DEVELOPMENT OF A SCREENING TOOL FOR BI/MULTILINGUAL ADULTS WITH DYSLEXIA

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Certificate

This is to certify that this dissertation entitled ***" Development of a screening tool for bi/multilingual adults with Dyslexia"*** *is a bonafide work in part fulfillment for the degree of Master of Science (Speech –Language Pathology) of the student Registration No.11SLP023. This has been carried under the guidance of a Faculty of this institute and has not been submitted earlier to any other university for the award of any diploma or degree.*

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Declaration

This is to certify that this master's dissertation entitled ***"development of a screening tool for bi/multilingual adults with dyslexia"*** *is the result of my own study and has not been submitted earlier to any other university for the award of any degree or diploma*.

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CERTIFICATE

This is to certify that the dissertation entitled **'*Development of a screening tool for bi/multilingual adults with Dyslexia'*** has been prepared under my supervision and guidance. It is also certified that that this has not been submitted earlier in any other University for award of any Diploma or Degree.

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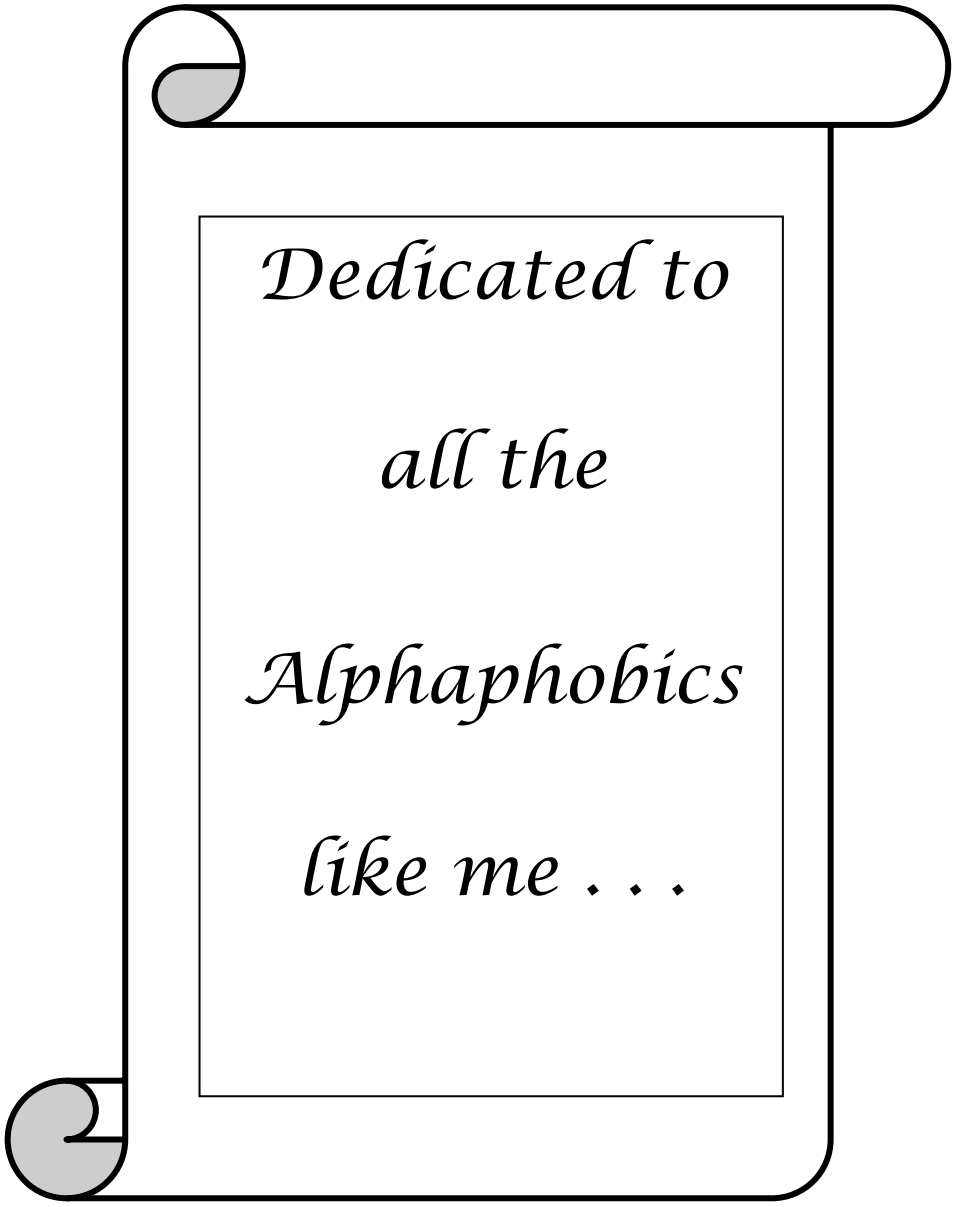
Dedicated to
all the
Alphaphobics
like me . . .

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INTRODUCTION

Developmental Dyslexia (DD) is defined as a disorder of literacy acquisition which is not attributed to any sort of neurological abnormality, low intelligence or inadequate educational exposure. These literacy acquisition deficits include difficulty in spelling formation in reading words accurately and fluently and in other writing skills. It has been accepted as a life span disorder (Grigorenko.E.L.2008).

When compared to general population , the individuals with DD are characterized to be having lower profile of indicators of educational background, low employment status, and also are rated low for reading and writing activities at work and at home environment(Chapman, Tunmer & Allen,2003;Fawcett, as well as high status of social mal-adaption (Skaalvik,2004; Winter, Holland, & Collins , 1997) and reported to have emotional(Mc Nutty.2003) and mental health problems(Undheim.2003).

However, if observed the development of these individual's, trajectories of reading and writing performance is not constant across the life span. So, gradually these individuals develop their own coping strategies. So, these individuals diagnosed with DD are either referred to as "compensated" or "non –compensated" readers.

As mentioned by standardized tests of reading and spellings, the compensated readers reach average level of functioning in their reading skills, which allows them to pursue formal academic studies and reach a labor mark which requires adequate reading skills. Where in uncompensated readers get limited educational and employment opportunities because of their poor reading skills (Pennington et al., 1986).

It appears that the presence and experience of the difficulties faced due to DD in childhood triggers certain events that determine the trajectory of cognitive development, which results in a detectable dynamically distinct profile of cognitive skills in such adults with DD whether compensated or not.

There is a profound difference exhibited on different reading related tasks at both cognitive (Bruck,1988; Brunswick et al.1999; Elbro , Neilson and petesen,1994; Gottardo, Siegal and Stanovich, 1997; Leong,1999; Shaywitz et al.1999; Snowling, Nation, Moxham, Gallagher and Firth, 1997) and brain levels (Paulesu et al.1996; Shywitz et al.2003) in compensated readers . But the mechanism of compensation is still unclear. For example, adults who are compensated readers tend to rely more on context while reading when compared to typical readers.(Bendror, Pollutset, Searpati1991).

In a country like India people migrate to different states for employment and education where they are exposed to different languages other than their mother tongue and English (it being the common official language across the country). The educational system of India differs in every state and includes the orthography of regional language also in the syllabus. So the individuals are not only exposed to many languages at a time but also are exposed to different orthographies thus developing the majorty of the population as – bilingual or multilingual.

So as per the educational providers and other language therapist it gets difficult to assess the individuals with reading and writing difficulties in the usual medium of English language as these individuals would have mostly acquired English as a 2^{nd} or 3^{rd} language and may not have mastered the language skills. This inability of providers

denies the learner or the target population to get the specialist support which they need in order to improve or to make progress.

When we look into the question of what are difficulties faced in assessing multilingual learners for dyslexia? We come across several factors which are again confusing.

First ,

- Is the difficulties faced by the individuals due to dyslexia or that they are learning a new language such as English.
- Is the established language interfering or influencing the second language learning.
- If the individual had minimal schooling , then that will also influence the performance in the assessment.

  So, to make a proper diagnosis, consideration of these points becomes necessary to prepare a detailed profile of the individual. Information regarding any difficulties faced in their own language ,details about the structure of first language , educational and language background of the individual, the length of time of exposure to English , level of spoken English compared to reading and writing skill in English must be obtained. Also taking into account the other evidences from normal tests for Dyslexia, and thus drawing conclusions will make it possible to give a multilingual individual with reading and writing difficulties access to a fair dyslexia diagnosis and intervention as received by English peers in foreign countries.

Review of literature

Indicators of Developmental Dyslexia

Marja Laasonen , Sami Leppamaki, Laura Hokkanen conducted a study to compare adults with dyslexia , with attention deficit / hyperactivity disorder (ADHD) and adults with dyslexia together with ADHD. They proposed an assessment battery with the following domains : Adult Reading History questionnarie(ARH; Lefly and Pennington,2000); attention deficit scale; Cognitive function assessing immediate and delayed memory using word lists , letter number sequencing , logical memory and forward and backward digit span; attention by color trails test(D'Elia, Staz, Uchiyama, and White, 1996); continuous performance tests (Conners, 2004); phonological processing including awareness, memory and naming; reading and spelling with three sub domains- technical reading (which included word list, nonsense word list, reading aloud and narrative text), reading comprehension (included searching for nonsense word in a story), spelling (included nonsense word reading) and mathematics.

In the finding they characterized the dyslexics as well as ADHD and also common group, the main finding were both population showed a significant impairment in processing speed in which apparently deficit was emphasized more in dyslexics. They quoted one of their early finding(unpublished results of the data by Laasonen,2002) in which dyslexics when compared to typical population showed statistically significant difference in various areas of processing speed such as in confrontation naming ,temporal processing , non verbal logics and prominently in reading speed.

They also added on the difficulties in phonological processing as one of the major indicators of Dyslexia. They further reported that dyslexics exhibited poor scores in backward and forward digit span, thus implying the difficulty in working memory specific to dyslexics relative to typically developing individuals supporting earlier literature.

Again in following year in a Project DYADD , Laasonen.M. et al.(2010) published another study to investigate the domains affected in phonological processing, spelling and reading in individuals with reading and writing difficulties. She considered 110 adults and sub grouped them i.e. individuals with dyslexia, ADHD and other typical adults. In this study, five main domains were considered i.e. phonological processing, technical reading, reading comprehension, spelling and arithmetic.

They found that in individuals with dyslexia, some aspects like accuracy of awareness, memory and speed of naming was affected in phonological processing domain showing a significant difference from controls.

There were many more research work reported give us a profile of Individual with dyslexia.

A study by Catherine C.B. Griffiths (2007) examined compensated group of adults with dyslexia within the age bracket of 18 to 45 years in comparison to age matched typical population to check whether these individuals showed any deficit in pragmatics such as any kind of social interaction in group demands, an efficient working memory and attention with a good language processing speech. So she suspected that

overload of contents to be processed and memory may lead these individuals to fail to interpret the pragmatic contents when compared to typical peers.

Adults with dyslexia are reported to have shown deficiency in situations of pressure and stress such as in "public speaking" where they may need their skills of organizing and sentence construction to be used simultaneously. She quoted Hoien and Lundberg(2000) who pointed that in individuals with mild dyslexia , phonological deficits may not be prominent until and unless intense demand in placed on the skill , which is usually faced by them in higher educational level or job scenarios where they would have to present their own ideas to explain themselves which is expected in a short social time gap. The need of multi-tasking at this level also makes their deficits prominent secondary to their Automatisation deficit (Fawcett and Nicolson,1994) . Another deficit which may affect pragmatics in these individuals could be the difficulty in finding the right word (Chinn and Crossman,1995) which leaves them at a disadvantage due to misperception, misjudgment within the social circle. So in this study 20 students (pre diagnosed with dyslexia) and 20 typical students were included as subjects. Seven subtest were used from Dyslexia adult screening test(Fawcett and Nicolson ,1998) in order to examine working memory and other dyslexic evidences. To assess pragmatic competence , Right Hemisphere Language Battery (Bryan,1995) was used. And a questionnaire was also used to get a detailed history of all the subjects. The domains used from DAST were :

- Rapid naming: due to well established automatization deficit ,dyslexics were expected to be slower than normal group in this task.

- Phonemic segmentation and spoonerism: due to poor memory skills and processing speed, individuals with dyslexia are said to persist in their deficits in phonological skills to adulthood and spoonerism making the task more challenging and thus it becomes a classic task to assess these individuals.
- Backward Digit task : again due to poor working memory skills backward counting of digits is considered one of the sensitive pointers to dyslexia.
- Nonsense passage reading: reading the non meaningful word is reported to be difficult in these individuals secondary to their deficit in orthographic analysis skills.
- Verbal fluency and semantic fluency: because of the anxiety and word finding difficulty this task is difficult for the individuals with dyslexia when compared to normal peers.

  The domains to assess high level pragmatics in RHLB were metaphor picture test, written metaphor test, comprehension of inferred meaning test and appreciation of humor test.

Results according to DAST indicated all the adults with dyslexia in high risk quotient though 75% of them were in the mild level. Everyone in the typical population obtained scores placing them into category of 'no sign of dyslexia'. When correlated with scores of RHLB, they found that there was increased impairment of pragmatics as the at risk quotients increased .these results supported by other studies by Smith-Spark, Fawcett ,Nicolson and Fisk(2001) who examined the cognitive abilities and distractibility in individuals with dyslexia and found a significant difference from the normal peers considered.

Ramus et al.,(2003) studied the deficits in university students with DD, 32 subjects were considered . Out of whom 16 students showed prominent phonological deficits, 10 exhibited auditory deficits and all other individuals showed deficits in other domains such as visual and motor skills, understanding of environmental stimulus, working memory. For this reason of heterogeneity identification of individuals with dyslexia becomes challenging in adulthood due to acquired compensatory strategies and different time period of intervention and intensity and practice of techniques in intervention.

M. Patel, M. Magnusson, D. Lush, S. Gomezand P. A. Fransson 2010 conducted a study to know the affects of postural control. The study considered adults with Dyslexia using the adult Dyslexia checklist (ADCL) ,comparing them with typical population, another aim was ti investigate the correlation between the scores of ADCL and postural stability. He also mentioned about the theory proposed by Stoodley, Fawcett , Nicolson and Stein,(2005) i.e. cerebellar hypopthesis, which states in individuals with dyslexia the functions of the cerebellum in affected mildly, being the central to the coordination and smoothness of movements(Diedrichsen Cricimagna- hemminger, and Shadmehr,2007) and responsible for balance responses, modulating the time and amplitude of any movement made by the body. In cerebellar hypothesis of Dyslexia, the deficits in motor and coordination involves speech articulation also leading to deficits in phonological representations, poor skills in reading and writing.(Ramus etal.,2003).

The cerebellar hypothesis states that the failure to automate the postural controls, and also increases the requirement of attentional resources to keep the control on postural

stability , however Dyslexics have attention deficits (Nicolson and Fawcett, 1990) which may leave them with less attentional resources for maintaining the postural stability.

The study had 53 adults aged between 18 to 25 years with a average mass of 68kgs and average height of 168 cm , 14 of these participants were diagnosed as dyslexics. To divide the population in to two groups of dyslexics and non dyslexics, ADCL (Vinegrad,1994) was administered on each individual.

In results it was found that there good correlation between the score of ADCL and torque variance. Keeping the review by several other authors, study gave a conclusion that the individuals with high ADCL scores may experience balance deficits.

Another study reported by Menghini. D.. Carlesimo .G .A., Marotta .L., Finzi .A., Vicari .S.(2010) investigate whether the deficits in learning in individuals with dyslexia was limited to verbal component of the long term memory or also involved visual-spatial and visual- objects domains too, they also investigated the value of non verbal long term memory abilities with respect to non word and real word reading in individuals with dyslexia.

They supported their study by a strong review pointing the characteristics of individuals with dyslexia , namely auditory processing deficits (Tallal,1980),attention deficits(facoetti , Paganoni, Turatto, Marzola and Mascetti, 2000), information processing deficits (Nicolson and Fawcett,1995), deficits in Visuo-spatial skills in complex working memory tasks(Smith-Spark, Fisk, Fawcett and Nicolson, 2003), difficulty in analyzing and processing the phonological characteristics of the spoken words (Snowling, 1987;Snow , Burns and Griffin, 1998), all of these indicated that

individual with DD may be associated with multiple cognitive disorders (pennington,2006).

In this study two groups of individuals were examined, the first group consisted 60 members who were pre diagnosed as individuals with dyslexia and second consisted 65 member of typical population. General intelligence tests and reading assessments were carried out on each subject. The test used for reading assessment was 'The Battery for the Diagnosis of Dyslexia and Dysorthographia '(Sartori et al., 1995) ; two subtest s were chosen from the test ,one with 4 lists of 28 concrete and abstract , high and low frequency words and another included 4 lists of 16 legal non-words, the number of errors and the average speed in reading words were recorded and analyzed as a measure of inefficient reading. Results indicated a impairment of the episodic LTM capacities in dyslexics. They also reported that younger children scored consistently lower than the older group confirming that the learning abilities increase with the age, though they also mentioned the better performance of the older children was only observe in the visual- spatial and object task but not in the word list task which they accounted to the words being not familiar to the age group, but otherwise considering the main aim of the study they found the dyslexics scored lower scores than the typical population on all the task independent of the age , suggesting a impairment in memory in all the individuals with DD at all the ages considered.

Angela J.Fawcett and Roderick L. Nicolson has presented an extensive work Developmental Dyslexia across the ages. One of the chapters by Angela J. Fawcett about outlining the progress made in various aspects in the field of Dyslexia, suggested that with adults suspected dyslexia , a more descriptive screening and expert subsequent

assessment must be used emphazing more on job related difficulties. The chapter explains dyslexia at three levels – biological, cognitive and behavioral (Firth, 1997); working memory, phonological awareness, automatisation and slow processing speed is explained in the cognitive level, poor reading symptoms and rhyming deficits in behavioral level and the reported abnormalities found in cortical language areas , magnocellular pathways and cerebellum in biological level.

They explored all the manifestation of dyslexia stepping across the limit of phonological difficulties. They formulated and confirmed their hypothesis automatisation deficit in individuals with dyslexia; they found that these individuals did show a deficit in balance when prevented from concentrating on the task by asking them to perform two commands simultaneously.

Then in another study (Nicolson et al.,1999a) they performed PET scan on the adults with dyslexia and compared them to typical adults and found that adults with dyslexia showed only 10 to 20% activation of cerebellum when compared to the controls, which supported cerebellar deficit hypothesis which added on to the casual chain of dyslexic characteristics like phonological deficits. Organizing the findings (Nicolson and Fawcett,1999) gave a ontogenetic chain explaining the individuals with dyslexics which was as follows – cerebellar impairment led to balance impairment and motor skill impairment which may be the cause of writing difficulties in individuals with dyslexia; cerebro cerebellar loop led to problems in automatising skill and knowledge which in combination with effected word recognition module caused difficulty in spelling formations and combination of effected cerebellar and cerebro cerebellar loop affected

articulatory skills which in turn caused impaired phonological awareness causing major difficulties in reading abilities.

They also reported other impairments like motion sensitivity, rapid auditory discrimination, they also say that individuals with dyslexia may show good non verbal reasoning , vocabulary and other problem solving skills, though it may not be clear that these strengths are specific to the types of dyslexia.

In case of adolescents and adults they reported other surface findings like poor work presentation, declining performance profile under strict time schedule, difficulty in holding on information in memory and manipulating it, problems in organizational skills and the ability to check work.

These authors have given a series of screening tests for all ages – the preschool screening test for age range 3.5 to 4.5(Fawcett, Nicolson and Lee,2003), the dyslexia early screening test for age range of 4.5 to 6.5 years, the dyslexia screening test for age range 6.5 to 16.5 years(Fawcett and Nicolson ,1996, 2004a, 2004b) and the dyslexia adult screening test for age range 16.5 to 65 years(Fawcett and Nicolson , 1998) ; considering all the domains found relevant to dyslexia from their numerous findings. These test include following subtests such as :

Phonological discrimination, forward and backward digit span, sound order, rhyming, vocabulary, first letter sound, shape and letter copying, postural stability, Digit naming, repetition.

They also recommend certain early tests which could provide a deeper analysis of some narrow range of specific skills. Phonological abilities test (Mutter et al.,1997) , Pre

reading inventory of phonological awareness, PIPA(Dodd et al.,2003). Earlier discussed Assessment of Language and Literacy (Lombardino et al.,2005) for assessing early literacy skills.

They express the need of the cross linguistic research and need to identify commonalities between dyslexia in different languages with an aim to search for positive indicators of dyslexia in different languages. They suggest that a battery must be planned including all the fundamental tests which could examine all the aspect of performance and crossing the limitation of multilingualism.

All of the studies quoted above gives us an elaborate review on the most sensitive indicators for Developmental Dyslexia, namely

- Impairment in processing speed
- Difficulties in phonological processing
- The difficulty in working memory specific to dyslexic relative difficulties
- Aspects like accuracy of awareness, memory and speed of naming are affected in phonological processing domain
- Deficiency in situations of pressure and stress such as in ”public speaking” where they may need their skills of organizing and sentence construction to be used simultaneously.
- Poor working memory skills
- Deficit in orthographic analysis skills
- Word finding difficulty
- Deficits in domains such as visual and motor skills

- Difficulty in understanding of environmental stimulus
- Balance deficits
- Information processing deficits
- Auditory processing deficits
- Deficits in Visuo-spatial skills in complex working memory tasks
- Difficulty in analyzing and processing the phonological characteristics of the spoken words
- Poor reading symptoms and rhyming deficits
- Automatisation deficit
- Impairments like motion sensitivity, rapid auditory discrimination
- Surface findings like poor work presentation, declining performance profile under strict time schedule, difficulty in holding on information in memory and manipulating it, problems in organizational skills and the ability to check work.

Do these characteristics persist in Adulthood ?

An attempt by Richard L.Sparks and Benjamin J.Lovett, 2009 to update the review of literature on college going population who were classified as learning disabled gave an elaborate overview on the diagnostic procedure used to assess reading difficulties to give a valid diagnoses, the most common ones were Woodcock-johnson tests of achievement, Nelson- Denny reading test , only specific domains reading, mathematics and written language were emphasized .

Amongst one of the findings they reported that many of the students were only diagnosed as learning disabled after entering post secondary education and one of the

reason may be that those students were compensated achievers in their academic skills and also these difficulties were more evident at the point advanced level of education demanding good reading comprehension skills.

They also reported that many of the studies reviewed, failed to give an empirical based diagnostic criteria for learning disability, the definition used for defining the individuals with learning disability at postsecondary level of education was heterogeneous, which at results showed discrepancy labeling few students as learning disabled who reported no history of any academic difficulty. So this statement implies that the population of the individuals with Developmental dyslexia should be assessed keeping the most general characteristics reported for this disability as in due course of the age, Individuals with dyslexia may would have learnt strategies to compensate for their difficulties to cope with day to day increasing challenges, though they may not be successful in compensating for all the difficulties secondary to their impairment.

Undheim, A.M., (2009) carried out an extensive research by conducting a thirteen-year follow up study of young Norwegian adults who were diagnosed as having dyslexia at ten years of age in the domains of reading and educational levels. It is a but widely accepted fact that more research has been done in the area of childhood dyslexia but this has unfortunately not translated into evidence documenting the problems that these children continue to face into young adulthood.

Thus this longitudinal study aimed at documenting the performance of the 21 young adults who were presently twenty three and had been diagnosed as having dyslexia at age ten. Due to the non availability of reading and spelling ability norms of young

adults, the norms of 12-14 year olds was utilized as the cut off score and any score below these norms was considered to indicate reading and spelling problems.

To evaluate the reading, spelling and decoding abilities of the young adults the followings tests were carried out:

- a reading comprehension test

- Reading of 400 single words, each word followed by presentation of four figure drawings and selection of appropriate figure task

- Speed of reading 72 single words correctly

- Speed of reading 36 three, five and seven letter non words each presented for 5 seconds

- Spelling task at word and sentence level

School and work history details was obtained by having the subjects respond to 48 closed ended questions

Results of the study show that dyslexia impairments persisted into adulthood for all the 21 subjects except for two subjects and thus the findings of this extensive longitudinal study supports the hypothesis that dyslexia in childhood persists into adulthood.

Dyslexia in Bi/Multilingual individuals.

Joshi , R.M., Padakannaya ,P., Nishanimath,S.(2010) studied the nature of reading difficulties in two individuals who were bilinguals with their first language as kannada and second language as English, which vary in their orthographic depth and script layout.

One of the individual had Hyperlexia and another one had Dyslexia. The influence of orthographies on reading was explained by "Orthographic depth hypothesis(ODH)"(Frost,Katz, and Bentin,1987) which states that recognition in shallow orthographies is mediated by phonemic cues generated prelexically by grapheme to phoneme transalation , it is defined as the relation between the orthography and phonology of the written word, which influences the rate and ease with which literacy skills are acquired. Critchey(1970) reported about three bilingual individual with dyslexia , one spoke Hebrew as first language and other two spoke Arabic as first language with English as second language. He reported that all the three subjects made analogous errors in their first language , those errors were more as visual errors than in English. There are other older studies like obler(1984) concluded that if a person was dyslexic in one language then he/she is by rule dyslexic in the second language. But studies by Wydell and Butterworth (1999) reported that the impairment was not dependent about the sequence of language learnt but it was dependent on the structure of the languages as in his study a bilingual individual with dyslexia showed dyslexic component in English but not in Japanese which was his second language. Karanth (1992) reported a study on a bilingual (English- kannada) and a trilingual (English-Hindi-kannada). Both the individuals had difficulty in reading and writing of all the three languages, the errors exhibited were analyzed in both subjects in all the languages which led to a conclusion that the irregular feature that contribute to the reading difficulty and the severity of the reading difficulty appeared to be linked to the amount of irregularity in the script.

In the study two 16 year old bilinguals ,one was Hyperlexia and another dyslexic ,they were compared to eight typical group ,3 were 10 years old, 3 were 16 years, 2

were14 years , the years of training in each language was recorded. Various test instruments were used to assess the skill of mental ability, decoding, comprehension, spelling and dictation, speed of processing and phonological in both the languages.

Results showed that the individual with dyslexia showed dyslexic features in both the language, his decoding ability was poor compared to listening and reading comprehension, decoding problem was seen in phonemic level in English and not at syllabic level as in Kannada. So it was concluded that in spite of orthography being different in both languages, the errors were consistent. Other finding stated that in case of bilinguals, difficulty in reading in one or both the language depends on the "orthographic distance" of the two languages, if the orthography is similar in two languages then the difficulty may be observed in both the languages but if the orthography was far apart then impairment may be observed in one and not in other language.

Linder, De Renzi, and Richman(1985) reported the prevalence of Developmental Dyslexia in the school population was found varied across languages of various countries, it was higher in languages with non transparent orthography and lower for orthography which had strict rule grapheme – phoneme correspondence.

The authors Helland and Kaasa (2004) focused their study on cross cultural communication in Norwegian 12 year old children with dyslexia having English as their L2 language compared to an age and gender matched control group. They study aimed at understanding how Norwegian dyslexics learn English as a second language. The authors emphasize on the relationship between a diagnoses of mixed receptive – expressive language disorder (DSM – IV, 1994) and persistence of this as dyslexia in later school

years. These authors believe that since dyslexia is by definition a constitutional impairment based on language mainly, the differences in verbal skills between languages can be contrasted significantly in children with dyslexia.

The method adopted seeks to reflect how dyslexic Norwegian pupils perform in English as L2 and for this an appropriate test battery was created. The test battery developed assessed L2 English in two parts each having three subtests as:

1) Verbal skills

- Receptive language

- Expressive language

- Pragmatics

2) Literacy skills

- Spelling

- Reading

- Translation

The findings of the study firstly indicate that there were significant differences between the control group and the dyslexia group in skills of morphology, syntax, semantics and orthography. Secondly the comprehension skills were a valid marker to differentiate between control group and dyslexia group. Thirdly, the scores on the test battery indicated which areas in the transition from L1 to English as the L2 were problematic.

Screening tests available for assessment for adults with dyslexia

An apt screening tool is expected to include tests to assess maximum of the important indicators of the impairment and also each task in the test is expected to be sensitive enough to identify minimum level of impairment. Many screening test were proposed but only few include all the important domains to assess the major indicators, they are:

Singleton, C., Horne, J. and Simmons, F. (2009) examined an alternative approach to dyslexia screening, using three tests that depend heavily on phonological processing, lexical access and working memory, but which are not conventional measures of literacy. They compared 69adult dyslexic students with non dyslexic from same university and the results showed that the dyslexic and non-dyslexic groups were significantly different on all three computer-based tests, with an average effect size of 1.55 and sensitivity rate of 90.6% and a specificity rate of 90.0%.

A study by Re, A. M., Tressoldi, P. E., Cornoldi, C. and Lucangeli, D. (2011) reported that measures of phonological automaticity are the best indexes of reading decoding competence, particularly in adults. They attempted to validate their self developed Battery for the Assessment of Reading and Writing in Adulthood through comparison of the performance of 24 university students with a history of severe developmental dyslexia and 99 controls. All the reading, writing, lexical decision and spelling tasks of the battery, except omissions in a lexical decision task and reading comprehension, showed a good discriminatory power. In addition, use of just two of these tasks (fluency in reading a text and spelling under articulatory suppression) gave 87% sensitivity and 97% specificity.

In a very recent study Kane,T.S., Walker,J.H., Schmidt,G.R. in 2011 described the development and validation of Learning Difficulties Assessment (LDA) which is web based survey to assess the perceived difficulties with reading , writing , spelling , mathematics, listening, concentration, memory , organizational skills , sense of controls, and anxiety in university level students. The data of the study was collected across 5 years in order to validate the instrument as a screening tool for learning disabled as well as ADHD, the study had four aim, first to map individuals learning strengths and weakness , second to provide users wuth a comparative sense of their academic skills , third to integrate research in user –interface design to assist those with reading and learning difficulties and fourth to indentify individuals who are at risk for impairment .

This study concentrated on learning disabled as whole not specifically one of the learning disability in reading i.e. Dyslexia., though as the dyslexia was found to be the most common learning disability, reading ability was focused in the test. They report that there is a lack of research regarding the assessment of collage level learning difficulties and development of college level screening tools, one of which they mentioned was DAST(Fawcett and Nicolson,1998) which is normed on the British college population and they also pointed on the concerns expressed regarding DAST by Harrison and Nichols(2005).

They made a team of LD specialist, disability service providers and psychologist and pooled subscales constructs that represented the college level learning skills and challenges. The test was administered on 267 participants seeking the assessment of a possible LD and /or ADHD at a university based learning disorder clinic in a time span of 5 years. The group was divided later after test, 32% of participants were grouped into one

group which did not show scores for ‘at risk’ and other 182 participants were grouped into second group who were at risk and then group b had to undergo extensive standardized test like diagnostic and Statistical manual of mental disorders, Woodcock-Johnson test of achievement to assess the target domains .results showed 64% sensitivity to assess Learning Disability.

Fawcett and Nicolson (1998) published “The Dyslexia Adult Screening Test”(DAST) covering a age bracket of 16 to 65 years, it was based on their test Dyslexia Screening Test (DST) (Fawcett and Nicolson,1996) which was normed on a population of 800 individuals, This test consists of 11 domains including both weakness and strengths of the individuals with dyslexia giving both test of attainment and diagnostic tests. The test domains such as one minute reading, two minute spelling, one minute writing, mainly provided with the details on spelling fluency or writing speed. These were stated as tests of attainment as these cover the three critical requirements for impairment ion dyslexia, these could also provide evidence relating to examination concessions for adult in education system. Other diagnostic test domains were rapid naming, postural stability, phonemic segmentation, backward digit span, nonsense passage reading, verbal and semantic fluency. These include all the important positive indicators for developmental dyslexia in comparison to all other test mentioned in above review.

For the purpose of preparation of the ’at risk’ score, to get the norms , each sub domain was administered on 550 students from the university of Sheffield. There were different score prepared for the general population as well as students. To make the scoring easy for the screening tool they split the percentile into five categories namely

triple minus (---) indicating highly at risk , (--) for high risk ,(-) at risk,(0) normal performance, (+) well above average. The scoring procedure was to get the raw scores for each domain according to the bonus and penalty criteria suggested and compare it in each domain and obtaining the at risk score for each domain from the at risk index provided for that particular age range and finally calculate the "At risk quotient" which gives the' at risk cut-off'. The test also provided a record form which could give a descriptive profile of each client to select the individualized goals for intervention.

Harrison, A. G. and Nichols, E. (2005) investigated the ability of the Dyslexia Adult Screening Test (DAST) to discriminate between Specific learning disabled and typical population. Results indicated that the DAST correctly identified 74% of the students with SLDs as 'highly at risk' for dyslexia. They gave a detailed critical evaluation report on DAST , pointing the strengths and weakness of the test . After the analysis of the test stimuli and scoring, they suggested recalculation of DAST, removal of the domain- postural stability because of least consistent & lowest inter-rater agreement, removal of subtests with largest group overlap, removal of subjects with non verbal learning disability , also recalculation of ARQ based on 7 subtests and also reconsideration of the normative and cutoff scores and the subtest composition may facilitate critical adjustments needed to increase the hit rate and reduce the false alarm rate of the DAST. The use of a larger sample of dyslexic participants in any recalibration would likely result in more stable incidence rates, hit rates, and false alarm rates across different populations. A preliminary exploration of the implications of recalculating normative scores and cutoffs in order to improve the scoring criteria of the DAST was attempted in the study. Despite its limitations, the relatively high hit rates attainable by

the DAST suggested that this instrument has great promise as a tool that can be both efficient and cost-effective given further refinement and validation.

So in country like India where bilingual and multilingual population account for 80 to 90 % of the total population, it is imperative to have a tool for screening dyslexia that caters to the diverse needs of the ever growing bilinguals and multilingual population. There is an immediate need for screening tool for dyslexia foe adults with reading and writing difficulties as there are no screening measures for adult population while there are many tools for children.

Method

Aim:

The aim of the study was to construct a screening tool for bilingual/ multi lingual adults with Dyslexia for Indian population.

Material development:

As this study aimed at constructing a screening tool for bi/multilingual adults with dyslexia (age range – 16 to 21 years), the review constituted a vital part and the first step of the study.

Item pooling:

A review about the characteristics observed in adults with developmental Dyslexia were obtained through various sources such as the following: ,

-Dyslexia assessment tools ,

- Different formats and protocols

- Journal articles

- Web based search was employed.

All of these items were then classified under eleven domains selected from Dyslexia Adult Screening Test (DAST) (Fawcett and Nicolson ,1998)

Subjects:

60 typical participants (meeting inclusion criteria) and age matched 15 individuals pre -diagnosed as dyslexia was considered for the study.

Typical Subject inclusion criteria**:**

- Participants in all the groups were in the age range of 16-21years.
- They had vision and hearing acuity within normal limits respectively.
- For the typical developing group the history of neurological and psychological disorders was ruled out by using the WHO ten questions disability screening checklist. (Singhi, et. al 2007)
- All the participants were rated for proficiency in their known languages on the International Second Language Proficiency Rating scale (ISLPR) (Wylie & Ingram 2006).
- Multilingual (Kannada, English, Hindi) population with proficiency measured in these three languages were considered. Proficiency was measured in percentage for each language and these results were considered while interpreting the data.
- Population who were categorized as the 'last rankers' when graded on academic performance and were considered following a ratio of 1:6 to the other students with good performance in academic scores.
- The participants were selected from various English medium schools and colleges in and around Mysore city.

Individuals with dyslexia inclusion criteria

- Participants in all the groups were in the age range of 16-21years.
- They had vision and hearing acuity within normal limits.
- The diagnosis of Dyslexia was confirmed by both Speech Language Pathologist and clinical psychologist in childhood.
- Participants with Dyslexia were checked as to whether they have a history of delayed speech and language milestones or a diagnosis of Specific language impairment. The same was noted for analysis and interpretation.
- The participants were selected from various English medium schools and colleges in and around Mysore city.
- The treatment undertaken by participants with Dyslexia was be noted and an interpretation was made accordingly.

Procedure:

The study was carried in three main phases, as follows:

I. Phase : 1

This phase included the development of the screening tool considering the elaborate review about the best indicators of Dyslexia, following this the domains of the test from Dyslexia Adult Screening test(DAST) given by Fawcett and Nicolson(1998) were selected. The domains selected were based on the extensive literature review done as the best indicators of dyslexia. The domains included were:

- Rapid naming
- One minute reading
- Postural stability

- Phonetic segment
- Two Minute Spelling
- Backward span
- Non sense passage
- Non verbal Reasoning
- One minute writing
- Verbal Fluency
- Semantic fluency

Then each of the sub tests was constructed to suit the Indian population. For this purpose , after preparation of the stimulus in all the domains, the subtest stimuli was given to a population of 30 typically developing individuals . The criteria considered to select those subjects were:

- They should be within the age bracket of 16 to 21years to match the educational level of the typical subjects considered for the main study.
- They should be multilingual with their first language as Kannada, second language as English and third language as Hindi.

Further method of pilot study will be explained under each domain.

1) Rapid naming test:

Thirty pictures were selected from Hundred Picture Naming Test (HPNT), Fisher, J.P. and Glenister, J.M., (1992). The pictures were selected on the basis of frequency of the target occurring in daily life in the Indian scenario. After the pictures were selected it was given to 30 subjects participating in the pilot study. They were given a rating scale to rate the pictures on familiarity and frequency i.e. it is very common, common, rare, very

rare; and also write the name of each picture in Kannada, English as well as Hindi. Names in these three languages were obtained in order to make a list of common names for the targets in pictures.

After the study, results were analyzed, and the pictures which were rated as common were considered for the main test instead of "very common" category to keep the test adequately challenging and age appropriate.

Once the final list of the pictures was prepared, one answer key was also prepared for the clinician with list of names of the picture in all three languages (Kannada, English and Hindi) as per the order in stimuli card.

2) One minute reading

The list of 120 words from one minute reading test of DAST (Fawcett and Nicolson, 1998) was given to the 30 subjects and they were asked to rate those words in the rating scale provided as - very common, common, rare, not heard. Out of 120 words 25 words were in the category from rare to not heard of. These words were then replaced by few other syllabically equal words which were also rated as common by the 30 subjects of the pilot study.

3) Postural stability

The main focus in this subtest was to check for any balance problem supporting the cerebellar hypothesis. One subtest from the Quick Neurological Screening Test (QNST) was taken up as the task in this domain. i.e.,

- Tandem Walk

Heel-to-toe walking was performed satisfactorily in 100% of normal school aged children. Backward tandem walking is a skill not acquired until 7 years of age. Failure is an indicator of cerebellar-vestibular dysfunction.

4) Phonemic Segmentation

This sub test was divided into two sub parts- Segmentation and Spoonerism.

In the first sub test, out of the 12words From DAST, 9 words were replaced by syllabically equal words which were more familiar to the Indian context.

In the second sub test three names of famous personalities were chosen from the Indian scenario for spoonerism task where the subjects had to swap round the beginning of each word. These names were chosen from famous personalities to make it a meaningful utterance to the subjects.

After the preparation of the stimulus the words of both the sub tests were given to the 30 subjects from pilot study to rate the words on the familiarity rating scale of very common to rare. All the subjects rated all the words in common category, so the test was finalized accordingly.

5) Two minute spelling:

Thirty two word list was prepared which included words ranging from bisyllabic to multisyllabic words in an increasing order, i.e., from easy to complex. These words were given to the 30subjects to rate on the scale of 1 to 4 i.e. very easy to challenging. The stimuli was then finalized accordingly.

6) Backward Digit span

This subtest was adapted from the subtest of DAST i.e. backward digit span with the same stimuli as it involves numbers and does not differ culturally.

7) Non sense passage

A 74 words passage was selected from Indian context, 15 words from the passage were selected and the positions of the phonemes were interchanged to prepare non sense words. For example: a word such as “crocodile” was changed to “docrolice”. The nonsense words prepared were arranged into the passage and the passage was given to 30 subjects to identify the nonsense words. All the 30 subjects were able to identify 15 nonsense words in the passage.

8) Non verbal Reasoning

The subtest was adapted from the subtest of DAST i.e., non verbal reasoning with same stimuli [With prior written permission from the authors(Fawcett & Nicolson,1988)]. The time given for each test was one minute instead of one minute thirty seconds as in DAST.

9) One Minute Writing

The rainbow passage given by the author Grant Fairbanks was taken as the stimuli for the subtest wherein only first 50 words were considered from the passage. The passage was given to 30 subjects to rate as very easy, easy, complex, and very complex. All the subjects rated the passage as easy based on the word and sentence complexity levels.

10) Verbal Fluency

The Verbal fluency task was adapted as it is from DAST, wherein the subjects were asked to name as many words they can think of starting from the letter /s/ or sounds ‘suh’ in one minute.

11) Semantic Fluency

The semantic fluency task was adapted as it is from DAST, wherein the subjects were asked to name as many animals as they can think of in one minute.

SCORING FOR 'At risk quotient'

Since the scoring of all the subtests in the present study followed the scoring pattern as it is in DAST, the 'at risk quotient index' was also adapted from DAST.

[Please refer appendix:3 for the At risk index]

The test procedure is as follows:

The present screening tool for bi/multilingual adults with dyslexia took 30 minutes in total for complete testing.

[Please refer Appendix: 2 for the test stimuli and answer keys]

Material required was:

- The instruction manual
- The stimuli and answer keys for each domain
- Pencil and record form constructed.

The subjects were informed about the test duration and that there would be 11 tests done. One trial was given prior the testing to make sure the subject had understood the instructions correctly, the client was made comfortable by telling them that they could ask for a break any time during the testing procedure.

The test procedure was carried out in a relatively noise free room with minimal distractions.

The domains were administered in following sequence:

1) Rapid naming test.

The subject was instructed that in this test they would be shown set of pictures and he/she would be asked to name the picture shown as quickly as possible. The subject was encouraged to use which ever language first comes to thoughts.

First the practice card was shown and they were asked to name the picture, after the clinician confirmed the subject has understood the instruction well, main test was administered.

After the timer was set by the clinician, the subject was asked to start naming the picture stimuli shown. When the subject got stuck at any stimuli, after five seconds the clinician helped the subject out.

The total time of the main test excluding the practice session was recorded, for each mistake made, 5 seconds were added to the total time score. The responses in any preferred language was given marks.The final score i.e. time taken +5 seconds for each mistake was considered for the raw score for calculating the at risk quotient.

2) One minute reading

The subject was instructed that in this test the subject will be given few words on the card and he/ she would have to read it aloud. First the subject was given practice card first and was instructed to read it aloud.

Then the main stimuli card was and the subject as asked to read aloud the word and the performance was timed. The clinician had extra copy of the stimuli in which she recorded any mistake made.

Then the scoring was calculated marking 1 mark for each correct response, if the subject read the complete sheet taking less than one minute then bonus was given for every second less than 60 seconds.i.e. if subject took 57 seconds then 3 points were to the total score. So the total score considered was correct words said +any bonus . this total was considered as the raw score for the calculation of at risk quotient.

3) Postural Stability

The subject was informed about both the subtest i.e.

- Rapidly Reversing Repetitive Hand Movements- the subtest was instructed to rotate the hands one after the other in inward movements as fast as possible
- Tandem Walk

The client was asked to walk keeping the toe one in front of other in a line and walk back in the same way keeping one toe behind the other heel.

The scoring was done on a rating scale by clinician:

0- Walked in proper line, back and forth

1- Walked well forward but walked backward in a slant line

2- Walked well forward but lost the balance when walking backward

3- Didn't maintain the walk on a line

4- Lost balance and couldn't walk.

The subjects were rated on the performance and that score was considered as the raw score for the at risk index. But 95% of the subjects , even dyslexic population except for two subjects got the rating as 0 and didn't show any balance problem, so considering the study by Harrison, A. G. and Nichols, E. (2005), this sub section was not considered for the At risk quotient calculation.

4) Phonemic segmentation:

The subject was given examples in order to make them understand the task. When client said a word, then the subject was instructed to break down the word into smaller constituent parts by deleting the syllable or a consonant as asked by the clinician.

Trial was given first. The clinician gave a word "football" and asked the subject to say the word again but without ball. Few more similar examples were given.

Then the main test with 12 words was administered giving the stimuli one by one, and then the second part of the test was introduced where the subject had to swap round the beginning sound of the name given. He/she was given an example for the task i.e. if the name given by the clinician is “Madhuri Dixit” then the expected answer will be “dadhuri mixit”. After the subject understood the task , the target three names were presented timing the test using a timer.

The total score was calculated by total number of correct segmentation plus spoonerism, penalty of 1 mark was given if the subject took more than 50 seconds to complete the whole test(only if at least one spoonerism task was correct)as it indicates considerable difficulty with the task consistent with diagnosis of Dyslexia.

5) Two minute spelling

The subject was provided with a pen and a paper and was instructed that in this task dictation will be given by clinician and the subject would have to write the first thought about the spelling on the paper.

As in all other test the trail was given by dictating few simple words to make the task clear to the subject. Then the main test was given consisting of 32 words. If any subject made more than 2 mistakes in the first set of words then some initial spellings prepared will be dictated.

The scoring was given by 1 mark per correct spelling and if subject didn’t need the extra word set then marks was added to the total score obtained. This was the final score considered for at risk quotient calculation.

6) Backward digit span:

The instruction in this subtest was repeat back the numbers sequence given but in a reverse order. First the trial session was given, the clinician spoke the sequence of number as in 1sec per number, the subject was to repeat it in reverse order. Once the instructions were clear to the subject , the main test was administered in similar manner, no prompts were given.

The scoring was calculated considering total number correct sequences repeated in the main test, same was considered as the raw score for the at risk quotient calculation.

7) Nonsense passage reading

   The subject was instructed that they would be given a passage with a number of nonsense words and meaningful words in it, their task was just ti read it aloud. For practice they were given an example: "godo people dtno drink" and they were asked to read it loud and say pass if they cannot read the non sense word and move to next word. The test was timed.

   After the instructions were clear the subject was given the target passage as part of main test.

   Scoring was as follows: 1 mark for each correct word read and 2 marks for each nonsense word read correctly, one mark if at least a close try. If the time taken was less than 1 minute and minimum of 11 to 15 non sense words were correct then 1 extra marks for each 2 seconds under the minute, if the time taken was over a minute then 1 mark was subtracted for every 2 second above a minute. The addition total marks and the bonus minus the penalty was considered as the final raw score for the calculation of the at risk quotient.

8) Nonverbal reasoning

There are three subsections of this test:

Question 1to 3 – the next one in the sentence- the subject were shown the card and asked workout which was the next in the sequence, first a practice card was shown and later the main card. In total 90 seconds were given for three questions.

Question 4 to 6- analogies (A is to B as C is to ?)- Similar to last task first the subject given a practice and then main cards. In total 1 min 30 seconds for the three questions.

Question 7 to 8- two versus three's – In these set of question they instructed that out of 5 pictures , two of them can be split into pair and other in another group. Similar to last two tasks, the subject was given the practice figure and then the main test was given. In total 1 minute was given for three questions.

Each correct answer was given 1 mark making the total of 9 questions scores as the raw score for at risk calculation.

9) One minute writing

The instruction for this test was to copy down the paragraph presented. First a trial session was given, and the trial was timed to give a feedback to the subject that he/she took this much of time to copy.

After the instruction were clear the rainbow passage prepared a stimuli was presented and the subject was asked to copy it down in provided paper. The test was timed.

The timer was stopped at 60 seconds, if the subject had completed before 60 seconds then the timed left was noted down, the basic score was the number of words completed out of maximum of 50, if the time taken was less than 60 seconds then 1 mark was awarded for every 2 second under 60 seconds, penalty was given if there

were any omitted words or any spelling mistakes, if the handwriting was not legible then more 3 marks were deducted, if there was any mistakes in punctuation then another 2 marks were deducted. After all the bonus and deduction, the score obtained was considered as raw score for the calculation for at risk scores.

10) Verbal fluency

The instruction to the subject was to think of as many words as possible and say it in a minute's time with the particular letter given. A trial was given using the letter 'D' or sound"duh". And later after the instructions were well understood main test was given using the sound's' or sound 'suh'.

One mark was given for each valid word i.e. valid response in English starting with 's' letter and in case of kannada and Hindi starting with sound /suh/.the total scores obtained were considered as raw score for at risk quotient calculation.

11) Semantic Fluency

The instruction to the subject was to think of as many objects in the given category as possible and say it in a minute's time. In the main test ,subject was asked to say as many animals possible in a minute. One mark for each valid response was awarded and the total scores obtained were considered as raw score for at risk quotient calculation.

PHASE: 2

This phase included the Data collection. This phase was divided into two steps.

1) 60 participants falling in the selected criterion were screened using British Dyslexia Association checklist for adult dyslexic (Ian Smythe &John Everatt. 2001). And will be categorized into two groups i.e.

Group –A: typical population, according to the results from checklist consisted of 45 subjects.

Group -B: At risk population, according to the results from checklist consisted of 15 subjects. Amongst which 11 subjects fall in mild category and 4 into severe category. So , group B was further divided into group –B(1) Average and group –B(2) poor.

[For the checklist please refer the appendix: 1]

On the basis of the information from the questions in the checklist and the few general questions asked, A profile was prepared for the group B of the reading and writing problems faced by them.

Table :1 GROUP:B details

	Age/sex	**any difficulty experienced in studies?**	**Difficulty in remembering the matter studied?**	**Has repeated an academic year ?**	**has been through any assesment or thearpy for these problems?**
Group-b(1)	average				
	18/m	Yes	yes	no	no
	17/m	No	yes	no	no
	17/f	No	yes	no	no
	18/m	No	yes	no	no
	20/m	Yes	yes	no	no
	17/m	Yes	yes	no	no
	20/m	No	yes	yes	no
	21/m	Yes	yes	no	no
	16/m	No	yes	no	no
	18/m	No	yes	no	no
	19/m	Yes	yes	no	no
Group-B(2)	poor				
	17/m	Yes	yes	yes	no
	16/m	Yes	yes	yes	no
	17/m	Yes	yes	yes	no
	20/m	Yes	yes	yes	no

Then the prepared main test for screening adults with dyslexia was administered on both groups- A and B. The raw scores were recorded.

2) In the second step of PHASE:2 the third group i.e. the controls, a total of 15 subjects, who fall in subject criteria and were pre diagnosed as having Dyslexia were contacted and a detailed history about the intervention and whereabouts was obtained.

Table :2 Group –C , Adults with dyslexia

Group C(dys)	**age/sex**	**age at which the they were diagnosed as Dyslexics**	**total time period of therapy taken**
	16/m	at age of 10	1 year
	17/m	at age of 9	9 months
	16/m	at age of 10	4 years
	21/m	at age of 10	1.5 years
	19/m	at age of 10	1 year
	18/m	at age of 10	10 months
	16/m	at age of 11	4.5 years
	20/m	at age of 10	1 year
	20/m	at age of 11	8 months
	20/m	at age of 11	2 years
	20/m	at age of 10	1 years
	17/m	at age of 10	3 years
	17/m	at age of 11	7 months
	19/m	at age of 9	9 months
	20/m	at age of 12	8 months

The main test prepared for the screening for the adults with dyslexia was administered on the this group and raw scores were recorded.

PHASE:3

This phase included the calculation of ‘at risk quotient’, the statistical analysis and the final results.

[Please refer to Appendix :4 for sample of record form, certain parts adapted from DAST with prior written permission from the authors(Fawcett & Nicolson,1988)]

The Raw scores obtained from each group for each domain was recorded in the record form provided and then used to get the score on the “at risk index” and At risk scores were made. As 95% of the total subjects including controls performed well on third subtest i.e. postural stability and also considering review, At risk quotient was calculated considering 10 subtest instead 11 excluding score for “postural stability test”.

Statistical analysis:

- The One way MANOVA was done to see the significant difference across all the four groups i.e. group- A, B(1),B(2) and C. Later post doc analysis i.e. Bonaferroni pair wise comparison was done.
- The One way ANOVA was used for “At risk quotient” analysis.

  According to the ‘At risk quotient ‘ obtained the subjects were put in at risk or not at risk for dyslexia. The following criteria was used :ARQ of .7 or more = slightly at risk ARQ of 1 or more = highly at risk

RESULTS AND DISCUSSION

The aim of the present was to develop a screening tool for bi/multilingual adults with dyslexia that would help to identify the positive indicators of developmental dyslexia if any in Bi/multilingual adults in India. A screening tool protocol was developed specific to the present study based on DAST (Fawcett & Nicolson,1998) aiming for a age bracket of 16 to 21 years. Seventy five subjects grouped into 2 main groups or 4 sub groups were administered the screening protocol and the raw score obtained from each of the 11 domains were compared across the groups to check if any significant difference is present between the group.

The data was recorded on record forms provided. At the outset a descriptive analysis of the performance of all the subjects in all the domains was done. The one way MANOVA was done to see the significant difference across all the groups in each domain. And since there was a significant difference seen across the four groups, further post doc analysis i.e. Bonaferroni pair wise comparison was done to profile the significant difference between each two groups.

The results are discussed under following headings:

1) Comparison of each domain across 4 groups.
2) Comparison of "At risk quotient" across four groups.

Comparison of each domain across 4 groups

Domain 1: Rapid Naming

Table :3 Comparison of score in rapid naming domain across four groups:

S. No.	Groups	Mean	SD	f value	P value
1	Normal	15.47	2.029	233.804	0.000 **
2	Average	18.91	0.944	233.804	0.000 **
3	Poor	36.75	0.957	233.804	0.000 **
4	Dyslexics	54.07	10.694	233.804	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

The statistical analysis (table .3)reveals that there was significant difference found in the performance across the four groups in the domain – rapid naming where the subject was assessed on the time taken to name the simple picture cards. The fourth Group of controls i.e. Individual with dyslexia showed the highest mean score which considering the task was the most poor score as it shows that Individuals with dyslexia took more time when assessed on the skills like speed to access lexical access and articulation in comparison to all other groups. The post hoc analysis to compare each two groups showed that there was no significant difference between the scores of normal and Individual with dyslexia but had a significant difference in score when compared to the individuals who scored poor on the test as well as individuals with dyslexia ,control group of the study.

Table.4 Pair – Wise Comparison for rapid naming

S. No.	Groups		P Values
1.	Normal	Average	0.273
	Normal	Poor	0.000**
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.000**
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.000**

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

The findings show that the individuals with dyslexia were slow at naming the simple pictures that tapped skills like lexicon access speed that processing the visual object given and retrieving the name from the lexicon. This finding is supported by Nicolson and Fawcett(1995) who reported that individuals with dyslexia had information processing deficits and Menghini. D.. Carlesimo .G .A., Marotta .L., Finzi .A., Vicari .S.(2010) who reported that individuals with dyslexia also had deficit in visual- spatial as well visual- object domains too.

Domain 2: One-Minute Reading

In the One –minute reading the task was name the words on the given card in a minute which was designed to tap the skill of reading fluency, here we found a significant difference in the performance amongst the four groups. The controls who were pre

diagnosed with dyslexia showed the most poor performance followed by the poor score group and then average score group.

Table.5 Comparison of scores for one minute reading across four groups.

S. No.	Groups	Mean	SD	f value	P value
1	Normal	124.64	6.106	451.296	0.000 **
2	Average	75.36	0.505	451.296	0.000 **
3	Poor	64.00	4.967	451.296	0.000 **
4	LDs	62.27	10.166	451.296	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Pair wise comparison showed that normal's performance was good compared to all other three groups showed a significant difference but Average group compared to poor showed mild difference where as average group compared to individuals with dyslexia showed a significant difference, and also Poor group and the individuals with dyslexia did not show any difference in their performance. The reading loud of the word list needed a fast visual perception and processing speed of the phonemes in the words to enhance the reading speed where phonological processing plays an important role , which was reported as a impaired skill for the individuals with dyslexia by Laasonen (2002) who also found a significant difference in various areas of processing speed , including reading speed in Individuals with dyslexia when compared to typical population.

Table-6: Pair – Wise Comparison for one minute reading

S. No.	Groups		P Values
1.	Normal	Average	0.000**
	Normal	Poor	0.000**
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.028
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	1.000

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 3: Postural Stability

In this domain we found very mild difference in the performance amongst all the groups. In fact out seventy five subjects in total only two subjects who happened to be the individuals pre diagnosed as having dyslexia showed relatively poor score than other groups, 95% of the subjects performed the task accurately with no signs of any dysfunction of cerebellum causing balance problems as reported by Diedrichsen Cricimagna- hemminger, and Shadmehr(2007).

As in the present study was conducted on a small population , it is difficult to make any concrete conclusions, as two subjects though not significant ,did show a slight balance difficulty.

Table- 7 Comparison of the score for postural stability amongst four groups

S. No.	Groups	Mean	SD	f value	P value
1	Normal	0.000	0.000	2.913	0.040
2	Average	0.000	0.000	2.913	0.040
3	Poor	0.000	0.000	2.913	0.040
4	dyslexics	0.13	0.352	2.913	0.040

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

As an account of 2 subjects from Dyslexic group showing minimal difficulty in balance, in pair wise comparison, normal and average group compared to individuals with dyslexia show a significant difference statistically.

Table -8 Pair – Wise Comparison for postural stability

S. No.	Groups		P Values
1.	Normal	Average	1.000
	Normal	Poor	1.000
	Normal	Dyslexics	0.033
2.	Average	Poor	1.000
	Average	Dyslexics	0.210
3.	Poor	Dyslexics	0.803

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 4: Phonetic Segmentation

Performance of all the four groups in phonetic segment which taps phonological skills in an individual ,show a significant difference with individuals with dyslexia showing the minimum score followed by poor group and average group in an increasing order. The pair-wise comparison shows that there is a highly significant difference between the score of normal and scores of the individuals with dyslexia, poor group and the average group. Also between the average and the poor group but the poor and group of individuals with dyslexia were observed to be equally poor. This findings thus second the findings by Snowling (1987);Snow , Burns and Griffin(1998) who reported individuals with dyslexia had difficulty in analyzing and processing the phonological characteristics of the spoken words; Firth(1997) who explained dyslexia at a biological level where in skills like phonological awareness was reported to be poor; Undheim, A.M., (2009) who evaluated decoding abilities in individuals with dyslexia and found that it was affected.

Table -9 Comparison of scores for phonetic segment amongst Four groups.

S. No.	**Groups**	**Mean**	**SD**	**f value**	**P value**
1	Normal	14.90	0.288	139.654	0.000 **
2	Average	12.64	0.505	139.654	0.000 **
3	Poor	7.75	1.500	139.654	0.000 **
4	Dyslexics	7.67	2.743	139.654	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Table- 10 Pair – Wise Comparison for phonetic segmentation

S. No.	Groups		P Values
1.	Normal	Average	0.000 **
	Normal	Poor	0.000 **
	Normal	Dyslexics	0.000 **
2.	Average	Poor	0.000 **
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	1.000

* Significant value if p <0.05 ** Highly significant value if p < 0.01

Domain 5: Two Minute Spelling

Two minute spelling where in the subjects were asked spells the given words correctly to tap the skills of spelling fluency, the performance of all the four groups showed highly significant difference. Normal showed the best scores as expected where as individuals with dyslexia showed poor scores.

Table- 11 Comparison of the scores for the two minute spelling amongst the four groups.

S. No.	Groups	Mean	SD	f value	P value
1	Normal	39.13	1.660	176.044	0.000 **
2	Average	26.64	1.963	176.044	0.000 **
3	Poor	26.50	1.732	176.044	0.000 **
4	Dyslexics	24.27	4.559	176.044	0.000 **

* Significant value if p <0.05 ** Highly significant value if p < 0.01

The pair-wise comparison showed a highly significant difference in between normal and all other three groups, between average and the group of individuals with dyslexia, but there was no significant difference seen in between average group and poor group and also in between poor and individuals with dyslexia. These findings second the findings of Undheim, A.M., (2009) who reported that individuals with dyslexia had deficits in decoding and spelling the given words. Nicolson and Fawcett(1999) also reported based on their cerebral hypothesis that cerebro cerebellar loop led to problems in automatising skill and knowledge which in combination with effected word recognition module caused difficulty in spelling formations.

Table 11 Pair – Wise Comparison for two minute spelling

S. No.	**Groups**		**P Values**
1.	Normal	Average	0.000 **
	Normal	Poor	0.000 **
	Normal	Dyslexics	0.000 **
2.	Average	Poor	1.000
	Average	Dyslexics	0.131
3.	Poor	Dyslexics	0.740

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 6: Backward Digit Span

Backward digit span administered to check the working memory showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores. In pair- wise comparison, there was a

highly significant difference seen in between the normal and other groups. The average and the group of individual with dyslexia also showed a significant difference but average and poor groups show no significant difference, the poor and the group of individual with dyslexia showed a similar score. These findings can be supported by the finding by Nicolson and Fawcett (1999) who reported that adolescents and adults with dyslexia had difficulty in holding on information in memory. Bryan (1995) also suggested that due to poor working memory skills in individuals with dyslexia, backward counting of digits is considered one of the sensitive pointers to dyslexia.

Table- 12 Comparison of the scores for the Backward digit span amongst the four groups.

S. No.	**Groups**	**Mean**	**SD**	**f value**	**P value**
1	Normal	9.82	1.072	141.907	0.000 **
2	Average	6.18	0.405	141.907	0.000 **
3	Poor	5.75	0.500	141.907	0.000 **
4	Dyslexics	5.13	0.352	141.907	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Table- 13Pair – Wise Comparison for Backward digit span.

S. No.	Groups		P Values
1.	Normal	Average	0.000 **
	Normal	Poor	0.000 **
	Normal	Dyslexics	0.000 **
2.	Average	Poor	1.000
	Average	Dyslexics	0.022
3.	Poor	Dyslexics	1.000

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 7: Non Sense Passage

Non sense passage to assess the grapheme- phoneme translation skills showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores. In pair – wise comparison also all the groups showed a highly significant difference. These findings can be supported by the Fawcett and Nicolson(1998) who report that the reading of the non meaningful word to be difficult in the individuals with dyslexia secondary to their deficit in orthographic analysis skills and also decoding difficulty reported by Undheim, A.M., (2009).

Table -14 Comparison of the scores for the Non sense passage amongst the four groups

S. No.	Groups	Mean	SD	f value	P value
1	Normal	99.00	0.000	585.286	0.000 **
2	Average	81.55	0.688	585.286	0.000 **
3	Poor	76.50	3.317	585.286	0.000 **
4	Dyslexics	68.27	5.700	585.286	0.000 **

* Significant value if p <0.05 ** Highly significant value if p < 0.01

Table -15 Pair – Wise Comparison for Non sense passage.

S. No.	Groups		P Values
1.	Normal	Average	0.000**
	Normal	Poor	0.000**
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.010
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.000**

* Significant value if p <0.05 ** Highly significant value if p < 0.01

Domain 8: Non Verbal Reasoning

Non verbal reasoning to test the non verbal learned skills showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores.

Table -16 Comparison of the scores for the Non verbal reasoning amongst the four groups

S. No.	Groups	Mean	SD	f value	P value
1	Normal	6.80	0.505	25.330	0.000 **
2	Average	6.73	0.467	25.330	0.000 **
3	Poor	6.00	1.155	25.330	0.000 **
4	Dyslexics	5.27	0.799	25.330	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

In pair- wise comparison only pair of normal and Individuals with dyslexia ; Average and individuals with dyslexia showed a highly significant difference. The finding thus suggest that individuals with dyslexia are relatively poor in this particular task when compared to normal population, similar findings were reported by Nicolson and Fawcett(1995) who reports individuals with dyslexia have deficits in information processing and analyzing. Smith-Spark, Fisk, Fawcett and Nicolson (2003) reported deficits in Visuo-spatial skills in complex working memory tasks.

Table- 17 Pair – Wise Comparison for non verbal reasoning

S. No.	Groups		P Values
1.	Normal	Average	1.000
	Normal	Poor	0.084
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.267
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.214

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 9: One Minute Writing

One minute writing aiming to assess transcription fluency by assess the number of words of a sentence correctly copied in one minute, showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores.

Table- 18 Comparison of the scores for the one minute writing amongst the four groups

S. No.	Groups	Mean	SD	f value	P value
1	Normal	44.73	1.232	558.446	0.000 **
2	Average	32.18	0.405	558.446	0.000 **
3	Poor	32.00	1.414	558.446	0.000 **
4	Dyslexics	29.07	2.404	558.446	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

In pair- wise comparison, all the pairs except of average versus poor group showed a highly significant difference. The finding thus suggests that individuals with dyslexia are relatively poor in this particular task when compared to normal population . One minute writing involves several tasks such as tracking the line , remembering the spelling and copying it down to the paper, to be done at the same time. According to Catherine C.B. Griffiths (2007) such need of multi-tasking at this level makes deficits in individuals with dyslexia prominent secondary to their Automatisation deficit (Fawcett and Nicolson,1994).

Table- 19 Pair – Wise Comparison for one minute writing

S. No.	**Groups**		**P Values**
1.	Normal	Average	0.000**
	Normal	Poor	0.000**
	Normal	Dyslexics	0.000**
2.	Average	Poor	1.000
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.004

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 10: Verbal Fluency

Verbal fluency aimed to check for fluency in verbal output scanning for the right word. This task showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores though not too prominently less.

Table-20 Comparison of the scores for Verbal fluency amongst all the four groups.

S. No.	Groups	Mean	SD	f value	P value
1	Normal	14.18	0.684	56.997	0.000 **
2	Average	14.09	0.539	56.997	0.000 **
3	Poor	13.00	0.816	56.997	0.000 **
4	Dyslexics	11.00	1.309	56.997	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

In pair- wise comparison only pair of normal and Individuals with dyslexia ; Average and individuals with dyslexia ; poor and group of individuals with dyslexia showed a highly significant difference. The finding thus suggests that individuals with dyslexia are relatively poor in this particular task when compared to normal population. Verbal fluency demands good skill of scanning through the vocabulary in the long term memory lexicon and retrieving the right word quickly, the test id specific to the phonological lexicon and the test is timed , it add to the stress and pressure on the subject. Catherine C.B. Griffiths (2007) reports that adults with dyslexia show deficiency in situations of pressure and stress where they may need their skills of organizing. Laasonen,2002 reported that the individual with dyslexia showed statistically significant difference in various areas of processing speed such as in confrontation naming ,temporal processing when compared to normal population. Menghini. D.. Carlesimo .G .A., Marotta .L., Finzi .A., Vicari .S.(2010) reported an impairment of the episodic LTM capacities in individual with dyslexia .

Table -21 Pair – Wise Comparison for Verbal fluency.

S. No.	Groups		P Values
1.	Normal	Average	1.000
	Normal	Poor	0.051
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.170
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.000**

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Domain 11: Semantic Fluency

Semantic fluency aimed to assess the fluency in retrieval of semantic lexicon by naming the the maximum number of animals in a time constraint of 1 minute. This task showed a highly significant difference amongst the groups all the four groups, poor group and the group of individual with dyslexia showing the least scores though not too prominently less.

Table-22 Comparison of the scores for semantic fluency amongst the four groups.

S. No.	Groups	Mean	SD	f value	P value
1	Normal	15.89	0.775	25.762	0.000 **
2	Average	15.91	1.044	25.762	0.000 **
3	Poor	14.50	0.577	25.762	0.000 **
4	Dyslexics	13.80	0.941	25.762	0.000 **

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

In pair- wise comparison only pair of normal and Individuals with dyslexia; Average and individuals with dyslexia showed a highly significant difference. The finding thus suggests that individuals with dyslexia are relatively poor in this particular task when compared to normal population. Similar to verbal fluency, semantic fluency also demands a good skill of scanning through the vocabulary in the long term memory lexicon and retrieving the right word quickly but in semantic fluency the task is specified to tap the semantic lexicon unlike verbal fluency. Again the test is timed , it add to the stress and pressure on the subject. . Catherine C.B. Griffiths (2007) reports that adults with dyslexia show deficiency in situations of pressure and stress where they may need their skills of organizing. Laasonen,2002 reported that the individual with dyslexia showed statistically significant difference in various areas of processing speed such as in confrontation naming ,temporal processing when compared to normal population. Menghini. D.. Carlesimo .G .A., Marotta .L., Finzi .A., Vicari .S.(2010) reported an impairment of the episodic LTM capacities in individual with dyslexia .

Table- 23 Pair – Wise Comparison for semantic fluency

S. No.	Groups		P Values
1.	Normal	Average	1.000
	Normal	Poor	0.014
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.034
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.874

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

So the above discussed results concluded that all the domains except for the domain-3 i.e. postural stability show a highly significant difference in between the controls and the target population proving to be a positive indicator for dyslexia. Thus when the "At risk quotient" was calculated using the above analyzed raw score with help of the scoring index adapt by the test from DAST (Fawcett and Nicolson,1998) postural stability was not considered .The quotient was calculated by dividing the total of 10 domains scores (except for postural stability) from the scoring index to 10 (total no. of domains considered).

As discussed above no conclusion is possible about the reliability on the postural stability as the present study has been targeted on a very small population. So considering the present scores and the future direction suggested by Harrison, A. G. and Nichols, E. (2005) in his study to validate the Dyslexia Adult Screening Test(DAST) to remove the

postural stability as it was least consistent , postural stability was not considered for the calculation of the “At risk quotient”.

At the at risk criteria decided was : ARQ of 0.7 or more = slightly at risk; ARQ of 1 or more = highly at risk

The results of One way ANOVA analysis was as follows:

Table- 23 Comparison of “At risk quotient” across four groups.

S. no	Groups	N	Mean	SD	F value	P value
1	Normal	45	0.098	.0583	417.004	0.000**
2	average	11	0.891	.0539	417.004	0.000**
3	poor	4	1.750	.2646	417.004	0.000**
4	Dyslexics	15	2.213	.4438	417.004	0.000**

There was highly significant difference seen amongst the four groups .In pair-wise analysis , there was highly significant difference seen in all the groups except for Poor group and group of Individuals with dyslexia showing similar at risk quotients .

Table -24 Pair – Wise Comparison for the at risk quotients

S. No.	Groups		P Values
1.	Normal	Average	0.000**
	Normal	Poor	0.000**
	Normal	Dyslexics	0.000**
2.	Average	Poor	0.000**
	Average	Dyslexics	0.000**
3.	Poor	Dyslexics	0.001

* Significant value if $p < 0.05$ ** Highly significant value if $p < 0.01$

Table -25 The maximum and minimum at risk quotient for each group.

S.no	Groups	Minimum	Maximum
1)	Normal	0.0	0.2
2)	Average	0.8	1.0
3)	Poor	1.5	2.1
4)	Dyslexics	1.4	2.6

Above table clearly shows that normal fall in between 0.0 and 0.2 at risk quotient, thus ruling out the possibilities of any risk of dyslexia.

Average group fall in between 0.8 to 1.0 at risk quotient, thus falling in mild risk for dyslexia. According to the checklist done in the phase 2 of the study , these individuals did report certain feature like poor memory in academics and also word finding difficulties, thus supporting the findings.

Poor group fall under the At risk quotient 1.5 to 2.1 placing them into high risk for dyslexia .According to the checklist done in the phase 2 of the study , these individuals exhibited many features such as poor memory in academics, word finding difficulties, avoiding reading , has repeated academic years because of failure, difficulty in understanding instruction , thus supporting the findings.

And controls i.e. Individuals with dyslexia who were pre diagnosed fall into the high risk , thus supporting the findings.

SUMMARY AND CONCLUSION

In Developmental Dyslexia (DD. literacy acquisition deficits include difficulty in spelling formation in reading words accurately and fluently and in other writing skills. It has been accepted as a life span disorder . When compared to general population , the individuals with DD are characterized to be having lower profile of indicators of educational background, low employment status, and also are rated low for reading and writing activities at work and at home environment. They show heterogeneous feature as the age progresses , as the environmental factors are different for different individual with respect to culture ,language and the education system may differ foe each person.

In a country like India people migrate to different states for employment and education where they are exposed to different languages other than their mother tongue and English (it being the common official language across the country). The educational system of India differs in every state and includes the orthography of regional language also in the syllabus. So the individuals are not only exposed to many languages at a time but also are exposed to different orthographies thus developing the majority of the population as – bilingual or multilingual. So for population here it is imperative to have a tool for screening dyslexia that caters to the diverse needs of the ever growing bilinguals and multilingual population.

So the present study aimed to construct a screening tool for bilingual/ multi lingual adults with Dyslexia for Indian population. The test was constructed on the base of the review collected and the included 11 domains were selected based on the Dyslexia Adult Screening Test(DAST) i.e. Rapid naming ,One minute reading, Postural stability,

Phonetic segment, Two Minute Spelling, Backward span, Non sense passage, Non verbal Reasoning, One minute writing, Verbal Fluency, Semantic fluency. The stimuli and the answer key were prepared with help of pilot study on 30 typical age matched subjects.

60 typical participants (meeting inclusion criteria) and age matched 15 individuals pre - diagnosed as dyslexia was considered for the study.

Group –A: typical population, according to the results from checklist consisted of 45 subjects.

Group -B: At risk population, according to the results from checklist consisted of 15 subjects. Amongst which 11 subjects fall in mild category and 4 into severe category. So , group B was further divided into group –B(1) Average and group –B(2) poor.

Group c- Individuals with dyslexia (pre –diagnosed)

The test was administered on both the groups and the scores were recorded.

The One way MANOVA and Bonaferroni test for pair-wise comparison was used to statistically analyze and compare the performance of the groups in each domain and results showed a highly significant difference in between all the groups for all the domains except for postural stability. Considering these findings The postural stability was not considered for further calculations for at risk quotient. Then One way ANOVA was used to compare the "At risk quotient" across the four groups and highly significant differences were seen across the four groups. Where in the individuals with dyslexia (group c) and group B(2) i.e. poor score group fall in the higher cut off above 1.0 indicating high risk for dyslexia and group –b(1) fall in above 0.7 and below 1.0 indicating at risk of mild dyslexia

The outcome of the study is the development of a screening protocol focusing on bi/multilingual adults with dyslexia that can be improvised and standardized thus can be used across a wide variety of cultures in India for the adult population approaching with difficulty of reading and writing.

Limitation of the study:

1) Small sample size
2) Incorporation of only two languages other than English- kannada and Hindi.
3) The scoring index used is British normed.

Suggestion for the further research:

1) The protocol can be standardized on a larger population.
2) Referring to more positive indicators for dyslexia, More sensitive domains can be added.
3) Different regional and cultural population can be compared with respect to their language.
4) Age based norms can be developed on large population.
5) Standardization across different cultures in India.

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APPENDIX

S.no	Appendix	Content
1	Appendix-1	BDA- British Dyslexia Adult Checklist
2	Appendix-2	Stimuli and Answer Keys
3	Appendix-3	Record Form
4	Appendix-4	At Risk Index

Appendix :1

Adult checklist for Dyslexia

A checklist for dyslexic adults will not provide enough information for a diagnostic assessment, but it can be very useful in promoting a better self-understanding and a pointer towards future assessment needs.

Below are the questions that were found to be more predictive of dyslexia (as measured by prior diagnosis). In order to provide the most informative checklist, scores for each answer indicate the relative importance of that question. Alongside each line you can keep a tally of your score and at the end find a total.

For each question, circle the number in the box which is closest to your response.

		rare	occasionally	often	most of the time	total
1	Do you confuse visually similar words such as cat and cot?	3	6	9	12	
2	Do you lose your place or miss out lines when reading?	2	4	6	8	
3	Do you confuse the names of objects, for example table for chair?	1	2	4	4	
4	Do you have trouble telling left from right?	1	2	4	4	
5	Is map reading or finding your way to a strange place confusing?	1	2	4	4	
6	Do you re-read paragraphs to understand them?	1	2	4	4	
7	Do you get confused when given several instructions at once?	1	2	4	4	
8	Do you make mistakes when taking down telephone messages?	1	2	4	4	
9	Do you find it difficult to find the right word to say?	1	2	4	4	
10	How often do you think of creative solutions to problems?	1	2	4	4	
		Easy	Challenging	Difficult	very difficult	total

11	How easy do you find it to sound out words such as e-le-phant?	3	6	9	12	
12	When writing, do you find it difficult to organize thoughts on paper?	2	4	9	8	
13	Did you learn your multiplication tables easily?	2	4	6	8	
14	How easy do you find it to recite the alphabet?	1	2	3	4	
15	How hard do you find it to read aloud?	1	2	3	4	

Results from the Adults Test - what it all means.

The research and development of the checklist has provided a valuable insight into the diversity of difficulties and is a clear reminder that every individual is different and should be treated and assessed as such. However, it is also interesting to note that a number of questions, the answers to which are said to be characteristics of dyslexic adults, are commonly found in the answers of non-dyslexics.

It is important to remember that this test does not constitute an assessment of one's difficulties. It is just an indication of some of the areas in which you or the person you are assessing may have difficulties. However this questionnaire may provide a better awareness of the nature of an individual's difficulties and may indicate that further professional assessment would be helpful.

Whilst we do stress that this is not a diagnostic tool, research suggests the following:

Score less than 45 - probably non-dyslexic.

Research results: no individual who was diagnosed as dyslexic through a full assessment was found to have scored less than 45 and therefore it is unlikely that if you score under 45 you will be dyslexic.

Score 45 to 60 - showing signs consistent with mild dyslexia.

Research results: most of those who were in this category showed signs of being at least moderately dyslexic. However, a number of persons not previously diagnosed as dyslexic (though they could just be unrecognised and undiagnosed) fell into this category.

Score Greater than 60 - signs consistent with moderate or severe

dyslexia. Research results: all those who recorded scores of more

than 60 were diagnosed as
moderately or severely dyslexic. Therefore we would suggest that a score greater than 60 suggests moderate or severe dyslexia. Please note that this should not be regarded as an assessment of one's difficulties. But if you feel that a dyslexia-type problem may exist, further advice should be sought.

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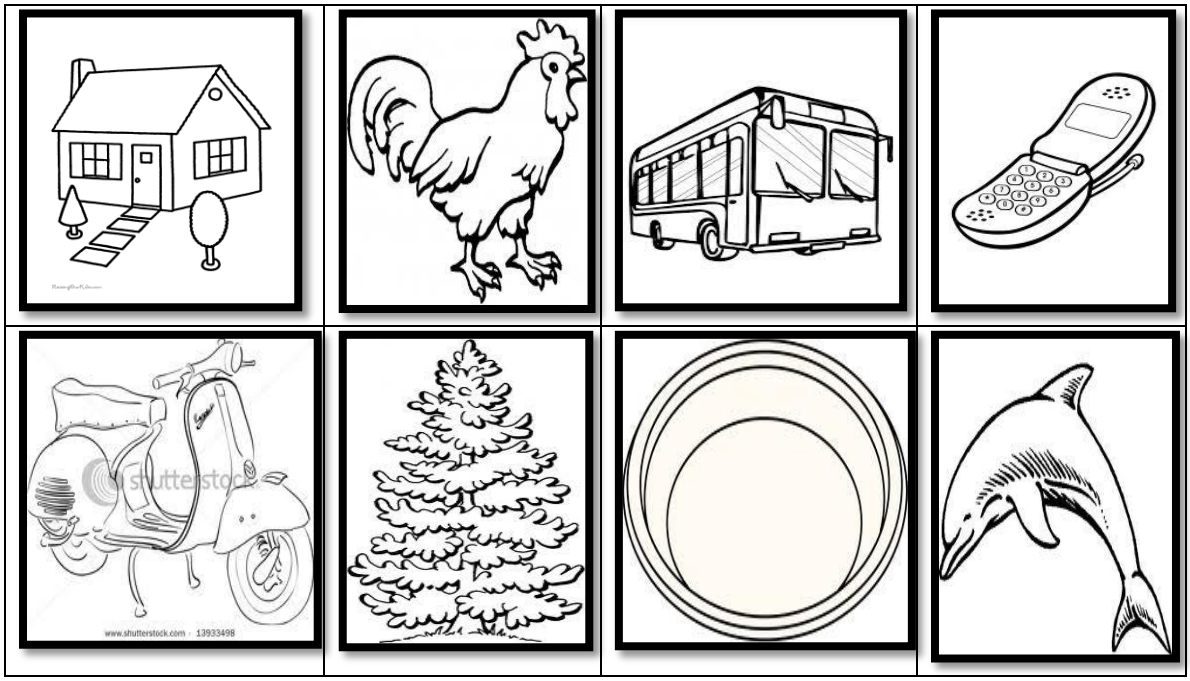
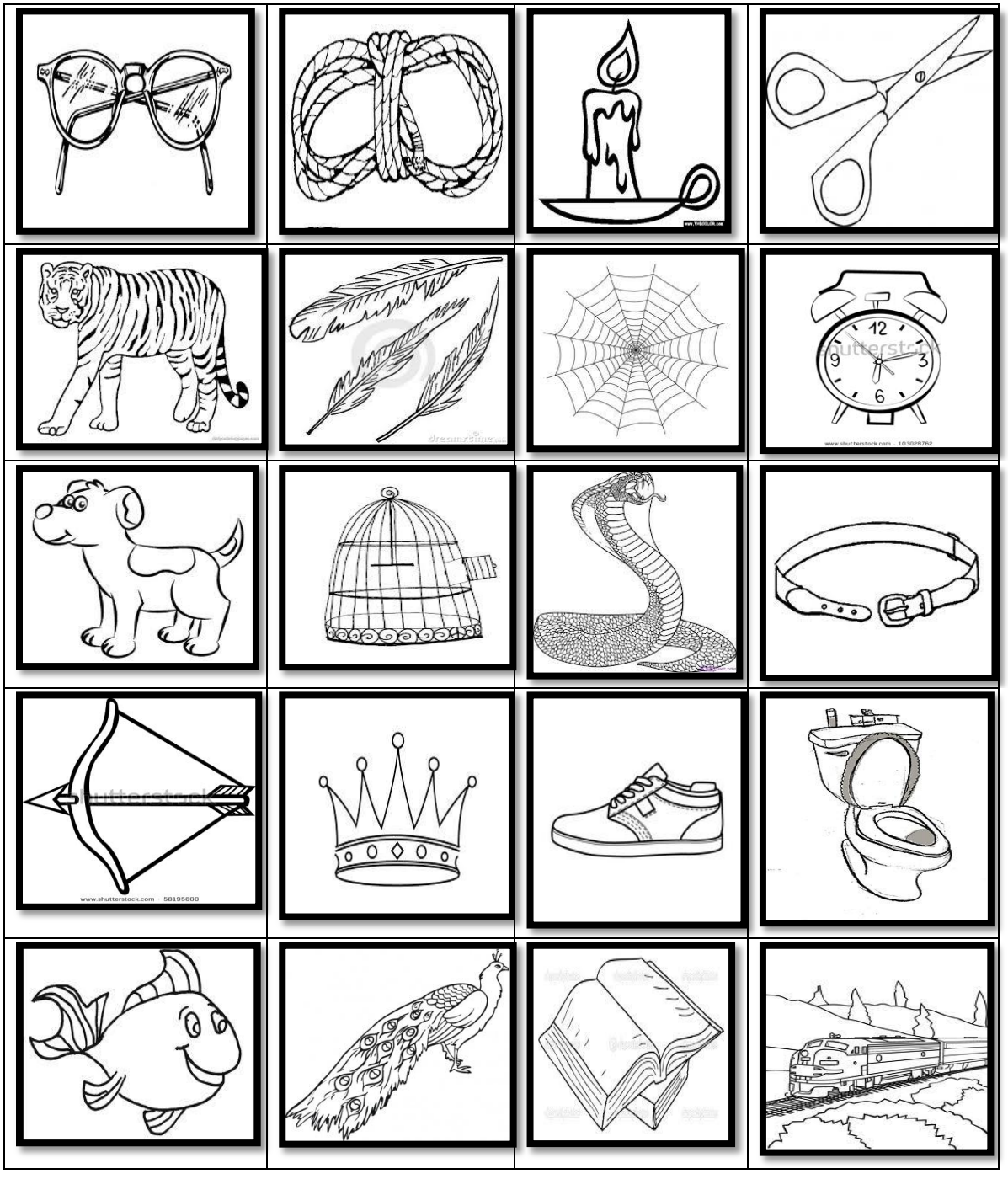
Appendix:2

Domain : 1 Rapid naming

Practice card



Main Card



Answer Key: Rapid naming

Item no. (left to right)	English	kannada	Hindi
Item no. 1	Spectacles	/kənnədkə/	/ʧɑːʃmə/
Item no. 2	Rope	/həggə/	/rɑːsɪ/
Item no. 3	Candle	/mʊmbɑːθɪ/	/mʊmbɑːθɪ/
Item no. 4	Scissor	/kəθərɪ/	/kətʃI/
Item no. 5	Tiger	/hʊlɪ/	/ʃeːr/
Item no. 6	Feather	/puːkkə	pãnkʊdɪ
Item no. 7	Web	/ʤədərə bəle/	/ʤɑːlə/
Item no. 8	Clock	/gədɪerə/	/gədɪ/
Item no. 9	Dog	/nɑːiː/	/kuːθə/
Item no. 10	Cage	/pɑːnʤərə/	/pɪnʤərə/
Item no. 11	Snake	/həvuː/	/sãp/
Item no. 12	Belt	/beltʊ/	/belt/
Item no. 13	Arrow	/bɑːnə/	/bãn/
Item no. 14	Crown	/kiːriːtɑː/	/θɑːʤ/
Item no. 15	Shoe	/ʃuː/	/ʤʊθə/
Item no. 16	Commode	/kəmoːd/	/kəmoːd/
Item no. 17	Fish	/miːnʊ/	/məʧəlɪ/
Item no. 18	Peacock	/nəviːlʊ/	/moːr/
Item no. 19	Book	/pʊsθkə/	/pʊsθk/
Item no. 20	Train	/riːlʊ/	/rel/

Domain :2- One minute reading

Practice card

dare	pair
scare	hair
glare	stare
park	dairy

Main List

mud	gentle	marriage	competition
cow	bright	mountain	foundation
bond	vary	brilliant	reflection
aim	atom	substance	profession
horn	iron	conscience	confidence
hat	paint	agency	destruction
key	merit	entire	headquarter
code	entry	memory	variety
lady	urban	uniform	economy
date	alert	tragedy	majority
myth	motor	citizen	territory
task	quiet	mystery	criticism
lord	usual	popular	automobile
dozen	ocean	rational	philosophy
pick	person	absolute	occasional
shear	debate	sympathy	legislation
prince	impact	approval	requirement
wound	junior	customer	competition
signal	master	accident	conservative
grave	signal	magazine	enthusiasm
price	native	magnitude	comment
chain	appeal	formation	foundation
faint	budget	insurance	reflection
brief	defeat	principal	profession
camera	classic	detective	confidence
birth	highway	intension	destruction
broke	intense	gentleman	headquarter
scheme	passion	essential	variety
branch	finance	cigarette	economy
choose	soldier	permission	majority

Domain:4 Phonemic segmentation

Practice stimuli:

1.	Say *football*	Say it again , without *ball*
2.	Say *breakfast*	Say it again, without */brek/*
3.	say *dog*	Say it again , but without first sound

Main stimuli:

1.	*rainbow*	Say it again ,but without *bow*
2.	*person*	Say it again , but without *son*
3.	*hospital*	Say it again , but without *hos*
4.	*dog*	Say it again , but without first sound
5.	*boat*	Say it again , but without first sound
6.	*prince*	Say it again , but without */pr/*
7.	*prince*	Say it again , but without */p/*
8.	*prince*	Say it again , but without*/s/*
9.	*signal*	Say it again , but without */l/*
10.	*flag*	Say it again , but without */f/*
11.	*glow*	Say it again , but without */l/*
12.	*perfume*	Say it again , but without */f/*
Spoonerism		Expected answer
13.	Mahatma Gandhi	[Gahatma Mandhi]
14.	Madhuri Dixit	[Dadhuri Mixit]
15.	Vasudev Krishna	[Kasudev Vrishna]

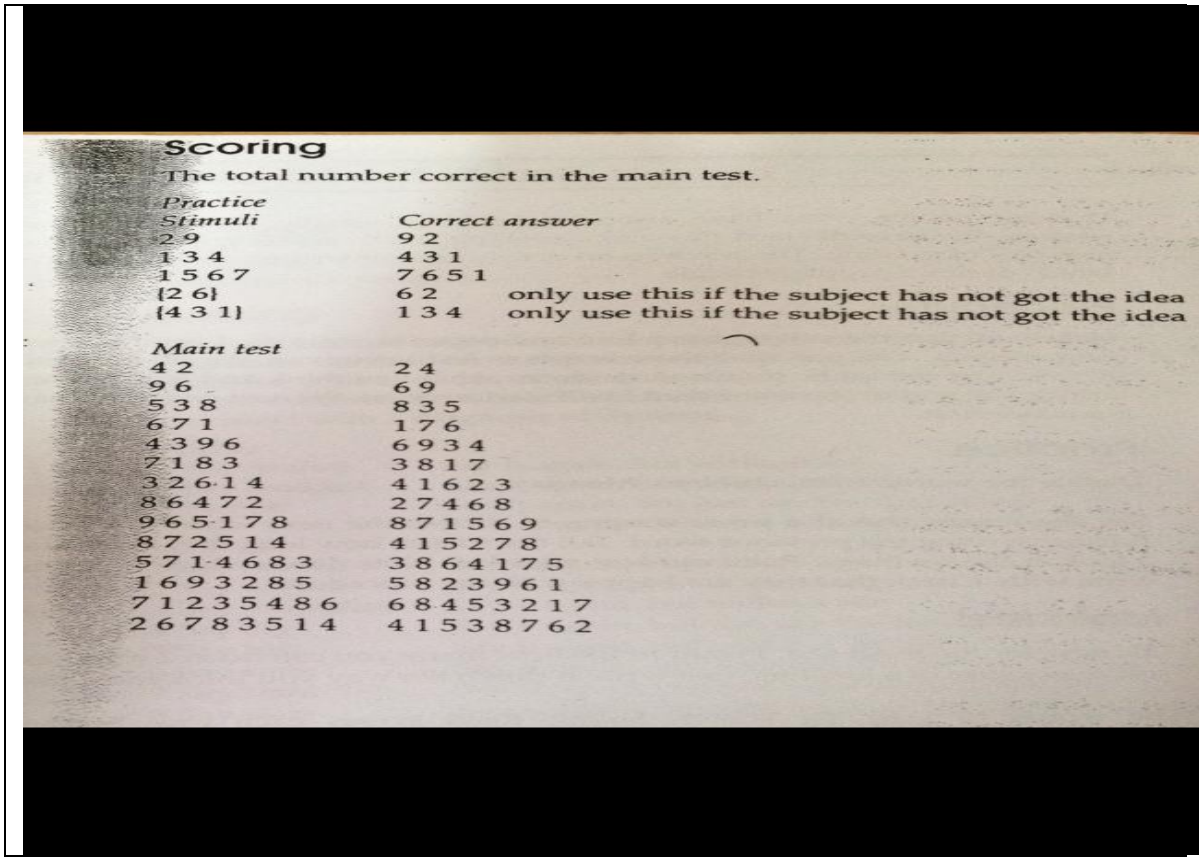
Domain: 5- Two minute spelling

Main test:

morning	**school**	**age**	**year**
tonight	**tomorrow**	**doctor**	**danger**
tongue	**laugh**	**September**	**success**
Thursday	**foreign**	**forty**	**tomato**
address	**sincerely**	**obedient**	**priority**
characteristic	**doubt**	**electricity**	**pension**
consequence	**insurance**	**accessory**	**competition**
prescription	**government**	**separate**	**receipt**

Additional initial spellings for those making 2+ mistakes on the line 1			
bus	**cat**	**bed**	**sand**
day	**five**	**home**	**book**

Domain -6 – Backward digit span



Scoring

The total number correct in the main test.

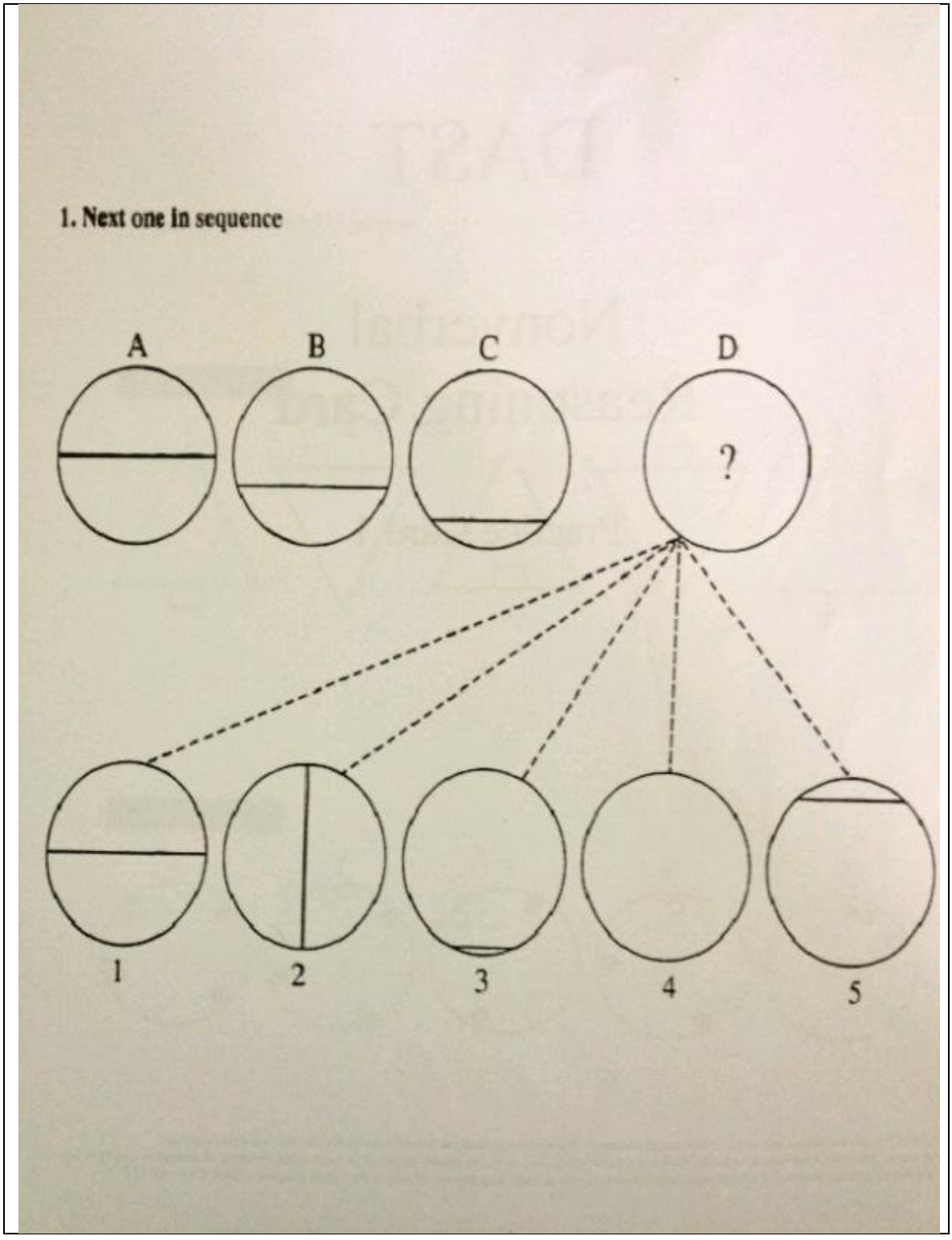
Practice Stimuli	*Correct answer*	
2 9	9 2	
1 3 4	4 3 1	
1 5 6 7	7 6 5 1	
{2 6}	6 2	only use this if the subject has not got the idea
{4 3 1}	1 3 4	only use this if the subject has not got the idea
Main test		
4 2	2 4	
9 6	6 9	
5 3 8	8 3 5	
6 7 1	1 7 6	
4 3 9 6	6 9 3 4	
7 1 8 3	3 8 1 7	
3 2 6 1 4	4 1 6 2 3	
8 6 4 7 2	2 7 4 6 8	
9 6 5 1 7 8	8 7 1 5 6 9	
8 7 2 5 1 4	4 1 5 2 7 8	
5 7 1 4 6 8 3	3 8 6 4 1 7 5	
1 6 9 3 2 8 5	5 8 2 3 9 6 1	
7 1 2 3 5 4 8 6	6 8 4 5 3 2 1 7	
2 6 7 8 3 5 1 4	4 1 5 3 8 7 6 2	

Domain: 7- Nonsense passage

India is a coynurt of ancient emites and ulinemitd natural resources. Its ancient lucuter, not to forget its exotic sipces, make the country a nodwerluf lapce to visit, to live. Mark Tinwa once said: "So raf as I am able to dugej, nothing has been left undone, either by man or tanrue, to make India the most traxeordinary country that the sun visits on his nordus. Nothing seems to have nebe forgotten, nothing rovekedloo."

Domain:8- Nonverbal reasoning

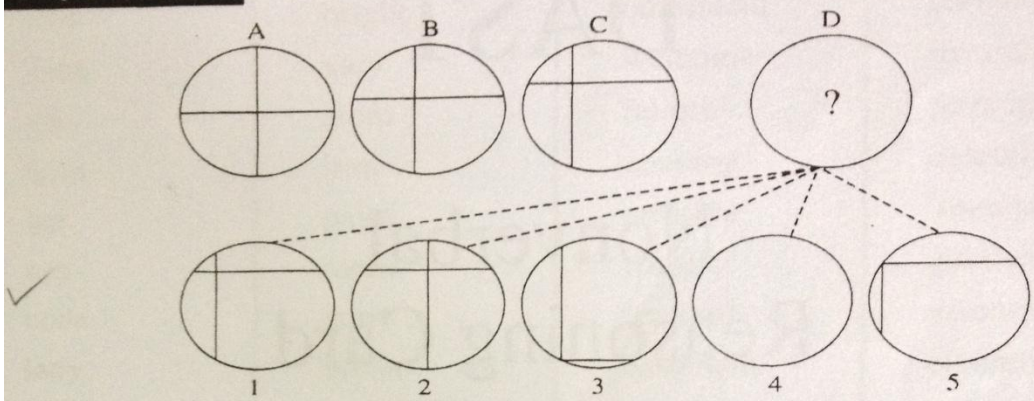
Practice card 1



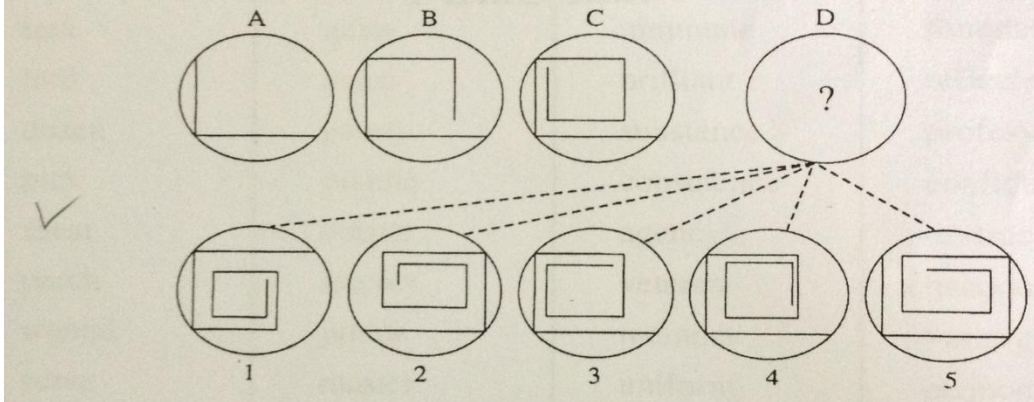
Main card 1

1. Next one in sequence (2 minutes)

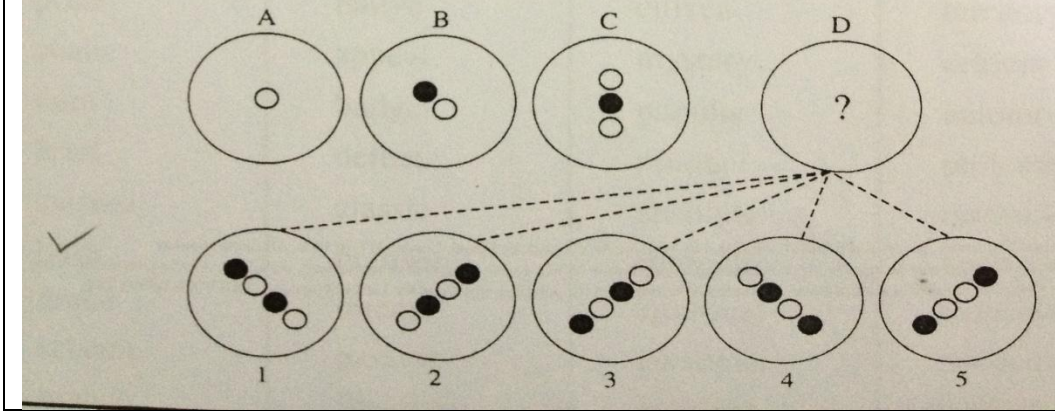
Question 1



Question 2

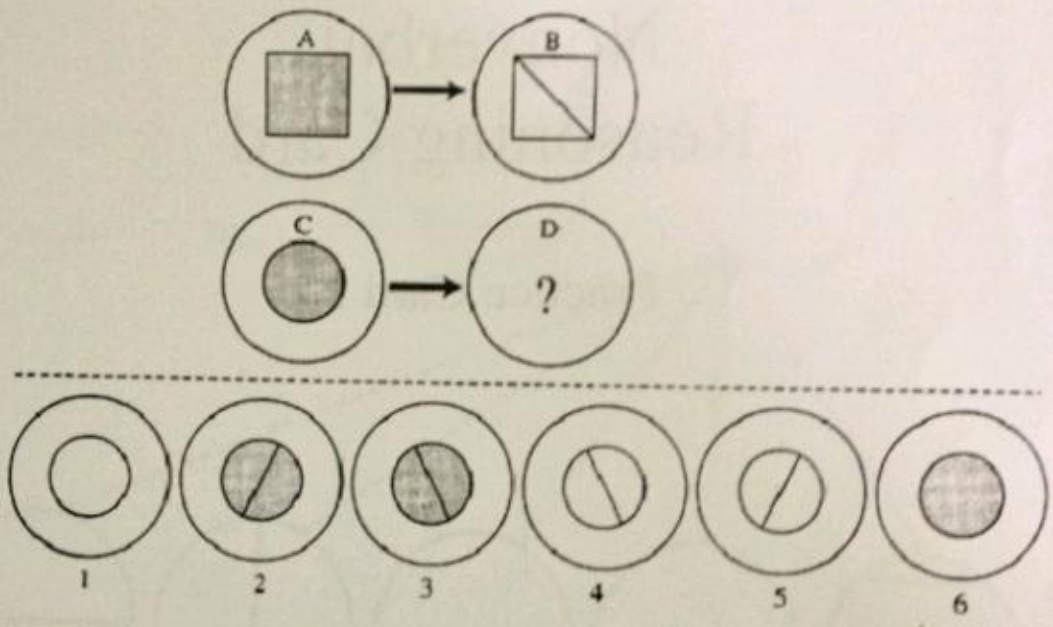


Question 3

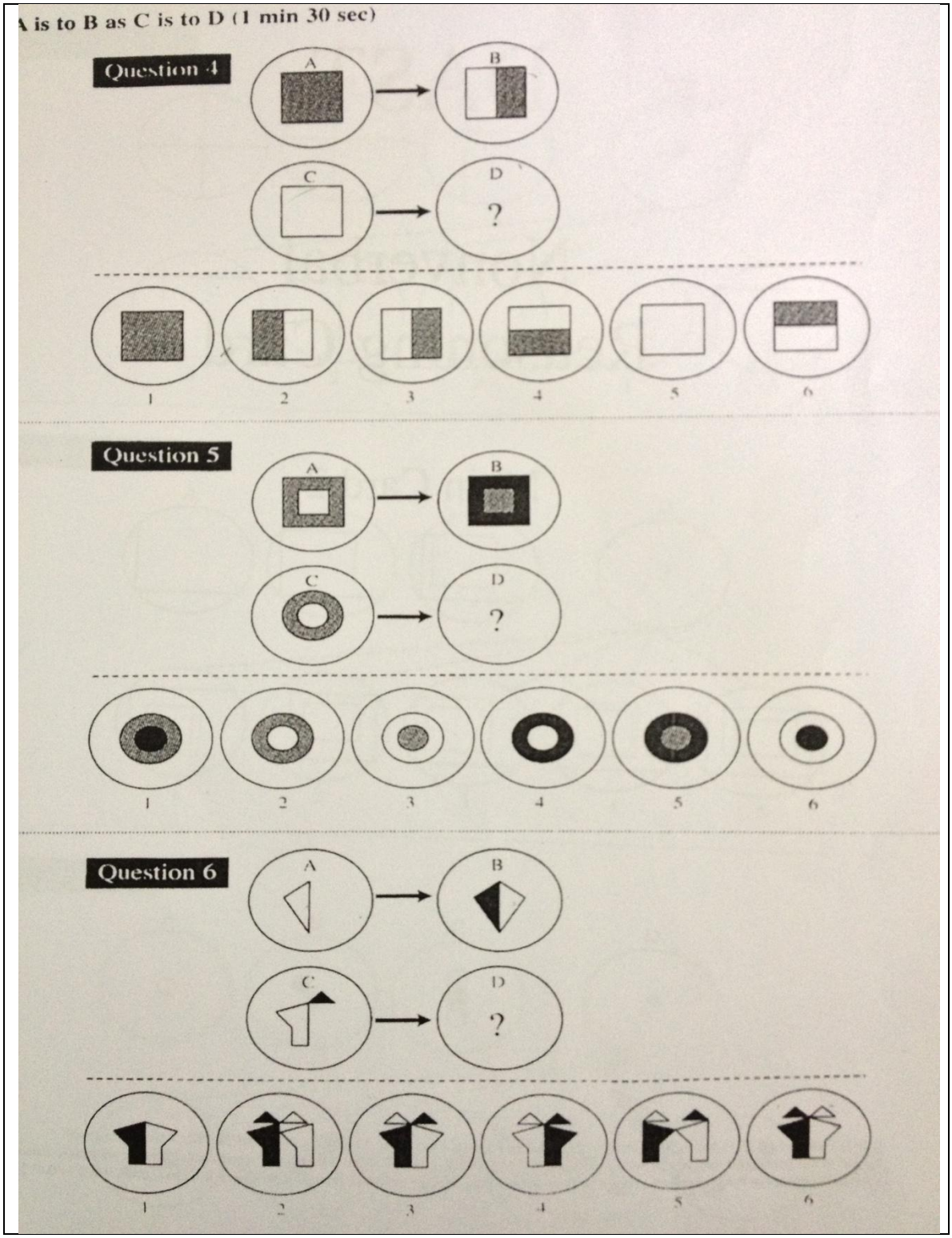


Practice card :2

2. A is to B as C is to D

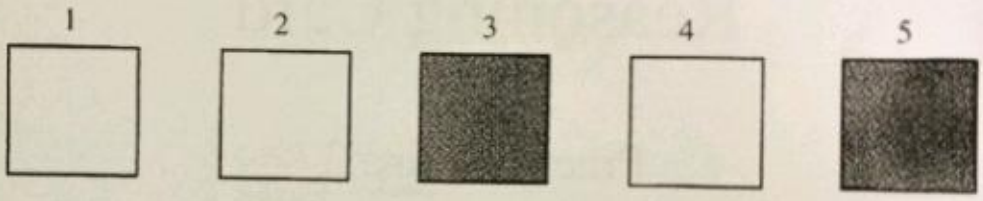


Main card :2


A is to B as C is to D (1 min 30 sec)
Question 4
A
B
C
D
?
1
2
3
4
5
6
Question 5
A
B
C
D
?
1
2
3
4
5
6
Question 6
A
B
C
D
?
1
2
3
4
5
6

Practice card:3

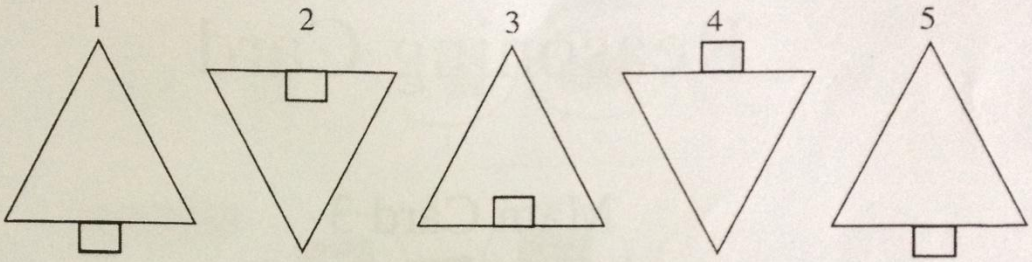
3. Two's versus three's



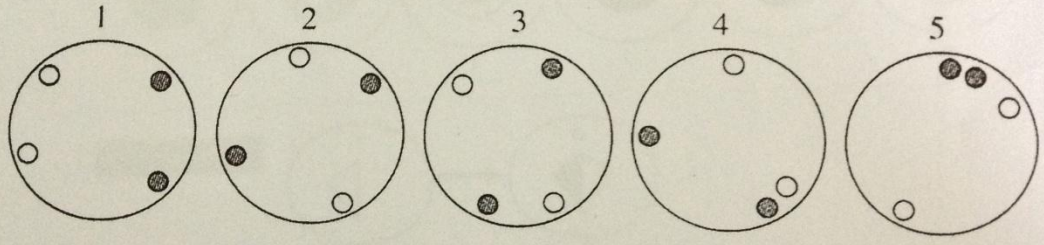
Main card :3

3. Two's versus three's (1 minute)

Question 7



Question 8



END OF REASONING TEST

Domain: 9 One minute writing

Main test: can you copy this ?

When the sunlight strikes raindrops in the air, they act as a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it.

Appendix: 3

Record Form– page 1

1. Rapid naming	2. One minute reading	3. postural stability	8. non verbal reasoning
Time (secs)	errors		1.
error	Passes		2.
	Last word read		3.
Time = 5 *errors	(a) word attempted		4.
	(b) No. of errors and passes		5.
	(c) Score (a-b)		6.
	Time		7.
	(d) Bonus if ≤60sec		8.
Total	Total (c+d)		
4. Phonemic segmentation	5. Two minute spelling	6. Backward span	10.verbal fluency
1. rainbow	Hand used	2 4	S
2. person	hand writing quality (good/ ave/poor)	6 9	
3. hospital		8 3 5	
4. dog	number completed	1 7 6	
5. boat	number of errors	6 9 3 4	
6. prince	number correct	3 8 1 7	
7. prince	add 8 if used only the more complex spellings	4 1 6 2 3	11.Semantic Fluency
8. prince		2 7 4 6 8	animals
9. signal	Time if less than 2 mins (not used for bonus)	8 7 1 5 6 9	
10. flag		4 1 5 2 7 8	
11. glow		3 8 6 4 1 7 5	
12. perfume		5 8 2 3 9 6 1	
13. .Mahatma Gandhi		6 8 4 5 3 2 1 7	
14. Madhuri Dixit		4 1 5 3 8 7 6 2	
15. Vasudev Krishna			
Spoonerism Time (t)			

penalty of 1 if t≥50s			
score (max 15)	Total score (max.40)	Total score	Total
7. Non sense Passage reading		9.One minute writing	
India is a coynurt of ancient emites and ulinemitd natural resources. Its ancient lucuter, not to forget its exotic sipces, make the country a nodwerluf lapce to visit, to live. Mark Tinwa once said: "So raf as I am able to dugej, nothing has been left undone, either by man or tanrue, to make India the most traxeordinary country that the sun visits on his nordus. Nothing seems to have nebe forgotten, nothing rovekedloo."		(a) words (max 50) Time (b) bonus (1 point for each 2 secs under 60) (c) lesser of B or 10 Errors (d)Error penalty(1 point for each 2 errors) Writing quality (good, ave, poor) (e)penalty if writing poor (1-3) (f)penalty for poor punctuation(0-2)	
(a) Real words correct : (max=59)		a+c-d-e-f=	
(b) 2* non sense words correct(max=30)			
(c) Score = a+b			
Time			
Time bonus -1 per 2secs less than 60 secs, if score of 22+ on non sense words(max 10) or time penalty(1 per 2 secs more than 60 secs) (max 60)			
(d) Score after penalty/ bonus			
(e) Half score(equal to half of c)			
total score (greater of D and E)		Total score:	

Record form – Page 2

Entering Scores

Write the test scores in the 'Test Score' column of the score table below. Find the Score Key appropriate for the subject's
or not you want the student norms). Place it carefully on top of this sheet. The cutaway allows you to enter the 'At Risk
the third column of the score table. Look up the corresponding index (---, --, -, 0, +) in the right hand columns of the Sco
instructions at the top of the Score Key) and enter it in the 'At Risk' column on this sheet. Make sure you use the appropri

	Test Score	'At Risk' Index	---	--	-	0
1. Rapid Naming						
2. One Minute Reading						
3. Postural Stability						
4. Phonemic Segment*						
5. Two Minute Spelling						
6. Backwards Span						
7. Nonsense Passage						
8. Nonverbal Reasoning						
9. One Minute Writing						
10. Verbal Fluency (S)						
11. Semantic Fluency						

Interpretation

Work out the numbers of (---), (--) and (-) scores. If 4 or more are (---) or (--), or 7 or more are either (---), (--) or (-), the
isk'. For a quantitative measure score 3 for (---), 2 for (--), 1 for (-), 0 for the remainder and add up the scores. The 'At R
ien the sum divided by 11. An ARQ of 1.0 or greater is strong evidence of being 'At Risk'. Also complete the Profile Chart
ich as Segmentation suggest possible remediation work. Digit Span weakness suggests possible memory difficulties. Areas
rovide the basis for a remedial strategy.

Full Name _____

Company etc _____

D.o.b/age at testing _____

History of learning difficulties ☐ Sex (M/F)

Age of school leaving/FE/HE _____

Occupation _____

Test behaviour: concentration _____

anxiety _____

Other info:

Number with --- _____ (A)

Number with -- _____ (B)

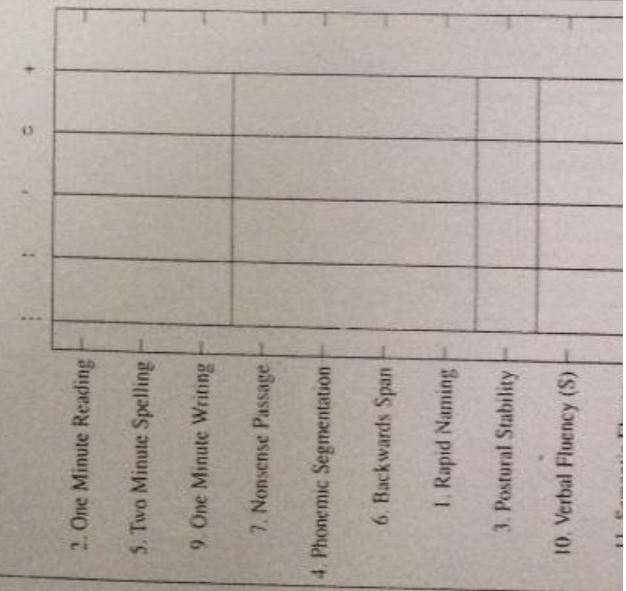
Number with - _____ (C)

At Risk' score (3xA) + (2xB) + C _____ (D)

At Risk' quotient (D)/11 _____ (E)

Screening diagnosis _____

Tester _____ Date _____



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Appendix :4 – At Risk Index

Score key: For age 16 to 21 years.

After the test scores are written into the 'test Score' column of the 'record form', enter the at risk index scores in the third column of the record form. Look up the corresponding index (---, --, -, 0,+) in the right hand column of this score key and enter the "at risk " .For instance , foe Rapid Naming foe a student of age 19, you would enter '---' for a score of 48, '—' for a score of 35, '-' for a score of 34. '0 'for a score of 23 and '+' for a score of 18. The score key should be used only for the students in between the age range of 16 to 21 years.

---	--	-	0	+
40 or more	35-39	28-34	20-27	19 or less
74 or less	75-91	92-103	104-126	127 or more
10 or more	5-9	2-4	0-1	0
11 or less	12	13	14-15	15
24 or less	25-30	32-33	34-39	40
4 or less	5	6	7-10	11 or more
71 or less	72-0	81-87	88-89	99
3 or less	4	5	6-7	8
28 or less	29-31	32-33	34-39	40 or more
10 or less	12	13-14	15-21	22 or more
12 or less	14	15-16	17-22	23 or more