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Lexical access through semantic memory task in "at risk" learning disabled children.

Ramandeep Kaur*

Department of Pediatrics, Guru Gobind Singh Medical College, Faridkot, Punjab, India

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Abstract

Memory is the mental ability of an organism to acquire, store, retain and retrieve information. In order to assess memory, speech language pathologists consider confrontational naming as an effective method. Semantic memory, a part of explicit long term memory, has been assessed in various groups of children. Including bilingual and monolingual, children with down syndrome, specific language impairment, developmental dyslexia. In Indian context, analyses of semantic association in mental lexicon revealed faster judgment in semantically associated word pairs relative to the un-associated pairs. Also, among school children, high performers perform significantly better in semantic memory tasks relative to low performers.

However, the literature confirms a narrow research work available on demonstrating the relation between semantic memory and language processing. Thus, present study aimed at measuring the accuracy and response times for lexical items, through semantic memory, in a group of school going "at risk" learning disabled children. The results illustrated a good performance of "at risk" learning disabled group when lexical items were accessed through semantic memory tasks. Overall results of "at risk" learning disabled children seem to be similar to the high performing typically developing children and are much higher than typically developing low performers in terms of both accuracy and speed of responses.

Keywords: Phonologic, Memory deficits, Inferiolateral, Knowledge.

Introduction

Memory is defined as the mental ability of an organism to acquire, store, retain and retrieve information. In order to understand different aspects of memory, the assessment could be performed in various ways. These include paired associative learning, which associates a specific word with another word in order to memorize. Another method is free recall, where a subject memorizes a list of words and then sometimes later the individual is asked to recall the memorized word/segment [1]. Lastly, the most commonly used technique includes recognition tasks, in which an individual is shown various pictures or words to memorize and then the memory responses are elicited from some other related pictures or words [2].

One such type of recognition task, used by speech language pathologists is called confrontational naming. In order to assess memory, speech language pathologists consider this type of naming as an effective method. Confrontational naming entails representation of an object or a line drawing to the patient and then requesting the correct verbal label from the subject. Mild cognitive impairments reveal reduced confrontational naming, mainly pertaining to semantic memory deficits [3].

Semantic memory, a part of explicit long term memory, includes word meaning, understanding and other concept based knowledge particularly unrelated to specific experiences. There are not many studies available to understand the semantic memory in children, thereby; in children the representation of semantic memory with respect to language processing is not clearly understood. Assessing semantic memory is one of the critical aspects in abnormal children. To validate one's diagnosis it is essential for a clinician to carry out a detailed formal assessment [4].

Language and semantic memory

Cognitive models of language hypothesize that spoken naming involves both semantic as well as phonologic levels of processing. In general, semantic knowledge is accessed first followed by the activation of a corresponding phonologic word form in the lexicon. Subsequently, peripheral procedures are enacted including the planning and execution of motor movements for spoken word production. One view of semantic memory organization holds that model conceptual representations that comprise the semantic memory are supported by the anterior and inferiolateral temporal lobes bilaterally compared the relation between words and concepts, and found an associative link [5]. This associative link between language and meaning enables us to make inferences about the structure of semantic memory from language. In other words, in the absence of impaired access to word meaning (as in aphasia), lexical knowledge is also semantic knowledge. Confrontational naming is perhaps the most efficient toll to assess the integrity of language functioning and thus the integrity of semantic memory [6].

Numerous neurological studies on normal and brain damaged individuals revealed two important models which provide important information about the organization of the semantic knowledge. These models are feature based models and domain based models. The principle of feature based model is that they consider category specific impairments to emerge from damage to underlying features that define concepts. Another model called domain based model hypothesizes that impairments in semantics are domain specific impairments. In general, it is the integration of stored factual knowledge with the control process that allows us to access and make connections among pieces of knowledge in an appropriate way [7].

Various neuroimaging studies like those involving positron emission tomography, functional magnetic resonance imaging etc introduced an involvement of frontal lobe, temporal lobe and sub cortical structures in processing of semantic memory. Disproportionate difficulty processing conceptual representation of actions was observed after lesion to the left frontal cortex of a group of individuals reported lack of conceptual knowledge in individuals with chronic and degenerative lesion in frontal cortex. In addition, disproportional semantic impairments were also observed in individuals with parietal lobe and posterior middle temporal cortex lesions. Left pre frontal and inferior frontal regions have also been associated in executive control of semantic knowledge [8]. In addition to the role of frontal lobe which helps mainly in conceptualization and naming the actions, the left inferior temporal lobe also is associated greatly with the semantic processing. Mainly damage to the posterior region leads to a disconnection between semantic knowledge and phonologic word forms. In contrast, central semantic impairment has also been associated with damage to more anterior temporal regions [9].

Semantic memory in children

The script based memorization strategies among young children yield more utility, perhaps due to involvement of semantic memory. Lucariello and Nelson model, 1985, postulated that the learning process is actually embedded in activities (scripts) and hence, thinking and speaking are related to those scripts which involve categories derived from an association of items with the functional roles. Maaka, Margaret, Wong and Eddie confirmed these findings by reporting that a group of six year old could perform significantly well using scripts to structure their semantic memory. This age group was followed by five year and then four year old children. A developmental shift in language learning was also observed. Thereby, indicating an increased utility for script based memorization strategies in young as well as older children. Moreover, the effects of auditory semantic distracters on category recall were observed to be functionally distinct from those found in the context of serial short term memory [10].

The semantic memory has been assessed in various other groups of children. These include bilingual children where the relationship between episodic and semantic memory with bilingualism was assessed using verbal and word fluency tasks respectively. The findings suggested an integration or common organization of semantic information between two languages. Regarding children with down's syndrome the verbal short term memory was assessed by manipulating phonological and semantic demands of verbal short term memory tasks. The results revealed a phonological weakness which further contributed to the verbal short term memory deficits in children with down's syndrome. Moreover, specific language impaired children revealed presence of sparse semantic knowledge for naming. The words represented in these children's semantic lexicon were more or less vulnerable to retrieval failure and thus led to frequent naming errors. Furthermore, children with developmental dyslexia show semantic impairment during sentence reading. This, in turn, reduced responses in left anterior brain regions and subsequently modulated a more sustained response in left inferior parietal regions [11].

Among the Indian contexts, analyses of semantic association in mental lexicon revealed words with common semantic features receive double activation which, thereby, facilitates a faster judgment in semantically associated word pairs relative to the un associated pairs assessed the performance of semantic memory task in school going, typical, high and low performing children. The high performing group performed significantly better in semantic memory tasks relative to the low performing group. Moreover, with adequate training a significant improvement was observed in semantic memory task among low performers [12].

Need for the study

Speech language pathologists are interested in a wide variety of disorders of speech and language in both children and adults. Of this, groups of school going children and particularly poorly performing children with specific characteristics similar to learning disabled children are slowly becoming a major focus [13].

The literature confirmed a narrow research work available on demonstrating the relation between semantic memory and language processing; however majority studies focus on development of language with chronological age. It is important to understand the association between object meaning and its coding onto a specific word. Thereby, the present study primarily focused on assessment of lexical access through semantic memory task in (at risk) learning disabled children. These measurement techniques may further facilitate to document and quantify therapeutic progress more reliably when compared to the informal assessment procedures [14].

The present study aimed at:

- Measuring the performance of "at risk" learning disabled school going children on semantic memory task by measuring the accuracy and response times for common lexical items
- Comparison of the "at risk" Learning Disabled (LD) children to the higher academic performers as well as those low performers who do not show any "at risk" LD features

Materials and Methods

Participants

A total of thirty "at risk" learning disabled children were selected in the age range of 5 to 10 years (Mean age 8 years). These "at risk" learning disabled students were selected by school teachers after one hour of training program provided to teachers by experienced speech language pathologists. This program included necessary information about learning disability which thereby assisted in identification of "at risk" children from a group of typically developing children [15].

Post-pre training evaluation

After the training, a post pre training evaluation was carried out using a questionnaire, in order to determine the efficacy of the training program. The questionnaires provided to the teachers, contained various questions regarding the features on learning disabled children. These questionnaires were given to all the teachers after the training program and the teachers were instructed to answer the questions in two aspects, their knowledge of learning disability before training and their knowledge after the training. Thus, the efficacy of the program was checked not using pre post evaluation paradigm but by using post pre evaluation technique. Thus, the present study involved a post pre evaluation technique as it is much more efficient than the pre post evaluation, in which the participants have limited knowledge at the beginning of the program [16].

Special instructions were given to the teachers to be as trustworthy as possible while filling the questionnaires. This post pre training evaluation facilitated to assess the competency of teachers in identifying the children. As evident from Figure 1, when questionnaires were filled based on post training knowledge the scores were much better than those filled based on pre training knowledge [17]. This proves that after the training program, teachers could understand the features of Learning Disability much better than pre training, thereby, accounting for the efficacy of the training program (Figure 1).

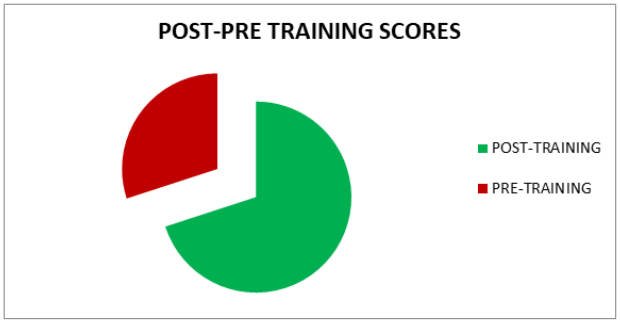

Figure 1. *Mean scores of questions answered by teachers before and after the training program, using a post pre evaluation paradigm.*

The scores are improved after the training period which shows that the teachers were much improved in diagnosing the "at risk" learning disabled children. The trained teachers subsequently evaluated the "at risk" children using a screening profile for learning disabled, developed by soumya. Further, an experienced speech language pathologist confirmed the presence of learning disability features in this group by using informal assessment procedures.

Stimulus

The stimulus included thirty two common words, developed based on paired associative learning. This involved most commonly occurring nominals, for each of which 4-5 semantic were devised. This included both structural and functional cues for each of the target word/picture. The test was conducted in two conditions.

Congruent: Four pictures were presented out of which one was the target picture and rest of the pictures included within the category distracters.

Incongruent: Here four unrelated pictures were presented. This included, one target picture and three distracter pictures, including one semantic distracter, one phonemic distracter and one random picture.

Scoring for responses

The reaction times for responses were measured for each participant. If the child responded for the first clue, a score of 3/word was awarded to the child. Thus, for thirty two words, a highest score of 96 was given. If the child responds for the second clue, 2/ word scoring was given. In case the response elicited in third clue, then a score of 1/ word was awarded. A score of 0 was given if the child failed to respond to any of the clues. These scores were then summed up in each category and a total score for both congruent and incongruent conditions was obtained. The scores were then subjected to a paired sample't' test in order to compare the congruent and incongruent conditions.

Results and Discussion

The results illustrated a good performance of "at risk" learning disabled children when lexical items were accessed through semantic memory tasks.

Accuracy

As evident from Figure 2, the mean percentage scores for the congruent condition were 72.40% and for the incongruent condition was 70%. This indicated that the stimulus words were meaningfully recalled with a fewer semantic cues in both the conditions.

The paired sample't' test conducted for the accuracy scores indicated no significant difference between semantic memory tasks carried out in congruent and incongruent conditions (Figure 2).

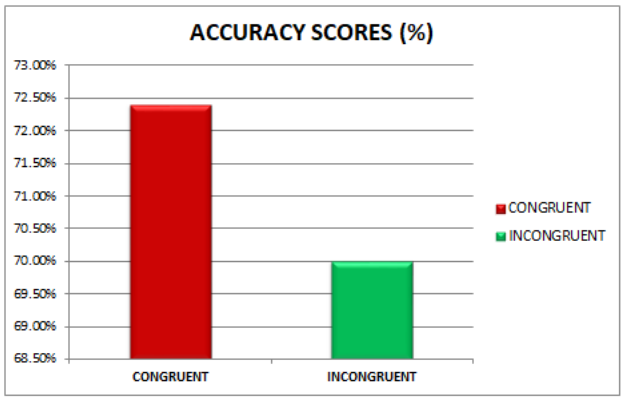

Figure 2. *Mean Scores for accuracy of "at risk" learning disabled children across congruent and incongruent conditions. Higher scores in the congruent condition indicate better understanding and reduced errors in this condition.*

Reaction time analyses

The mean scores obtained for reaction times (Figure 3) were 1.91 msec for congruent condition and 1.75 msec for the incongruent condition. This denotes faster reaction times for incongruent condition relative to the congruent one. Furthermore, the response time also showed no statistically significant difference in paired sample 't' test (Figure 3).

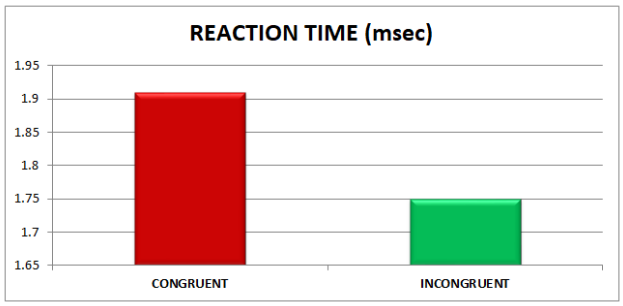

Figure 3. *Mean scores for reaction times of "at risk" learning disabled children across congruent and incongruent conditions. Higher scores in the incongruent condition indicate faster recognition of scores in the presence of unrelated distracters.*

The overall results of "at risk" learning disabled children were compared with the high and low performing children. The results seemed to be similar to the high performing typically developing children and are much higher than typically developing low performers in terms of both accuracy and speed of responses. Paired sample 't' test showed significant differences between the selected group of children and low performers. However, unlike the high and low performing children, there seems to be no significant difference between the scores obtained for congruent and incongruent conditions.

The study reported a good lexical access through semantic memory tasks in children who are "at risk" of learning disability. The scores for congruent condition were slightly better than the incongruent condition in "at risk" children, with an insignificant difference. The similarities between the target words/pictures accounted for these results. The results are much similar to those obtained from adults where a better scoring is observed in semantically related target words. However, this difference was not proved to be significant, thereby predicting a developmental improvement in scores across adults and children. Moreover, the reaction time analyses revealed faster recognition of incongruent words. The presence of various distracters, semantic and phonological, accounted for this better scoring. In other words, when the words are semantically related an individual takes more time in differentiating between the similar kinds of clues. However, when the words are unrelated it becomes easier and faster to differentiate between the possible target word and the distracters. Thus, less time is consumed in lexical decision task for incongruent words.

The findings of the present study did not co relate with that of Jaivikas who shows better performance in the congruent condition. The semantic cues given by Jaivikas had various ambiguities and thus these complex cues were simplified in order to make the experiment much simpler and accurate. This was perhaps one of the reasons for disparities seen in the results.

In the second part of the experiment, the scores obtained from the "at risk" learning disabled children were compared to the high performing and low performing children of same age group, school as well as similar socio economic status. Surprisingly, the scores for accuracy and speed of responses were very similar to the high performing typical school children, though the participants fell under the category of "at risk" learning disabled. On the contrary, their scores appeared to be much higher than the typical low performers. This predicted that the lexical access, especially through semantic memory tasks, was unaffected in the selected group of children. This further predicted a better paired associate task performance in this group of children in spite of various linguistic difficulties.

Conclusion

The study focused on assessing the lexical access by means of semantic cues given to a group of "at risk" Learning Disabled children. Since it is a pilot study a large group should be considered for better implication of the results which would further help in assessment and documentation of therapeutic progress. Also, the technique developed helps in quantifying and recording lexical access not only in children but also in adult and geriatric population where there is a high occurrence of the disorders like anomia, dementia and other semantic disorder.

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*Correspondence to:

Dr. Ramandeep Kaur

Department of Pediatric,

Guru Gobind Singh Medical College,

Punjab,

India

E-mail: ramandeepslp@fathermuller.in