

FAST MAPPING IN TYPICALLY DEVELOPING KANNADA SPEAKING TODDLERS

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Abstract

The ability to form a 'quick, initial, partial understanding of word's meaning' and thereby to learn and retain new words with only minimal exposure is known as Fast Mapping. Studies exploring fast mapping abilities especially in toddlers are limited, therefore research in this area would be highly valuable in understanding the way children accomplish the task of learning new words that add to their developing lexicon. Thus the present study was undertaken to investigate the fast mapping skills of toddlers by examining the effect of practice on the accessibility of the words in the lexical memory. Two groups of typically developing Kannada speaking children between the age of 16 to 20 months participated in the study. These children were taught the names of 24 unfamiliar objects over twelve training and testing sessions spread over a span of twenty four days. The amount of practice children had with individual words varied as a function of session. The experimental group underwent training and testing for all the sessions, while the control group were trained and tested during the first and last sessions only. The accuracy of identification, at every session was tabulated and subjected to statistical analysis. The results revealed that there was significant difference between the high practice words (words exposed to during all the sessions) of session '1' and Low practice words (words exposed to during the last session) of session '12' in both the groups. However, between the two groups, the performance on low practice words was not significant. Thus it can be concluded that fast mapping does occur in toddlers and learning some words primes the system to learn a novel set of words. Nevertheless, the present results should be interpreted with caution because of modest sample size considered.

Key Words: Novel words, lexical memory, comprehension.

Word learning involves learning lexical labels, which requires the ability to correctly recognize the phonemes in their proper order within a label and associate meaning with a phonetic string representing the word label. The ability to form a 'quick, initial, partial understanding of word's meaning' and thereby to learn and retain new words with only minimal exposure is known as Fast Mapping (Carey & Bartlett, 1978; Rice, 1989). Fast mapping is viewed as the critical first stage of learning new words, requiring intact phonological and semantic processing skills (Ellis Weismer & Evans, 2002; Gray, 2005).

In typically developing children the initial slow, one-at-a-time word learning is followed by an apparent 'explosion' in the lexicon (Bloom, Lifter & Broughton, 1985). Estimates suggest that children in their

preschool years may learn up to nine new words a day (Templin, 1957). Researchers hypothesize that this explosion in the lexicon occurs because of the phenomenon called Fast Mapping. According to Carey & Bartlett (1978) following a single exposure to a new phonological form that has semantic value leads to the formation of a preliminary mental recording, or form-meaning 'map'. Carey (1987) proposed that children learn the meaning of a word in two separate phases: (a) a fast mapping phase, in which the child establishes an initial link between word and referent, and (b) a subsequent, slow mapping phase. In the fast mapping phase, the child has only partial knowledge of the meaning of the word, whereas in the second phase of acquisition, the initial word representation becomes supplemented through

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additional experience, eventually coming to resemble the adult meaning. According to Crais (1992) the greater the exposure to a word, the more complete is the map. Fast mapping has been observed in typically developing children as young as 13 months of age (Kay-Raining Bird & Chapman, 1998; Schafer & Plunkett, 1998), children between 16-18 months (Gershkoff-Stowe & Hahn, 2007) and in children between 15 to 24 months (Bates, Bertherton & Snyder, 1988).

There are several factors that influence the ability of children to learn and use lexical labels. The sequence of sound that constitutes a lexical label can directly affect processing of that label. The phonotactic probability influences children's word learning (Strokel, 2001; Strokel & Rogers, 2000). The characteristics of the new word, characteristics of the referent, characteristics of the introducing event, mutual exclusivity, taxonomic organization, existing lexicon, word frequency and neighborhood density are some of the other factors influencing word learning.

Practice effects are also ubiquitous in learning (Newell & Rosenbloom, 1981). Word learning requires extensive practice. Although word learning involves simple acquisition of information in memory, it also importantly involves the fine-tuning of processes that enable increased accessibility to information (Rumelhart & Norman, 1978). Yet, to date, the role of practice in the lexical development of beginning word learners has received little attention. The more an item is selected for comprehension or production, the stronger the level of activation will be and hence the greater the probability of access. This suggests that practice with individual words in a rapidly expanding lexicon changes the operation of the lexicon through the accumulated activation of many items. This is accomplished through an increase in the base of lexical and semantic units and the strengthening of connections between them.

A few studies have investigated the effect of practice on the accessibility of the words in the lexical memory. One such study was carried out by Gershkoff-Stowe & Hahn (2007) who investigated mapping advantage in normally developing toddlers between 16-18 months of age. The purpose was to examine the effects of practice on the accessibility of words in lexical memory. The results showed that for the children in the experimental group, extended

practice with a novel set of high-practice words led to the rapid acquisition of a second set of low-practice words, while the children in the control group did not show the same lexical advantage.

In the Indian context, a few studies have been carried out to study the fast mapping ability. One such study was by Trupthi (2009) who assessed the fast mapping skills in 60 typically developing Kannada speaking children in two age groups, viz. 2.5- 3.5 years and 3.5- 4.5 years on a naming task. The accuracy of naming unfamiliar objects was scored ten minutes after training and one week later. She found that the children in the older age group performed better than the younger group. Further, the performance of all the children on an average, reduced when tested one week after training. The results indicated that the process of fast mapping may not be adequate for the development of lexicon and a subsequent extended slow mapping would also be necessary for word learning.

Need for the study

Although there are a number of studies carried out in the West which investigated the fast mapping abilities in children, the studies with respect to the effect of practice on word learning, especially in toddlers are limited. The age between one to two years, which has been known to be the first fifty word stage, explores the transition and development in the mapping of words. Moreover, this period is the time when many children experience a sudden, rapid spurt in production, and studying the pattern of development then could throw light on the vocal growth (Bloom, 1973; Gershkoff-Stowe & Smith, 1997). Considering that such studies exploring fast mapping abilities in toddlers in the Indian context are scarce and that such studies would be highly valuable in understanding the way children accomplish the task of learning new words that add to their developing lexicon, this study was planned.

Aim of the study

The main aim of the study was to investigate the fast mapping skills of toddlers by examining the effect of practice on the accessibility of the words in the lexical memory, i.e., whether the extended practice with a set of unfamiliar words would enhance the ability to access a new set of unfamiliar words in response to system wise changes in the activation of a new item.

Method

Participants: Two groups of typically developing Kannada speaking children ranging in age from 16 to 20 months participated in the study. The experimental group comprising of 8 Kannada speaking children (5 females and 3 males) (mean age: 1.61 yrs) were compared to a control group of 8 Kannada speaking children (4 females and 4 males) (mean age: 1.66yrs) using comprehension as a measure of fast mapping. Those children without any history of language, neurological, hearing, developmental, intellectual, social, emotional or orofacial disabilities only were included in the study. The children were screened to rule out any form of language deficits using the 'WHO Ten-question disability screening checklist' (Singhi, Kumar, Malhi & Kumar, 2007) and the Three-Dimensional Language Acquisition Test (Harlekhar & Karanth, 2002). An informal hearing screening was done to rule out hearing impairment. Ethical procedures were used to select the participants. The parents of the participants were explained the purpose and the procedures of the study and an informal oral consent was taken.

Materials and design

The parents of all the participants were asked to list out all the nouns in their child's receptive and expressive vocabulary. Due to the non-availability of standardized tests to assess the vocabulary of children below two years, the words from 'With a little bit of help-Early Language Training Manual' (Karanth, Manjula, Geetha & Prema, 1999) was used to assess the vocabulary of the child. Based on the above twelve familiar picturable words were selected which were used during the testing sessions for control group. Another set of picturable words which were unfamiliar to the children were prepared for the experimental group. The target words were selected based on the low incidence level in the receptive and expressive vocabulary of the child and hence assumed to be unfamiliar to the child. This was also ensured by naming it to the child and the child giving a negative response for the word. The words considered for the study were primarily 'nouns' since several studies suggest that majority of the children's first words are nouns (Dromi, 1987; Gershkoff-Stowe & Smith, 2004). These words were used for training the children in both the groups to maximize the probability that fast mapping would be observed. Bisyllabic Kannada

words were selected and they were matched approximately for object category. This was done based on reports from literature that semantic similarity between words is a potent force in early word learning (Baldwin, 1992; Smith, 2000; Gershkoff-Stowe, Connell & Smith, 2006). Twenty four picture cards with bright colors were prepared. The twenty four unfamiliar words were divided into four sets of six words each, the names of which were matched approximately for object category, syllable length and phonological complexity. The stimuli used for the study has been shown in the appendix.

Two of the lists were classified as 'high practice' words, considered so, as the children saw the sets during all the sessions. One list was classified as 'medium practice', which the children in the experimental group only saw during session 3, 6 and 9. The final list was classified as 'low practice' which each child saw only on the last i.e., the session 12. The medium practice and low practice words were accompanied with a set of high practice words for the purpose of counter balancing.

Procedure

A total of twelve sessions were carried out with each child in the experimental and control group. In each session, the child was shown twelve picture cards and was involved in training and testing phases. The schedule of the training and testing phases in the experimental group was as follows: The sessions 1, 2, 4, 5, 7, 8, 10 and 11 consisted of training and testing of twelve high practice words, while the sessions 3, 6 and 9 consisted of training and testing of six high practice and six medium practice words. The six low practice words were trained and tested only in the session 12 along with six high practice words. This schedule was adopted from the study carried out by Gershkoff-Stowe & Hahn (2007).

In the training phase, the parent and the experimenter together labeled each of the twelve pictured objects a minimum of six times per session. Naming occurred in an ostensive context by directly pairing the visual object with the auditory label, when both the child and adult were jointly focused on the referent (Schafer & Plunket, 1998). Ostensive learning is essentially optimal for children with smaller vocabulary who may otherwise not be able to demonstrate fast mapping (Lederberg, Preszbindowski & Spencer, 2000). This interaction was structured naturalistically. Words were typically

embedded in propositional statements to support the processing of word-referent pairing. Thus, the child might hear the parent/experimenter say for example- "See the bear? It lives in the forest!" No attempt was made to systematically manipulate the amount or kind of semantic information provided. The experimental words rather than the synonyms (e.g., mynah rather than bird) and the whole object rather than the part was named during training. The experimenter also requested that parents avoid deliberate attempts to name the object any time before/after the session.

Testing probes were administered immediately after training. In the testing phase, six out of twelve pictures were kept in front of the child and the child was asked to point to the correct picture as the experimenter named each object. The order and location of the picture were arranged randomly for each session and each child. The same procedure was repeated for the remaining six pictures. When errors occurred, the experimenter provided the correct name and picture.

A similar procedure was followed for the control group for the first and last session. This group was included to separate the contribution of maturity and familiarity with the procedure from the experience with learning words. They were shown two high practice sets in session '1' and one set of high practice and one set of low practice in the session '12'. For the intervening sessions, the parents were asked to name a set of twelve pictures of common everyday objects that were familiar to the child. These set of pictures were used at each of the ten middle intervening sessions and the children were expected to identify the named picture. These children were not exposed to the medium practice words at all. This design provided a between subject control for the testing and training sessions and experience with the procedure.

The two groups differed primarily in their exposure to the word referent pairs and amount of practice with the new unfamiliar words. The experimental group was exposed to the high practice words on all twelve sessions, whereas, the control group was exposed only in the first and the last session. Fast mapping was measured for each set by measuring the number of correctly identified words, at the session '1' where new words were introduced; session '1' for high practice, session '3' for medium practice and session '12' for low practice. Hence comparison of the child's learning of high, medium

and low practice words as a function of time was done. The response of each individual child in each session was scored and tabulated. The data was subjected to statistical analysis using SPSS (version 16). Mean and standard deviation was calculated. Other statistical measures were also applied to check for any significant difference between the experimental and the control group.

Results and Discussion

The results obtained on the fast mapping abilities in both the groups from different statistical analyses have been presented and discussed:

I. Comprehension of high practice words

To analyze how well children in both the groups learnt a new set of high practice words, it was important to see the increase in proportion of high practice words correctly identified from session '1' through session '12'. The mean and SD values of high practice words for experimental and control group are depicted in Table 1.

Table 1: Mean and Standard Deviation (SD) of identification scores in session '1' and session '12' of high practice words in experimental and control group

Group	Session*	Mean	SD
Experimental group	S1	9.38	6.95
	S12	79.17	14.77
Control Group	S1	25.0	19.92
	S12	54.17	31.81

*S1-Session '1', S12- session '12'

The experimental group correctly identified 9.38% of the high practice words in session '1' with only minimal exposure, compared to 79.17% in session '12'. The mean scores obtained were subjected to Wilcoxon Signed Rank test. The results revealed that there was a statistically significant difference ($z = 2.52, p < 0.05$) between first and the twelfth session. This shows that the children in the experimental group showed a gradual increase in the proportion of high practice words learned during the period of twelve sessions carried out. The children in the control group correctly identified 25% of the words correctly in Session 1, but showed little gain in session '12', with only 54.17% correct.

A comparison of the mean scores of identification of high practice words in session '12' by the two groups of children using Mann Whitney test, however, indicated no statistical significance, although the

performance by the experimental group was better as indicated by the mean value. The Figure 1 depicts the mean proportion of high practice words comprehended by experimental and the control group between session '1' and session '12'.

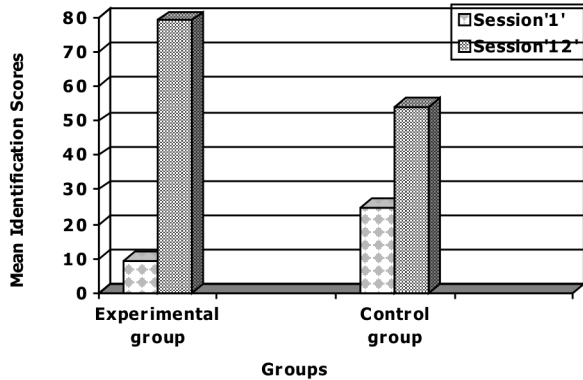


Fig 1: Mean proportion of high practice words comprehended by both the groups between session '1' and session '12'.

These results are not in consonance with the study by Gershkoff-Stowe & Hahn (2007) who found that children in the experimental group comprehended statistically greater number of high-practice words in the last session of testing than the control group. This could have occurred because of the difference in the duration of training. In their study, the fast mapping was measured over a period of twelve weeks, while the current study was carried out for a period of twenty four days only, i.e. there was a period of twenty two days between first and last exposure to the set of high practice words in the control group. This short time gap between the two episodes of testing could have facilitated retention of words taught in session '1'.

Additionally, only an informal means of assessing the vocabulary of the children before commencement of the experiment was done. Due to lack of availability of standardized tests to assess vocabulary of the children below two years in the Indian context, a sufficient and objective pre-test account of the vocabulary of the children could not be established. The children in the control group could hence have had a larger vocabulary than the experimental group to begin with. Moreover, there is evidence in the literature suggesting significant correlation between children's fast mapping skills and their vocabulary production scores on various standardized vocabulary tests (Ellis Weismer & Evans, 2002; Gray, 2005). Markman & Wachtel (1988) also opine that the child's

existing lexicon has an effect on word learning process.

In the days between first and last session, children in the control group received training on a set of familiar words that included everyday objects. This ensured that children in both groups received equivalent exposure in the experimental task. These children identified 100% of the familiar words in session '11', compared to only 54% of unfamiliar words in session '12'. This result suggests that like the experimental group, these children are equally capable of following the word learning experiment.

II. Comprehension of Experimental low practice words

The main question in this study was whether frequent exposure to a novel set of words would facilitate learning of an additional set of words. If this was the case, children in the experimental group would be expected to show better fast mapping skills than the control group. This was assessed by comparing the identification of low practice words by both the groups in session '12'. The experimental group did perform better than the control group with scores of 64.58% and 50% respectively. This indicates that the training of high practice words did indeed facilitate learning of a novel set of words especially in the experimental group. This has been depicted in Figure 2 below.

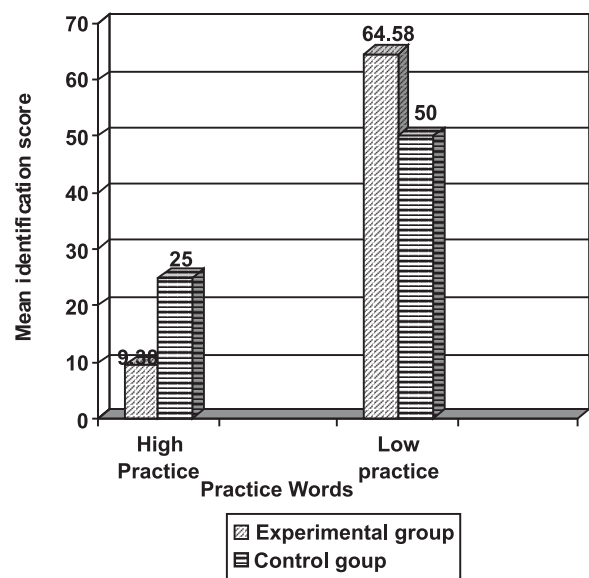


Fig 2: Performance for high & low practice words between the two groups.

Mann Whitney test of significance however, showed no statistical significance between the two

groups ($z=1.07, p > 0.05$). Though the experimental group did perform better than the control group, the small sample size and individual variations in the lexicon of the child, especially in the control group, could have led to these results. The greater scores in the experimental group compared to the control group indicate that fast mapping did occur in this group, though to a lesser extent. Due to the lack of a standardized test of vocabulary to assess the lexical development in toddlers in the Indian context, their exact vocabulary could not be assessed and this might have had an effect on the scores during final testing. The children, who received extended training in comprehension of unfamiliar words, progressed from learning each word individually to learning many words at once. This finding could be attributed to change in the strength of lexical activation due to repeated practice. These results are in partial agreement with the study by Gershkoff-Stowe & Hahn (2007) in which they found that the performance of the experimental group was significantly better than the control group. According to them, language processing system undergoes a shift from incremental improvements on a word-by-word basis to general, system wide growth in word retrieval skills. These results imply that fast mapping did occur in the experimental group, though the strength of the mapping could not be established.

The study also lends support to the fact that the semantic neighbourhood characteristics of a word also influenced the lexical access. The words used in the study were semantically related. They formed a unique "neighborhood" gradually increasing in strength as the number and density of task-related words also increased (Charles-Luce & Luce, 1990). This implies that through associative learning processes and prior experience, words and concepts can be organized into larger units or systems that facilitate 'fast, efficient, and parallel access to a broad base of related past knowledge' (Nelson, McEvoy & Pointer, 2003). Thus a small set of contextually related words can create a structural neighborhood that facilitates the spread of activation to other newly acquired words. This is consistent with adult studies showing that networks of association affect memory performance in tasks of recognition and cued recall (Nelson et al., 2003). Having a pre-established neighborhood in which to incorporate the new words thus appeared to have a facilitating effect on rapid word learning. This finding can be interpreted within

the context of a spreading activation model, i.e., broadening the base of conceptually related links within a single neighborhood produces patterns of activation that support the accessibility of individual words (Stemberger, 1989).

III. The medium practice set as a within subject control

A Friedman test was done to compare the results of learning at first presentation for high practice (session '1'), medium practice (session '3') and low practice (session '12') among the experimental group.

Table 2: Mean and Standard Deviation (SD) of identification scores in sessions experimental and control groups.

Sessions*	Mean	SD
S1 high practice	9.38	6.95
S3 medium practice	27.08	12.40
S12 low practice	64.58	22.60

*S1-Session '1', S12- session '12'

The children in the experimental group correctly identified 9.38% of high practice words in Session 1, 27.08% of medium practice words in Session 3 and 64.58% of low practice words in Session 12. The results revealed a significant difference ($F(2, 8) = 15.54, p < 0.001$). Figure 3 depicts the improvement made by the experimental group across different conditions.

The above findings also showed that the low practice words were identified best at first exposure, followed by medium practice words and high practice words at first exposure each. This establishes that the children in the experimental group not only identified better across time, but also improved performance every time a novel set of words was introduced.

There is a possibility however, that the improved performance of the children in session '12' was due to the familiarity with experimental procedure and not due to practice with learning words. If this was so, a significant increase should have occurred in the identification of words after a few days of training itself. To rule out this, a comparison of comprehension of high practice and medium practice set at second presentation was done. The children correctly identified 26.04% of high practice words at session '2' and 43.8% of medium practice words at session '6'. The Wilcoxon Signed Rank test revealed that the

mean scores were not statistically significant ($z = 1.6$, $p > 0.05$), thus indicating that the improvement was indeed due to the effect of learning and not due to familiarity with the procedure.

Conclusion

The present study aimed at studying the fast mapping skills in Kannada speaking toddlers. The children in the group that was provided repeated training of a novel set of words extended the learning and practice to another set of unfamiliar words i.e. fast mapping was seen in these children, although to a smaller extent. The high practice words created a neighborhood which facilitated the rapid learning of low practice words. In these children, learning of new words seemed to prime the system to knowing more words. Nevertheless, the present results should be interpreted with caution because of small sample size, but the study throws light on the importance of examining the potential changes in the strength of activation of words with repeated practice. In extending the results of this study to children who have difficulty accessing words for expressive use despite intact comprehension, it suggests that both listening to words as well as producing them influences lexical representation in memory. Though listening involves passive retrieval and expression involves active retrieval, both are mutually influential and activation in one modality would facilitate activation of units in another modality. Further research on fast mapping in a greater sample of children of various age groups and establishing norms on lexical vocabulary in children speaking Indian languages is warranted.

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APPENDIX

Experimental condition

High practice	Medium Practice	Low Practice
/hubbu/	/reppe /	/ede/
/vi:Ne/	/sita:r /	/Dho:lu/
/pengvIn/	/maina/	/gu:be/
/kempu/	/ ni:ll /	/ kappu/
/henchu/	/ be:ll /	/ chlmnI /
/e:DI/	/ to:La /	/me:ke/
		/galla/
		/ta:La/
		/hundza/
		/blll/
		/ba:vl/
		/ginke/

Control condition

Familiar word list

/kaNNu/	/kurchi/
/mane/	/a:ne/
/sara/	/ba:ji/
/ele/	/mu:gu/
/Chatri/	/ka:lu/
/tale/	/To:pi/