure*

Participants were given 200 seconds to read the list and 300 seconds to retrieve it in the written mode. They had to write the sentences which came to their memory and they were free to retrieve the sentences in any order. The data obtained from each participant was separately tabulated and was subjected to statistical analysis using SPSS software (version-10). Paired T test was administered to find out the statistical significance, mean and standard deviation for three variables i.e. retrieval abilities in Marathi, Hindi and English.

### **3.Results**

Comparison of serial position effect within the languages is detailed in Table 1. The results show that the recency effect was visible in the retrieval of all three languages i.e. English, Hindi, & Marathi. The sentences were correctly and maximally retrieved when they were serially kept at the third position (the extreme right hand side in the page). The

sentence retrieval discrepancy between the languages at the initial and third position did not show any significant difference. However, irrespective of the languages, the mean values were higher whenever the sentences were serially positioned at the third position which is indicative of superior recency effect over the primacy effect. When the serial position of language at first and second was compared, all languages, except English, showed statistically significant superior recency effect.

The comparative influence of languages on serial position effects is shown in Table 2. It can be seen that irrespective of the serial position, except at the second (middle) position, sentences were most correctly and maximally retrieved in English. Subsequently, sentences were retrieved more in Hindi and the least in Marathi. The mean retrieval values from this table also suggest the superiority of recency effect over the primacy effect. Although the relative recency and primacy effect on mother tongue Marathi was poor, a higher and statistically significant retrieval score was obtained when the Marathi sentences were serially placed at the middle of the list.

|        |    | Number of participants | Mean    | SD     | Statistical significance |
|--------|----|------------------------|---------|--------|--------------------------|
| Pair 1 | M1 | 15                     | 6.4000  | 3.3123 | .039*                    |
|        | M2 | 15                     | 9.8000  | 3.3424 |                          |
| Pair 2 | M1 | 15                     | 6.4000  | 3.3123 | .957                     |
|        | M3 | 15                     | 8.8000  | 3.1442 |                          |
| Pair 3 | M2 | 15                     | 9.8000  | 3.3424 | .023*                    |
|        | M3 | 15                     | 8.8000  | 3.1442 |                          |
| Pair 4 | H1 | 15                     | 8.4000  | 3.3764 | .001*                    |
|        | H2 | 15                     | 9.1333  | 3.7960 |                          |
| Pair 5 | H1 | 15                     | 8.4000  | 3.3764 | .131                     |
|        | H3 | 15                     | 11.1333 | 4.2066 |                          |
| Pair 6 | H2 | 15                     | 9.1333  | 3.7960 | .004*                    |
|        | H3 | 15                     | 11.1333 | 4.2066 |                          |
| Pair 7 | E1 | 15                     | 10.2000 | 3.5496 | .004*                    |
|        | E2 | 15                     | 7.4000  | 4.2224 |                          |
| Pair 8 | E1 | 15                     | 10.2000 | 3.5496 | .071                     |
|        | E3 | 15                     | 11.8667 | 3.9617 |                          |
| Pair 9 | E2 | 15                     | 7.4000  | 4.2224 | .037*                    |
|        | E3 | 15                     | 11.8667 | 3.9617 |                          |

*Table 1: Comparison of serial position effect within the languages*

*\* indicates statistically significant values.*

|        |    | Number of Participants | Mean    | S D    | Statistical significance. |
|--------|----|------------------------|---------|--------|---------------------------|
| Pair 1 | M1 | 15                     | 6.4000  | 3.3123 | .351                      |
|        | H1 | 15                     | 8.4000  | 3.3764 |                           |
| Pair 2 | M1 | 15                     | 6.4000  | 3.3123 | .326                      |
|        | E1 | 15                     | 10.2000 | 3.5496 |                           |
| Pair 3 | H1 | 15                     | 8.4000  | 3.3764 | .155                      |
|        | E1 | 15                     | 10.2000 | 3.5496 |                           |
| Pair 4 | M2 | 15                     | 9.8000  | 3.3424 | .002*                     |
|        | H2 | 15                     | 9.1333  | 3.7960 |                           |
| Pair 5 | M2 | 15                     | 9.8000  | 3.3424 | .010*                     |
|        | E2 | 15                     | 7.4000  | 4.2224 |                           |
| Pair 6 | H2 | 15                     | 9.1333  | 3.7960 | .005*                     |
|        | E2 | 15                     | 7.4000  | 4.2224 |                           |
| Pair 7 | M3 | 15                     | 8.8000  | 3.1442 | .055*                     |
|        | H3 | 15                     | 11.1333 | 4.2066 |                           |
| Pair 8 | M3 | 15                     | 8.8000  | 3.1442 | .189                      |
|        | E3 | 15                     | 11.8667 | 3.9617 |                           |
| Pair 9 | H3 | 15                     | 11.1333 | 4.2066 | .001*                     |
|        | E3 | 15                     | 11.8667 | 3.9617 |                           |

*Table 2: Comparison of influence of languages on serial position effects  
\* statistically significant values.*

The details of comparing the primacy and recency effect within the lists are shown in the Table 3. It can be observed that the highest mean retrieval score was for the serially third positioned language. It is notable that English sentences were retrieved more compared to Hindi and Marathi which showed a descending trend in the recency effect. However, in the list 3, which has English Hindi Marathi serial position, retrieval of sentences in English was the highest even when the primacy effect was considered.

|                  |    | Mean    | SD     |
|------------------|----|---------|--------|
| List1<br>M1H2E3  | M1 | 6.4000  | 3.3123 |
|                  | H2 | 9.1333  | 3.7960 |
|                  | E3 | 11.8667 | 3.9617 |
| List 2<br>H1M2E3 | H1 | 8.4000  | 3.3764 |
|                  | M2 | 9.8000  | 3.3424 |
|                  | E3 | 11.8667 | 3.9617 |
| List 3<br>E1H2M3 | E1 | 10.2000 | 3.5496 |
|                  | H2 | 9.1333  | 3.7960 |
|                  | M3 | 8.8000  | 3.1442 |
| List 4<br>M1E2H3 | M1 | 6.4000  | 3.3123 |
|                  | E2 | 7.4000  | 4.2224 |
|                  | H3 | 11.1333 | 4.2066 |
| List 5<br>H1E2M3 | H1 | 8.4000  | 3.3764 |
|                  | E2 | 7.4000  | 4.2224 |
|                  | M3 | 8.8000  | 3.1442 |
| List 6<br>E1M2H3 | E1 | 10.2000 | 3.5496 |
|                  | M2 | 9.8000  | 3.3424 |
|                  | H3 | 11.1333 | 4.2066 |

*Table 3 : Within the list Comparison of serial position effect*

#### **4.Discussion**

Fifteen multilinguals whose first, second and third languages were Marathi, Hindi and English respectively were selected for the study. The stimuli consisted of six lists of non standardised sentences, each list consisting of 10 Marathi sentences which were translated to English and Hindi languages. Participants were given 200 seconds to read the list and 300 seconds to retrieve it in the written mode. The results obtained from each participant were separately tabulated and subjected to statistical analysis using SPSS software (version-10). Paired T test was administered to find out the statistical significance, mean and standard deviation.

The results showed an obvious recency effect in the retrieval of all three languages i.e. English, Hindi, & Marathi. Although there were no statistically significant differences between the primacy and the recency effect for the retrieval of three languages in the list,



the mean values were higher for the serially positioned third sentences, indicative of superior recency effect over the primacy effect. This result is contradicting with previous observation by Thorn (2001) and Kuppuraj and Goswamy (2008) where they reported superior primacy effect on the serially positioned word and sentences.

When the serial positions of languages in the initial and middle positions were compared, all languages except English showed statistically significant relative superior recency effect. The difference in the retrieval of English sentences could be due to the individual's long term knowledge in and exposure to this language. Moreover, all the participants had been exposed to English throughout their education. This result is supporting the previous study by Thorn (2001) who stated that word recalling accuracy is good in the language in which a polyglot has good long term knowledge. Since the participants were actively using Hindi in their day to day life, the attrition effect in this language is doubtful.

It was also seen that in all serial positions, except the second serial position, sentences from English were most correctly and maximally retrieved, followed by sentences in Hindi and Marathi. This could be due to the language attrition effect, as many of the participants were using their mother tongue for communication purpose occasionally. This is agreeing with the study by Levy, McVeigh, Marful and Anderson (2007) which stated that when individuals who handle more than one language concentrate on foreign languages, they often have difficulty in retrieving native language words owing to the attrition effect of native language. The mean retrieval values from this table also suggested the superiority of recency effect over the primacy effect. Although the relative recency and primacy effects of mother tongue Marathi was poor in the first and the final serial positions, a higher and statistically significant retrieval scores obtained when Marathi sentences were placed at the middle serial of the list for reasons unknown.

All 6 lists except list 3, showed highest mean retrieval score for the serially third positioned language which indicated the better performance of recently occurring sentences rather than the primarily occurring sentences. Overall, in this comparison also, English sentences were retrieved more compared to Hindi and Marathi which showed a descending trend in the recency effect. So, these results provide evidence of superior recalling accuracy in the language in which a multilingual has good long-term knowledge and exposure.

Moreover, in the English-Hindi-Marathi serial positions, English was the most used and exposed language by the subjects, subsequently, Hindi and Marathi followed in the

decreasing order of usage and exposure. This was the only occasion when retrieval was with superior primacy effect. This could be because the most used English language was kept in the initial position and the least used native language i.e., Marathi at the final position and the participants must have relied more on the semantic representation rather than the phonological representation which mainly causes the superior recency effect. In addition to the superior recency effect, the primacy effect scores in English sentences were also remaining high across the lists, suggesting that both phonological and semantic representations of languages would be influenced depending upon the long term knowledge and usage.

### **5. Conclusion**

In the present study, multilinguals showed superior recency effect over primacy effect while retrieving the serially positioned multilanguage sentences in which they were proficient in. So it can be inferred that, phonological representation might be dominating or equating to the semantic representation of language while retrieving many languages. More over it is clear that use of phonological representation could be one of the major strategies or additional technique used by multilinguals whenever more taxing sentence retrievals are required. Since India is a multilingual and multicultural country, researches regarding multilingual performances across the languages would help speech language pathologists better understand and thereby to efficiently decide the treatment plans for their polyglot clients.

**6.Reference**

1. Ardial, A.(2005). Language representation and working memory with bilinguals. *Journal of communication disorders*. May – June, 36, 233-40
2. Atkinson, R.C. & Shiffrin, R.M. (1968) Human memory: A proposed system and its control processes. In K.W. Spence and J.T. Spence (Eds.), *The psychology of learning and motivation*, vol. 8. London: Academic Press
3. Baddeley, A.D., & Hitch, G. (1974). Working memory. In G.H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* 47--89. New York: Academic Press
4. Glanzer, M., & Cunitz, A. R. (1966). Two storage mechanisms in free recall. *Journal of Verbal Learning & Verbal Behavior*, 5, 351-360.
5. Levy, B.J., McVeigh, N.D., Marful, A., & Anderson, M.C. (2007). Inhibiting your native language: The role of retrieval-induced forgetting during second language acquisition. *Psychological Science*, 18, 29-34.
6. Lustig C, May CP, & Hasher L. (2001) Working memory span and the role of proactive interference. *Journal of Experimental Psychology*;130:199–207.
7. Miyake A. Individual differences in working memory (2001). Introduction to the special section. *Journal of Experimental Psychology* ;130:163–168.
8. Postman, L., & Phillips, L. W. (1965). Short term temporal changes in free recall. *Quarterly Journal of Experimental Psychology*, 17, 132-138
9. Reza Kormi-Nouri, Sadegheh Moniri & Lars-Göran Nilsson. (2003) Episodic and semantic memory in bilingual and monolingual children. *Scandinavian Journal of Psychology*, 44, 47 - 54
10. Thorn, A.S., & Gathercole, S.E. (1999). Language specific knowledge and short term memory in bilingual and non – bilingual children, *The quarterly journal of experimental psychology* May;52(2);303 – 24
11. Welch, G. B., & Burnett, C. T. (1924). Is Primacy a Factor in Association-Formation. *American Journal of Psychology*, 35, 396-401.