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Underpinning the Relationship between Non-Verbal Intelligence and English Literacy Skills at Grade 3: A Psychometric Test-Based Study

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ABSTRACT

This study aimed at exploring the relationship of IQ tasks of non-verbal nature with reading, and dictation skills in second language. A number of 66 participants were chosen from a huge sample meant for another study Farukh and Vulchanova, 2014 that had been conducted earlier by one of the current researchers. The specifications of the participant students were that all of them were of the same nine years of age and hailed from schools of public and private sectors situated in a comparatively under-developed district of the Punjab province. The participants were subjected to 7 standard non-verbal IQ tasks i.e. WISC III and Raven's Advanced Progressive Matrices, and to tasks covering English reading, and dictation skills. On all of the tasks, two diverse types of factors became the basis for loading scores i.e. firstly all of the IQ-related Nonverbal tasks, and secondly WISC IV digit coding, RAPM, arranging pictures, with Reading as well as Dictation.

Introduction

IQ stands for a summary measure on all ability-related tests performance. Results of IQ tests can be a means of an increase in the confidence for those individuals whose weak performance may otherwise be taken to mean a deficit in their intellectual capacity. It can also serve as a source of guidance to establish teaching expectations (Turner, 1997). Tests of IQ are most particularly utilized in test batteries that are employed for dyslexia assessment. These test scores are helpful in excluding the chances of the occurrence of any intellectual deficit that might lead to reading deficit besides dyslexia.

It needs to be discussed that what role does intelligence play in dyslexia and how is it related to disabilities in general reading. Milne (2005) suggested that children who faced problems in reading should be divided into two groups i.e. (1) the children who suffer from dyslexia, and (2) the children who are garden variety poor readers. Those suffering from dyslexia have impaired reading-supporting brain circuits that function abnormally (Morken, Helland, Hugdahl & Specht, 2014), while those who are garden variety poor readers possess reading circuits that are under-developed resulting from delay in development and from instruction that is not sufficient. However, neither all individuals who score low on IQ tests are essentially poor readers (Frederickson & Reason, 1995) nor do garden variety poor readers essentially lack intelligence.

There is still a contention to the role of IQ in persons suffering from reading disability like dyslexia or are garden variety poor readers. One of the opinions given is that low IQ is involved in the reading disability of those who are garden variety poor readers and that dyslexia is concomitant to adequate IQ always. The other opinion contends that it is not always that the case is true (Frederickson & Reason, 1995).

On the basis of all this, it can be deduced that IQ discrepancy diagnosis of dyslexia leads to burdening the IQ fairly high, despite the fact that exceptions can also be confirmed (Miles, 1996). A wide variation is found to exist in the scores of children with dyslexia when scores of them are compared on sub-tests of a test. For example, on WISC (Wechsler Intelligence Scale for Children an acid Profile is shown by them (Wechsler, 1992) implying that as compared to other scores of sub-tests, children having dyslexia have a tendency to point low scores on items of Coding Information, Arithmetic, and Digit Span. As recommended by Congdon (1989), instead of paying attention mainly on scores of global IQ, each subject's results profile should be the focus of attention.

To explore the nexus existing between the degree of working memory capacity (WMC) and RAMP (Raven, Raven and Court (1998), Wiley, Jarosz and Cushen Colflesh (2011) carried out a research. The requirement of bringing to mind, all the diverse principles, goals and findings of earlier attempts for problem solution is viewed as the cardinal determining factor in problem-solving difficulty (Baddeley & Hitch, 1974; Cary & Carlson, 2001; Kotovsky, Hayes & Simon, 1985; Sweller, 1988). Because WMC is considered to be related to the number of different representations, utilized, maintained or integrated in active memory, therefore problem-solving models comprise usually of a touchstone that stands for a buffer of constricted capacity for the sake of accurately fitting into human performance (Anderson & Lebiere, 1998; Carpenter, Just & Shell, 1990; Newell & Simon, 1972). But, astonishingly no studies have ever utilized the approaches of individual differences for exploring the actual effect of WMC variations on the process of problem-solving (Ash & Wiley, 2006; Hambrick & Engle, 2003). Baddeley and Hitch (1974) developed working memory system originally in the form of an

interim space for the storing and processing of information containing buffers of visuo-spatial and phonological nature along with containing a higher additional domain i.e. general central executive which is responsible for regulating the flowing in and out of information from these buffers. Individual differences' assessment in WMC is based both on a concurrent processing component and storage component, so as to engage the buffers as well as the central executive. In the same way, a vital role is played by WMC in reading and a nominal capacity of memory is considered as a trait of dyslexia (Siegel, 1993).

According to Wiley, Jarosz, Cushen and Colflesh (2011), in WMC, RAMP is the task that is investigated most frequently along with the individual differences. This task is characterized by problem-solving and visuo-spatial reasoning, and is designed basically for assessing intellectual proficiency (specifically Gf) psychometrically, needs its participants to deduce a group of relations or regulations that are operative between stimuli for completing a visual pattern. It has been suggested by Marshalek, Lohman and Snow (1983) that it is the executive control processes that determine performance on this test, as these processes permit a problem solver in analyzing complicated problems, in assembling strategies for solution, in monitoring the performance and in constantly adapting the performance as it moves forward.

The question arises that what else can be the cause of correlations existing between the RAMP and WMC task performance. Wiley, Jarosz, Cushen and Colflesh (2011) believe that because RAMP is thought as one of the finest measures of fluid intelligence, it implies that the RAMP exploits the proficiency of leaning a fresh task rapidly. Verguts and De Boeck (2002), and Guthke and Stein (1996) have, along the same lines, suggested that this fact can prove beneficial for the highly successful solvers that across the whole test set, a tiny group of rules recur again and again. There is higher likelihood that while taking the test, the abler solvers would learn applying the rules smoothly. Therefore, one of the hypotheses that gets generated is that, as compared to low WMC solvers, the high WMC solvers assimilate the rules better. However, despite the fact that Verguts and De Boeck (2002) have shown that continuous exposure to rules may negatively influence the rule use on succeeding problems, neither the study of Verguts and De Boeck (2002) nor the study of Guthke and Stein (1996) have made correlations between individual differences in WMC and performance. It can very simply be predicted on the basis of this learning efficiency account that WMC should very potently predict the performance on issues that need the using again of a rule combination again that has been viewed earlier in that set or as an alternative an increase will occur in the RAMP and WMC success relationship based on the instances wherein that rule combination has been applied. As an alternate, for tapping the ability of "educing" fresh relations or finding meaning in the complex stimuli, the RAMP was designed by Raven (Raven et al., 1998). The perspective on what is required by the task fits in well with more fresh conceptualizations about individual differences in the WMC as it is associated with finer executive function or with the

proficiency of controlling attention particularly while there are interference and distraction (Conwayetal, 2005; Engle, 2002).

Materials and Method

Participants and Preliminary Procedure

Out of a sample of 150 students of grade 3, including 54 females and 96 males, chosen for an earlier study (Farukh & Vulchanova, 2014), conducted by one of the current researchers, a fresh selection of 66 students was made for this study. The participant students were attending private and public schools hailing from an under-developed district of the Punjab province. In ordered to be screened for skills of reading and potential reading deficit, they were made to pass through a test of non-word repeating task in their national Urdu language involving a classical RAN battery.

On the basis of the scores made in reading speed; rapid automized naming of objects, numbers, colours, letters; and errors made during the repetition of non-words made of four-syllables, additional fresh groups of the students were formed. Those students whose scores on three or more tasks were lower than the 25th percentile were termed as ones facing reading deficit (RD), whereas those students whose scores on three or more tasks fell in the range between 25th and 75th percentile, were made to form control groups.

Throughout Pakistan, the medium of instruction for all of the schools falling in the public sector and majority of the schools falling in the private sector is the national language i.e. Urdu. Students for this study were chosen from the Urdu medium schools of both private and public sectors and the English medium schools of the private sector, where families with high socio-economic status (SES) admit their children.

For the identification of those students who are likely to be suffering from any type of the reading disorders, the phrase "reading deficit group" has been used. However, due to the unavailability of a standard test to diagnose dyslexia in the language of Urdu, it cannot be declared for certain reasons that those students really suffered from it. To test the original sample in the second phase, a group of 66 students was selected. Students from both of the English and Urdu medium schools were made to form a Reading Deficit English group comprising of 14 students, a Reading Deficit Urdu group comprising of 20 students, a control English group comprising of 14 students, and a control Urdu group comprising of 18 students.

In order to assess the participants for nonverbal IQ, they were made to pass, in the second phase, through a battery of tests that comprised certain standard WISC-III (1991) sub-tests. The sub-tests including digit coding, arithmetic, block design, picture arrangement, picture assembly, and picture

completion were conducted, apart from administering RAPM (Raven, Raven & Court, 1998). Since, according to Gunderson and Siegel (2001), performance on IQ tasks is bound with the respective culture, status, and language, and is not free of them, therefore, care was taken to translate all of the instructions accurately into Urdu, for ensuring that they could be equally comprehensible to students from both types of schools.

Tasks and Testing Procedure

This study is probing literacy skills in L2. Hence, the results are discussed, analyzed, and presented with respect to only two literacy tasks. Prior to conducting the test, its administration procedure and content had to be brought in consonance with the English skills of 3rd grade students, which was done. In order to adapt the content of the test, textbooks taught in the public sector schools of Pakistan were thoroughly checked, and, as a result, those items (that were usually not taught to 3rd graders) were excluded from the contents of the test. To keep up the same number of test items for the sake of scoring and analysis, those items that had been excluded were replaced by words used commonly in the Pakistani textbooks of 3rd graders. Besides, a printed version of the test was prepared also, because of the low computer literacy prevalent in the country, and it was ensured that the test is provided to most of the children in printed form. Manual administering of the test was adopted, which called for higher vigilance and alertness during the recording of reaction times and responses and then during the assessment of those responses.

English 2 Dyslexia Test: Structure and Adaptation

In Norway, a test called The English 2 Dyslexia Test, was designed by Kaasa, Sanne and Helland (2004) for the purpose of assessing the performance of the children with typically developing reading skills of the children and the children with reading deficit in both L1 and L2, apart from testing the L2 verbal and literacy skills. However, the focus of our probe in this research study is only literacy. Literary skills are assessed by the two subtests i.e. reading and spelling.

T5 Dictation/Spelling.

This task requires the participant to write down on paper, some simple selected words of high frequency use.

A sentence is read aloud, followed by instructions to write a specific word from the sentence in question. One point is given for every correctly spelt word, which gives a maximum of 22 points. Incorrectly spelt words do not give any points. The participants are made to listen to a sentence read aloud to them and are then asked to write down a specific word from it. When one word is spelt correctly, one point is awarded to the participant and hence a total of 22 points can be scored at the most. No point is awarded for spelling a word incorrectly.

T6 Reading

It is a reading sub-test that requires the participant the task of reading 10 various sentences to be recorded. Out of each sentence, two or three words are assessed and a 22 number of words are assessed at the maximum. Every correctly pronounced word carries a single point and every incorrectly pronounced word carries 0 marks, without leading to a subtraction of marks. The whole assessment focuses over the correctness of pronunciation of a word. This subtest as a whole carries 22 marks to the maximum.

Owing to copyright complications, abstinence from discussion over the procedure and contents of the English 2 Dyslexia test is being adopted.

Statistical Analyses and Results

Varimax rotation was used for carrying out a principal component analysis, in order to find out the relationship existing between the variables. Kaiser-Meyer-Olkin measure of sampling adequacy was (KMO) = .81, Barlett's test of sphericity $\chi 2$ (36) = 335.45, $p < .001$. Total numbers of variables were made to load on factors without the number of factors being specified, leading to loading on 2 factors with Kaiser Normalization.

Table 1
Rotated Component Matrix[a]

Component	1	2
Digit Coding Point	**.45**	.41
Picture Completion	**.76**	.16
Block design	**.80**	.25
Arithmetic	**.62**	.09
Picture Assembly	**.83**	-.08
Picture Arrangement	**.74**	**.43**
Ravens matrices	**.69**	**.48**
T6 Reading	.07	**.94**
T5 Dictation	.17	**.95**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization

a. Rotation converged in 3 iterations.

Factor 1-Nonverbal IQ

Factor 2-Digit coding speed, Picture arrangement, RAPM, Reading and Dictation. In factor 1 all nonverbal IQ measures loaded together on factor 1, whereas L2 reading, and L2 dictation, loaded with picture arrangement, and RAMP on factor 2.

Conclusions

As can be confirmed from the results, nonverbal IQ measures can be seen loaded together totally on factor 1. digit coding, block design, picture completion, arithmetic, picture arrangement, picture assembly, and on RAPM as a single factor. Whereas, both L2 dictation and L2 reading got loaded on the other factor with RAPM, and picture arrangement task. Therefore, this study does fall in agreement with the earlier ideas about a negative relation between reading deficit with arithematic and coding information (Congdon, 1989).

In the second factor, we see dictation and reading correlated to RAMP, reflecting their underlying intrinsic relationship that is in line with the findings of the earlier research holding that RAMP is a measure of WMC which plays a cardinal role in reading (Wiley, Jarosz, Cushen & Colflesh, 2011). It also bears out the concept of Siegel (1993), and Baddeley and Hitch (1974), according to which working memory system plays a role in reading via temporary storage and processing space for information containing the storage buffers of visuo-spacial and phonological nature, in addition to a higher domain-general central executive responsible for regulating the flowing in and out of the information from those buffers. For engaging the buffers as well as the central executive both, in WMC, the individual differences assessments engage a storage component in addition to a concurrent processing component. Similarly, WMC has a major role in reading, and limited capacity of working memory is assumed to be characteristic of dyslexia. In the same way, WMC plays a paramount role in reading, and dyslexia is assumed to be characterized by a working memory with limited capacity.

The study offers its pedagogical implication in the shape of clarifying it for us that reading is correlated to RAMP and WISC IV i.e. digit coding, and picture arrangement tasks. This study serves as an initial step in referring to the existence of a relationship; however, for further confirmation and clearer authentication of this relationship, the tests need to be applied over a bigger sample than the present one.

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