CROSS LINGUISTIC STUDY ON PHONOLOGICAL SIMILARITY EFFECT

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Abstract

The phonological similarity effect (PSE), poor retention of order for lists of similar-sounding items is a benchmark finding in the short-term memory literature. While the models of PSE have been investigated after extensive studies on monolinguals, the bilingual population would serve as a potential platform to examine PSE from cross linguistic perspective. The main aim of the study is to examine the PSE in Malayalam – English bilingual speakers and to find out a) The factors that facilitate serial recall b) Whether phonologically similar words have a detrimental effect on serial recall task c) Whether lexicality plays a role on PSE d) Whether the PSE on item recall is crucially affected by lexicality. Ten typical Malayalam -English bilinguals in the age range of 20 -25 years were selected for the study. Stimuli were categorized into five different lists, namely rhyming words list, alliterative words list, rhyming non- words, alliterative non words and simple non-word list in both English and Malayalam. The audio recorded stimuli were presented through the DMDX program. Subjects were instructed to recall maximum number of items in the serial order. The superior performance on rhyming words and alliterative words over simple non- words is in consonance with the lexicality effect reported in the literature. Consistent with the existing literature, our results also confirmed the categorical cueing effects which are responsible for better performance in recall of rhyme nonword over simple nonword and alliterative nonwords over simple nonwords which in turn supports feature based model. Overall the results show similarities in PSE between Malayalam and English thus suggesting that the PSE construct employed to propose short term memory models for English language would also explain PSE in Malayalam though the two languages are from different families.

Key words: Rhyme, Alliteration, Feature Based Model, Lexicality Effect, Category Cueing Effect

A robust finding in working memory research is that to recall a set of phonologically similar words is much more difficult than to recall a set of phonologically dissimilar words, which is the well-known phonological-similarity effect (Conrad & Hull, 1964). This finding points out that the capacity of information retention in our working memory store more or less depends on the phonological nature of the to-be-memorized information. The more similar (phonologically) the to-be-memorized item, the more difficult it is to retain in the working memory store.

Watkins, Watkins & Crowder (1974) compared serial recall of phonologically similar and phonologically dissimilar lists. Performance was assessed using the strict serial recall measure and it was found that the performance was better for the phonologically distinct lists, demonstrating the classic Phonologic Similarity Effect (PSE). However, no difference in performance in item recall measure was found for the phonologically similar versus dissimilar lists. Similarly, Gathercole (1982) compared serial recall of phonologically similar and phonologically dissimilar lists. Using the strict serial recall measure, performance was better for the phonologically distinct lists; however, item recall was actually better for the phonologically similar lists than for the phonologically dissimilar lists. Besner and Davelaar (1982) demonstrated that the phonemically similar lists were less accurately recalled than lists of phonemically distinct items, irrespective of the word likeness of

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the visually presented materials.

Poirier and Saint-Aubin operationally defined phonological similarity as lists of rhyming words while other studies have used lists of single syllable words with a common vowel and some overlap in the consonants (Coltheart, 1993). A study by Poirier and Saint-Aubin(1996) examined serial recall of lists of 2-syllable words. Strict serial recall was better for the phonologically distinct lists, but item recall was no different for the phonologically similar versus dissimilar lists. Some studies have obtained classic PSE that is PSE has been found in both item and serial recall. Drewnowski (1980) Coltheart (1993), found that recall was better for phonologically dissimilar than for phonologically similar lists in terms of both the strict serial recall and item recall measures.

Lian and Karlsen (2004) showed a significant interaction effect between lexicality and phonological similarity, indicating in their case that the phonological similarity factor affected words but not nonwords.

Roodenrys and Stokes (2004) found that there is a positive effect of word likeness on nonwords regardless of task. Non words of high word likeness appear subject to redintegration[1] leading to errors in serial recall task or position accuracy (Fallon, Mak and Tehan, 2005).

Fallon, Groves, and Tehan (1999) reported that both the rhyming and the phonemically similar condition showed impaired order memory compared to a dissimilar condition, the recall of item information was actually enhanced in the rhyming condition albeit in the wrong order than in phonologically dissimilar condition. They suggested that the rhyming similarity can act as an effective category cue, and therefore facilitates item recall; but the phonological overlap without rhyme does not provide an effective category cue, and therefore does not facilitate item recall. However, the rhyming-non rhyming manipulation in their experiments was confounded with a difference in the degree of within-list phonological overlap. Each member of similar rhyming lists shared two phonemes, whereas each member of similar non rhyming lists such as shared on average only one phoneme. The difference in item recall for these two types of lists could therefore have been due to cueing by the degree of phonemic overlap rather than by

rhyme category.

Theoretical account that has been proposed for the above observation is based on the feature model. The feature model of Nairne (1990) incorporates representations of this type. In this model, the effect of phonological similarity in serial memory arises from overlap of the feature vectors that represent the phonologically similar list items. Phonological similarity makes it difficult to recover an item's correct position within a list because there are overlapping features; however, common phonological features among list items can be used to discriminate the list as a whole from other lists, thus aiding item recall which is termed as category cue (Nairne & Kelley, 1999).The feature model would therefore predict that item recall for lists comprised of phonologically similar rhyming stimuli should be equivalent to that for lists comprised of phonologically similar non-rhyming stimuli such as alliterative lists, if the degree of phonological overlap is controlled which is referred to as *feature account.*

According to Baddeley's phonological loop model which comprises of two components, the phonological short-term store and the sub vocal rehearsal process, the source of PSE in immediate serial recall is the phonological store. It is argued that memory items that share a similar phonological structure will become more rapidly indiscriminable from one another due to decay than items with non-overlapping phonological structures (Baddeley, 1966).

Most of the studies regarding PSE have been carried out in English language. Cross- language investigations on PSE would be necessary to understand the influence of linguistic / structural differences in language processing. PSE on span of verbal short term memory in Persian language (Jahana, Baratzadeh & Nilipour, 2008) has been done using three different lists, namely rhyming words list, alliterative words list and dissimilar words list. The results showed significant difference between rhyming, alliterative and dissimilar words. There was no difference between rhyming and alliterative lists. They concluded that in rhyming and alliterative words, vowel, because of higher sonority (rather than the consonants) enhances the memory span as a cueing feature. Cross-language

differences, especially in phonemes sonority level may cause different phonological similarity effects among languages. Since verbal short term memory is sensitive to vowel in words, it seems that the verbal short term memory is linguistic in nature.

In English, rhyming words (similar final syllable) and alliterative words (similar initial consonant or syllable) have different significance since each syllable is stressed differently. Studies on PSE have not been conducted in Malayalam language, the language spoken in the state of Kerala. English is a phonemic or stressed language while Malayalam is considered as a syllabic language with equal stress. Therefore there would not be much difference with regard to position of stress. That is, both rhyming words and alliterative words will have the same effect provided the degree of overlap of the similar feature is constant.

Study of phonological similarity effect (PSE) in immediate serial recall (ISR) has produced a conflicting body of results. No studies have been able to distinguish both the influence of segmental as well as prosodic feature in PSE. Cross- language studies would help to understand the role of linguistic features in processing the phonological elements of language. No attempts have been made in Indian context to address this issue and to integrate linguistic research to short term memory models. This is also needed to verify if the short-term memory models developed in western context can be applied to Indian languages. The aim of this study is to examine PSE in cross-language context on span of verbal short term memory in Malayalam and English.

Aims of the study

The main objective of the study is to examine the PSE in Malayalam - English bilingual speakers. The study also aims to find out a) The factors that facilitate serial recall b) Whether phonologically similar words have a detrimental effect on serial recall task c) Whether lexicality plays a role on the order of detrimental PSE d) Whether the PSE on item recall is crucially affected by lexicality, a finding less well explained by the feature based model which is a prominent model of PSE.

Method

Participants: Ten typical Malayalam -English undergraduate students (females) in the age range of 20 -25 years with no history of neurological or psychological illness were selected for the study All the participants were early bilinguals studied in English medium school since preschool. All participants were self rated as highly proficient in both the languages based on their proficiency in reading, writing, and speaking in both the languages. No particular proficiency rating scale was used because of the nonavailability of standardized proficiency rating scale in the year of the study. The same group of subjects participated in all the experiments designed for the study.

Material and procedure: Stimuli were categorized into five different lists, namely rhyming words list (RW), alliterative words (AW), rhyming non- words (RNW), alliterative non words (ANW) and simple non-word (NW) list in both English (E) and Malayalam (M). Ten seven -item list were created for the five different categories of words. All to- be- recalled words were bisyllables. The stimuli were audio recorded in an adult female voice using PRAAT software sampling rate of 44.1 kHz on a Lenovo Y430 Idea pad computer. The audio recorded stimuli were presented through the DMDX[2] program. DMDX software was used to maintain uniform presentation time and response time. The subjects were seated comfortably in a quiet room and were instructed to listen to the stimuli presented through a headphone. Prior instructions were given to the subjects to serially recall (serial recall) the presented stimuli once each seven item list is heard. They were also asked to recall the maximum number of items (item recall) possible. Each sequence of items in the list was followed by a signal to indicate the participant to respond with recall of wordlists. There was a 4 second interval between words in each sequence. Two practice items were given prior to the test stimuli. The responses were recorded onto the system and verbatim transcription was done. The accuracy of the serial recall and number of items accurately recalled were checked. The time taken for each participant to complete the testing is approximately 40 minutes. Counter balance design was used were among the 10 subject's five subjects received stimuli in the order of Malayalam- English and 5 subjects in the order of English- Malayalam. Rhyme and nonwords were used to maintain the effect of prosodic feature and study the effect of semantics.

Non words were considered to family the effect of meaning in PSE. Alliterative words were used to study the effect of segmental feature. The degree of phonemic overlap was not consistent across the word list.

Results and Discussion

Statistical analysis was done for both item recall and serial recall tasks to examine the effects of wordlist across and within languages. One-way repeated measure ANOVA with wordlists as independent variable was carried out and the results revealed a significant main effect. Paired t- test was done to compare the performance for each wordlist within language. The results are discussed under three phases.

Phase I: This phase compares the performance on item and serial recall for rhyming words and alliterative words within languages. This is done in order to determine the feature responsible for PSE in both languages (Table 1).

Language & task	Word list	"t" value	Sig (2tailed)
Serial Recall (SRM)	RW-AW	1.590	.146
Serial recall (SRE)	RW-AW	.730	.484
Item recall(IRM)	RW-AW	.037	.971
Item recall (IRE)	RW-AW	6.263	0.000*

significant at .05 level of significance
Table1: *T Values and Significance*

In Malayalam language results of performance on serial recall and item recall for rhyming and alliterative words, shows no significant difference. This is attributable to the syllabic script of Malayalam in which rhyme and alliteration has the same effect.

In English serial recall of rhyme and alliterative words were not significantly different. This is probably because the category cueing effects of rhyming words were not strong to overcome the strict demands placed by the task. The rhyming words had consonantal overlap but the following vowel overlap was not present. This would have led to inadequate category cueing for serial recall also reported by Fallon, Groves and Tehan (1999). Results of item recall of rhyming and alliterative words in English show significant difference in accordance with the categorical cueing effect of the rhyme. This can also be in concordance with the findings of Poirier and Saint-Aubin (1996) where they found that there is no significant difference between phonologically similar versus dissimilar list in item recall.

Phase II: Phase two compared the performance of subjects in item recall and serial recall on rhyming words and alliterative words versus corresponding nonwords i.e. rhyming nonwords and alliterative nonwords, rhyming words versus nonwords and alliterative words versus nonwords within languages. In first two comparison features, which is rhyme and alliteration are kept constant and lexicality changes. In next two comparison both feature and lexicality changes. This was carried out to exclude the influence of word meaning (lexicality effect) and to study only the effect of features. If lexicality has a significant role in serial recall, rhyming and alliterative words must have larger scores compared to nonwords.
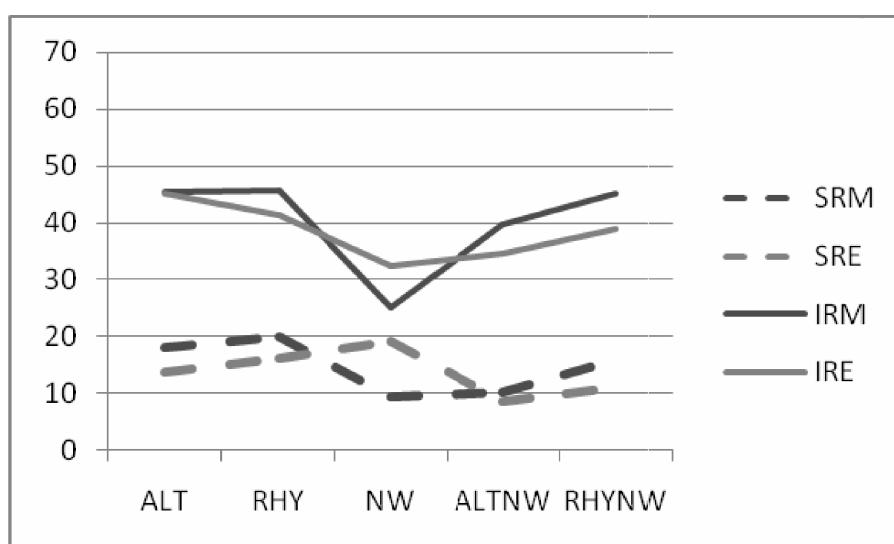
The results revealed significant difference between rhyme and simple nonword, alliteration and simple nonword, alliteration and alliteration nonword, rhyme nonword and alliteration nonword in both the languages for both item and serial recall task. The superior performance on rhyming words and alliterative words over simple non- words is in consonance with the lexicality effect consistent with the findings of Lian and Karlsen (2001) where they showed a significant interaction effect between lexicality and phonological similarity. Consistent with the existing literature, our results also confirmed the categorical cueing effects which are responsible for better performance in recall of rhyme nonword over simple nonwords and alliterative nonwords over simple nonwords. This shows that PSE is not only due to category cueing but also due to lexicality effect. The superior performance of rhyme words and alliterative words over simple nonwords in both the languages also in turn supports feature based model (Nairne, 1990).There was no significant difference between rhyme words and rhyme nonwords. This may be dues to the word likeness of the rhyme nonwords and redintegration as supported by Roodenrys and Stokes (2004).

Phase III: Phase III compared the performance on item and serial recall for the entire lists across language (graph 1). This is done for a cross linguistic comparison of PSE. Performance across all the wordlists were compared and analyze.

Languag e & task	Word list	"t" value	Sig(2tailed)
Serial Recall (SRM)	RW-RNW	1.132	0.287
	RW-NW	3.647	.005*
	ALW-NW	3 679	005*
	ALW-ALNW	3 234	0 010*
Serial recall (SRE)	RW-RNW	1.700	.123
	RW-NW	.728	.485
	ALW-NW	1.879	.095
	ALW-ALNW	1.933	.085
Item recall (IRM)	RW-RNW	.158	.878
	RW-NW	9.646	.000*
	ALW-NW	8.94	.000*
	ALW-ALNW	1.776	.109
Item recall (IRE)	RW-RNW	1 693	125
	RW-NW	5.416	.000*
	ALW-NW	11.279	.000*
	ALW-ALNW	10.036	.000*

*significant at .05 level of significance

Table 2: T Value and Significance between Rhyming and Alliterative Words and Non Words

Graph 1: Comparison of two languages in both SR and IR

Statistical analysis using one-way repeated measure ANOVA revealed that there was a significant main effect on all the type of tasks – item and serial across language (F (3, 36) = 7.354, p<0.001). Bonferroni multiple comparisons were done to find the word list that showed a significant difference.

The result showed a significant difference between non words (NW) (p<.05) across language. This can be explained by the word likeness of the words in the English non word list compared to Malayalam non words used in the study (Roodenrys & Stokes, 2004). Comparison of performance for rhyming words, alliterative words, rhyming nonwords and alliterative nonwords did not show a significant difference. This indicates that the PSE is similar in both the languages except in case of simple non-words. This can be attributed to the word likeness of the English nonwords when compared to those in Malayalam which is in consonance with the study by Roodenrys and Stokes (2004) where they found that there is a positive effect of word likeness on nonwords regardless of task. The similar results for PSE observed in both the languages for item and serial recall suggests close proximity of the two languages as though being on a continuum.

Conclusion

This study aimed to examine the phonological similarity effects between different word lists in

Malayalam-English bilinguals. From the first experiment it was found that performance for both item and serial recall tasks varied only for simple non words between the two languages. Performances on other wordlists were similar across both English and Malayalam. This shows the close proximity between these two languages. The superior performance on words over nonwords irrespective of the feature in both languages shows the effect of lexicality in both languages on both item recall and serial recall. The superior performance of rhyme words and alliterative words over simple nonwords in both the languages supports the premise that category cues for better recall which in turn supports feature based model (Nairne, 1990). Overall the results show similarities in PSE between Malayalam and English thus suggesting that the PSE construct employed to propose short term memory models for English language would also explain PSE in Malayalam though the two languages are from different families. This findings inturn suggest the need for incorporating the linguistic researches in short term memory models to verify the models as well as to consider the findings when adopting test materials from developed for western population. This should also be taken into account while developing test stimuli for assessing the short term memory as well as presenting stimuli during intervention.

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