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A tool to identify children at risk of specific learning disability in Bengali and English

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Abstract
Aim of the study is to evaluate and compare spelling skills in children with and without SLD in English and Bengali and appraise the sensitivity, specificity and hit rate of the developed tool in identifying children with SLD. Method: The participants included 60 children divided into two groups. Group- 1 consisting of children identified as SLD and group- 2 comprising of children without SLD (High academic achievers). The participantsare bilinguals and biliteratesin the age range of 8-11 years. The task was to identify the first and the last grapheme of a read out word in English and Bengali.
Results: the High academic achievers performed significantly better ($p \leq 0.05$) than the SLDs in both Bengali and English. The Bengali and English tool had the sensitivity of 77%&83%, specificity of 97.6%&96.6%, positive predictive value of 95%&96.6%, negative predictive value of 80% & 85% and correct classification/hit rate of 87% &90% respectively**.**

Keywords: Spellings, Specific learning disability, High academic achievever.

1. Introduction
Either right or wrong, the spelling standard or proficiency of an individual is often taken as indication of his intelligence and scholarship, poor readers are poor spellers (1; 2), are under achievers in schools, and are at risk to drop out from school (3). If diagnosed as having learning disabilities they have psychological and emotional difficulties (2; 4), behavior problems (5) and in turn may fail vocationally (6; 2). It's well appreciated by speech therapists, psychologists and educators that children diagnosed as having learning disabilities are notorious for their frequent misspellings, spelling alphabets in wrong order, mirror writing, letter reversals, inversion of letters, spelling words as they sound, display bizarre spelling, omissions, faulty sequencing, confusion, guessing or addition of letters, difficulties in matching letters, despite knowledge, making sparing use of punctuation.
Spelling capability of a child refers to the ability of the child to decode sound to letter (7). It's a phonological task and a way to demonstrate our phonological knowledge (8). The linguistic components that underlie spelling also underlie reading abilities (9). Darch, Kim, Johnson & James, 2000 (44) explained that students with learning disabilities have difficulties because they are less skilled at deducing/using spelling strategies, understanding their rules or since they do not use their knowledge of sound symbol correspondences effectively. If spelling depends a lot on decoding sound to letter/ grapheme/ akshara and children with learning disabilities have difficulties in mastering the rules governing sound to letter conversions it can be hypothesized that languages which have straight forward sound to letter conversion rules would be easier to spell as compared to languages which have a complicated/ poor sound to letter conversion rules. There are enough evidences to indicate varying neural excitations depending upon the language which is read. The dyslexics' brain while reading an alphabetic language, like English is activated differently as compared to reading Chinese where the left prefrontal cortex is activated and unlike the left temoroparital regions (12). Indian systems of writing are nonlinear and have excellent letter to sound conversion rules than that of English (13; 14; 15) which is a linear alphabetic script with poor rules governing letter/ grapheme to sound/ phoneme conversions (45). Reading English and Hindi/ Indian Language have shown to place different cortical demands for processing (16).
Thus there is a need to do language specific studies to identify spelling errors and spelling developments. Further spelling errors in children with and without learning disabilities cannot be ignored as, a major cause of school dropouts is poor academic achievements owing to impaired reading and writing skills (17).

Mittal, Zaidi, Puri, Duggal, Rath, and Bhargava, 1977; Ramaa, 2002; Sakhuja, 2004; Thaker 2007 (18,19, 20,17)agreed that about 15% of Indian school going children have specific learning disabilities (SLD) who are at a very high risk of being drop outs, poor academic achievers and fail to have a rewarding vocation in the long run. Fortunately the course of reading disability can be reversed provided that the children are identified early and have explicit reading instructions (21; 22; 23; 24; 46). Simos, Breier, Fletcher, Bergman, Foorman, Castillo, Davis, Fitzgerald, and Papanicolaou in 2002 found students identified as high risk for a reading disability showed similar brain map profiles as those identified as dyslexic. If children with specific learning disabilities are left to themselves, they deteriorate, drop outs from school owing to poor academic achievements. There is no automatic recovery with age rather the dropout's increase significantly from 28.49% between class I-V to 50.10 % between class I-VIII (25). While intervening those helps 56- 92% of at risk children to come within the range of average reading ability (26) and perform at par peers (27; 28; 23). Identification of at risk children by the school teachers is a challenge especially for Indian teachers who are burdened with responsibilities of a varied nature. They need a short and a simple tool. If the same can be provided it would promote achieving 100% literacy as targeted by the Sarva Sikha Abhayan (29). In India as well as in the west there is a need for a user-friendly assessment tools for teachers specifically designed to identify children who are at risk for learning disabilities is the need of the time (47). Aim of the study is to develop a short and simple tool to identify children at risk of spelling difficulties. For the purpose spelling skills in children with and without SLD in English and Bengali are evaluated and the sensitivity, specificity and hit rate of the developed tool is examined in terms of identifying children with SLD.

Method

Participants

The participants included 60 children divided in two groups. Group- 1 consisting of children identified as SLD and group- 2 comprising of children without SLD (High academic achievers). Group 2 scored 60 percent or higher in their exams and was identified as high academic achievers (HAA) by the class teacher. The participants were in the age range of 8-11 years. All were native speakers of Bengali along with exposure of English language since kindergarten, resided in urban Kolkata, attended regular school in class III to V, and belonged to middle socioeconomic strata. They were ruled out for having any sensory impairment including hearing Impairment. Though SLD were pre identified, List of basic skills as given by Brigance in 1997 (48) was administered on all the participants to confirm the classification. The SLD were provided remediation programme in the schools and had received about seven hours of inputs from a special educator at school.

Tool

The tool developed for the purpose of the study was done in association with the clinical linguist (Appendix I). The task was to identify the first and the last grapheme of a read out word in English and in Bengali. Face validity, done by 15 speech language pathologist and 15 special educators working with literacy, test retest reliability was administered. The tools got high reliability coefficient (r> .82). The instructions were given to the participants both in English and Bengali three examples were given as practice trials before the test phase begun. Apart from comparing the mean scores on chi-square; the tool in English and Bengali was further evaluated for its sensitivity, specificity, positive predictive value, negative predictive value and hit rate. To predict the sensitivity, specificity, positive predictive value, and negative predictive value and hit rate a cutoff score needs to be decided so as to classify students as high academic achievers and children with SLD based upon their obtained score. A cutoff used was the mean score obtained in Bengali and English by the SLD plus one standard deviation. The calculation is based upon numbers after tabulating the data in the following format. The scores based upon the cut-off score was categorized into two groups SLDs and Non- SLDs and the data was tabulated.

The cells a,b,c,d in the table were filled with actual numbers and then the following was calculated: Sensitivity = a/(a+c), Specificity = d/(b+d) , Positive Predictive Value = a/(a+b) , Negative Predictive Value = d/(c+d), Correct classification/hit rate = a+d/(a+b+c+d). Sensitivity (also called the *true positive rate*, or the recall rate in some fields) measures the proportion of actual positives which are correctly identified as such (e.g. the percentage of sick people who are correctly identified as having the condition). Specificity measures the proportion of negatives which are correctly identified as such (e.g. the percentage of healthy people who are correctly identified as not having the condition, sometimes called the *true negative rate*). These two measures are closely related to the concepts of type I and type II errors. A perfect predictor would be described as 100% sensitive (i.e. predicting all people from the sick group as sick) and 100% specific (i.e. not predicting anyone from the healthy group as sick); however, theoretically any predictor will possess a minimum error bound known as the Bayes error rate.

Appendix I

English Tool:

5. Spelling

Give the student a pencil and a sheet of lined paper. Write the student's responses over the words.

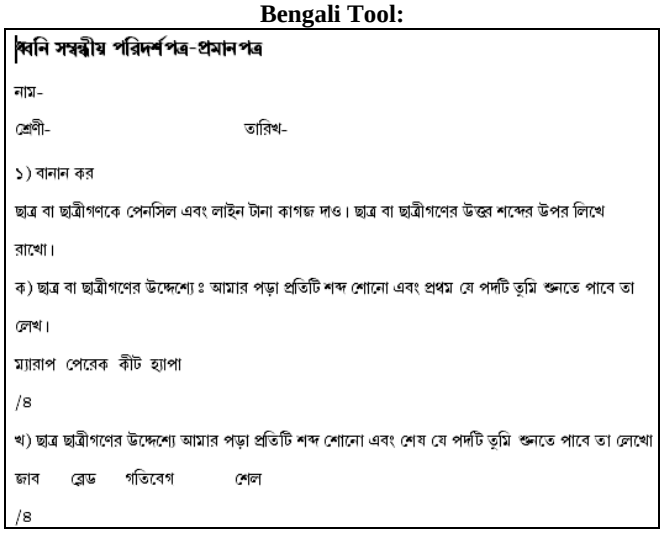
A. **Tell the student**: Listen to each of the words I read and write the first sound you hear.

/4 map pen kid hand

B. **Tell the student**: Listen to each of the words I read and write the last sound you hear.

/4 rub fled leg sell

Bengali Tool:



ধ্বনি সম্বন্ধীয় পরিদর্শপত্র-প্রমানপত্র

নাম-

শ্রেণী- তারিখ-

১) বানান কর

ছাত্র বা ছাত্রীগণকে পেনসিল এবং লাইন টানা কাগজ দাও। ছাত্র বা ছাত্রীগণের উত্তর শব্দের উপর লিখে রাখো।

ক) ছাত্র বা ছাত্রীগণের উদ্দেশ্যে ঃ আমার পড়া প্রতিটি শব্দ শোনো এবং প্রথম যে পদটি তুমি শুনতে পাবে তা লেখ।

ম্যারাপ পেরেক কীট হ্যাপা

/৪

খ) ছাত্র ছাত্রীগণের উদ্দেশ্যে আমার পড়া প্রতিটি শব্দ শোনো এবং শেষ যে পদটি তুমি শুনতে পাবে তা লেখো

জাব ব্লেড গতিবেগ শেল

/৪

Results

After the measures were administered to all the participants their responses were recorded, scored and subjected to a series of statistical analysis. The results have been discussed under two subheadings; Firstly, the sensitivity specificity, positive predictive value, negative predictive value and hit rate of the tool was calculated and secondly, the performance between HA and SLD was compared to identify any significant difference in scores.

The sensitivity, specificity and hit rate of the tool:

To calculate the sensitivity, specificity, positive predictive value, negative predictive value and hit rate of the tool in both the languages the mean and standard deviation of HA and SLD group was calculated.

For the language Bengali the mean and standard deviation for the SLD group were 2.9 and ±1.8 respectively. Cut-off score was decided as mean plus one standard deviation. The calculated cut-off score is 2.9 + 1.8 = 4.7. Therefore, the cut off score for Bengali was considered to be four and below. Participants scoring four and below were placed as having SLD and participants scoring above were categorized as No-SLDs. From the group of diagnosed SLD, out of 30 participants seven candidates scored above four and rest 23 participants scored below four. Sensitivity was calculated to be 77%, Specificity to be 97%, Positive predictive value 96%, Negative predictive value to be .81% and hit rate to be 87%.

For the language English the mean and standard deviation for the SLD group were 4.5 and ±1.9 respectively. Cut-off score was decided as mean plus one standard deviation. The calculated cut-off score is 4.5 + 1.9 = 6.4. Therefore, the cut off score for English was considered to be 6 and below. From the group of SLD out of 30 participants 5 candidates scored above 6 and rest (30-5= 25) 25 participants scored below 6. Sensitivity was calculated to be 83%, Specificity to be 97%, Positive predictive value 96%, Negative predictive value to be 85% and hit rate to be 90%.

The comparison of performance between HA and SLD:

The performance of HA and SLD has been analyzed using three statistical tests; percentage of mean scores, standard deviation and chi-square test. To compare the score obtained in both the languages percentage of mean scores were considered. The mean percentage scores of HA are higher in all skills than SLD in both the languages. The standard deviation of SLD is higher in both the languages.

To summarize the result the High academic achievers performed significantly better ($p \leq 0.05$) than the SLDs in both Bengali and English. The Mean scores obtained by SLDs in Bengali (X: 2.9±1.8) and in English (X: 4.5±1.9) and the High academic achievers in Bengali (X: 7.8 ±0.48) and in English (X: 7.7±0.5). On an Average the SLDs took double the time to complete the test as compared to the peers.

Discussion

Children with SLD performed poorly in both the languages as compared to the age matched peers in both English and Bengali. A series of factors like phonological awareness, visual storage, orthographic knowledge, morphological knowledge, cognitive abilities and instructional techniques (8; 31; 32; 33), may be responsible for the poor performance of the children.

Deficits in RD associated with processing of auditory presented stimuli,

An increasing body of research suggests that the core deficit in developmental dyslexia (or reading disability (RD) lies within the language system, most prominently at the level of phonological processing and analysis (40; 49). Moreover, a significant body of neuroimaging research has now established a common neurobiological characteristic of RD as a disruption across a number of critical left-hemisphere (LH) reading-related sites. This disruption typically manifests as an under activation relative to non-impaired (NI) individuals and is primarily observed in both LH temporo parietal and LH occipito temporal (OT) regions. Moreover, this relative under activation is particularly pronounced during tasks that require printed word processing or make explicit demands on phonological processing or analysis, e.g., a rhyme task (50; 51; 52). This functional anomaly in LH regions has been observed consistently in children (53) and adults (54; 55). Furthermore, this relative hypoactivation in LH posterior regions (notably the LH OT) seems to be stable across alphabetic languages (56) and is detectable as early as the end of kindergarten (46).

Given that the core deficit in RD is typically proposed to reside within the phonological component of the language system (40; 49), one question that arises is the extent to which reading difficulties associated with RD and the corresponding neurobiological dysfunction are circumscribed to printed language processing (57). Behaviorally, individuals with RD do not typically have difficulty processing spoken words

unless the task is explicitly phonological (i.e., tests of phonological awareness such as elision and blending of phonemes and words or rhyming of words or syllables) or for longer utterances or more complex tasks such as syntactic processing or vocabulary knowledge (58). However, there is some evidence indicating difficulty with processing of smaller units of speech or tones when the task is not explicitly phonological; for example, impairments have been observed when individuals with RD need to make temporal order judgments to rapidly presented tones (59; 60); under circumstances where auditory stimuli must be extracted from noise (61); and for particular types of categorical perception (62). Consistent with these behavioural findings, neurobiological dysfunction during several lower-level auditory processing tasks has been observed in children and adults with RD. For example, Gaab, Gabrieli, Deutsch, Tallal, and Temple in 2007 (63) found that RD children exhibited comparable activation in left prefrontal cortex during processing of rapid frequency changing and slow frequency changing non-linguistic [synthesized consonant vowel consonant (CVC)-like] stimuli, whereas controls showed increased activation for stimuli with rapid frequency transitions. Temple, Poldrack, Protopapas, Nagarajan, Saltz, Tallal, in 2000 (64) report similar findings for adults with RD compared to NI adults: preferential activation in left prefrontal cortex for rapid relative to slow changing transitions in NI but not for RD adults. Moreover, Ruff, Marie, Celsis, Cardebat, and Demonet in 2003 (65) observed deficits in categorical perception, such that RD adults failed to show neural response to deviant stimuli in a pre-attentive (pa-ta) oddball task; NI individuals exhibited increased activation to deviants in multiple language-related LH regions (including the angular gyrus). Finally, Brier, Simos, Fletcher, Castillo, Zhang, and Papanicolaou, in 2003 (66), using MEG, found differences in laterality (more LH activation for NI, more RH for RD) in a syllable discrimination task using a voice onset time series continuum. These findings suggest that, at least for some individuals with RD, there may be an underlying lower-level auditory processing difficulty and/or phoneme discrimination deficit; however, it is unclear (particularly in the case of rapid auditory processing) how this difficulty is related to the more commonly observed phonological processing and decoding deficits observed in RD (49, and 67). Neurobiological studies of spoken language processing in RD at the word and sentence level processing are surprisingly rare, especially considering the large number of studies on printed word processing in RD. Several early PET studies of adults with RD were consistent with findings from behavioural studies indicate spoken word dysfunction only for tasks that were explicitly phonological.

The dual route Cascade model (34) can be used to explain the different demands placed by unrelated orthographies on processing. The variation in mean scores and standard deviation in both the languages can be ascribed to the difference in the nature of phoneme grapheme correspondences in them as well as the instructional techniques used to teach the languages. The mean scores of English was higher than Bengali for the SLD in spite of a greater transparency probably owing to the instructional techniques used with the identified SLD who had begun having remedial education for a period of one month. However the group 2 could perform better in Bengali and had a lower variance owing to their inbuilt skills and the transparency of Bengali. Perfetti and Bell in 1991 (35) strongly claim about the time course of "phonemic activation" in word recognition. It is well known that children with SLD have poor vocabulary (36) and poor phonological awareness (37; 38; 39; 40) thus words time taken by SLDs to complete was relatively longer. The English tool was found to have a higher sensitivity and hit rate than the Bengali spelling tool to identify children at risk of SLD so may be used as a tool by teachers to early identify children in the class room.

Conclusion

It can be concluded that nature of the language plays an important role on academic achievements. The difference in scholastic performance between SLD group and high achievers may be attributed in part to inadequate spelling skills. Consequently, this issue should be carefully considered during classroom teaching. The developed tool can be used for the screening purpose in classroom. The SLPs should also build up their skills in this area and provide assistance to children who are poor language learners but do not present any overt symptoms of delay or deviance of linguistic skills.

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