The relationship between a teacher check list and standardised tests for visual perception skills:
A South African remedial primary school perspective

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ABSTRACT

Occupational therapy in remedial education settings has been questioned by the South African Government as they see occupational therapy as a costly service and thus has challenged occupational therapy clinicians' approach to assessment. This study was undertaken to establish whether the results of standardised tests of visual perception skills, relate to teachers' observations in respect of primary remedial school age children (six to eleven years) attending a short term remedial school because of low scholastic achievement despite having average or above intellectual ability. The Test of Visual Perceptual Skills – Revised, the Developmental Test of Visual Perception-2, the Jordan Left-Right reversals Test and a teacher check list as the only teacher observation source, were used. Scores on the visual perceptual tests and the teacher check list ratings were compared using Spearman's rho coefficient.

The overall scores on the visual perceptual tests and teachers' observations were found to be related; however this was often not the case between the subscales of the visual perceptual tests and the teacher check list. The check list may be a valuable tool in identifying children with visual perceptual difficulties but further development and standardisation is required to establish it as a valid, cost-effective measure of visual perception for use in schools where there is a limit on occupational therapy time.

Key words: Developmental Test of Visual Perception-2, Test of Visual Perceptual Skills-Revised, Jordan Left Right Reversals Test, Teacher Checklist.

Introduction
The option of using time-consuming and expensive formal assessment of a child's visual perceptual skills is being challenged by the South African Education Department[1], especially in the area of learning difficulties[2-5]. With continued financial restraints on occupational therapy services in schools, a quick, effective method of assessing visual perceptual difficulties is necessary to identify learners requiring occupational therapy and to monitor their progress.

Ongoing clinical observations show clustering of certain visual perceptual difficulties as identified by standardised assessments at specific grade levels[6-8]. However, some researchers have found that class teachers reported observations of developmental phase or academic level do not always relate to these visual perceptual scores in occupational therapy[9,10]. Although this research may not accurately reflect the South African situation, it does reflect the need for accurate instruments of visual perception connected to occupational performance in academic tasks. Moreover, there is a need for an inexpensive indicator of visual perceptual skills for use in schools with limited occupational therapy resources, especially within the South African context.

This research investigated the use of a teacher check list[11] for identifying those learners with visual perceptual difficulties and monitoring their progress during subsequent therapy. Standardised visual perceptual test results were compared with the academic performance of learners from Grades one to four (children aged six years to eleven years) in a remedial school, obtained through a teacher check list.

Problem Statement
Traditional standardised methods of assessment enable diagnostic interpretations and subsequent interventions[12] in occupational therapy, if certain limitations are applied. However, a recommendation was made in the South African Education White Paper Six[1] that learners should only be subjected to standardised tests which have proven useful in identifying barriers to learning, thus the most appropriate assessments should be applied. In addition, Fawcett[13] identified the need to screen young learners from four years old in a quick, simple and politically acceptable test which would also be thorough and cost-effective. The question thus raised was: Are occupational therapists over using standardised assessments and can a teacher check list be used as an efficient, accurate and cost saving assessment to identify visual perceptual barriers to learning?

Literature Review
The literature review focussed on the correlation between visual perceptual skills and academic performance as this would directly influence the need to use or abandon the option of assessing visual perception in school aged children who were finding learning challenging. Thus, the emphasis was placed on the relationship of visual perceptual skill development in reading, writing, comprehending, computing, memory and reversal tendencies.

The optimum period for development of visual perception is prior to and overlapping the first years at school (four and a half to seven years), but may continue up to 12 years of age[14,15,16]. Learning problems occur when children fail to develop an adequate perceptual motor match, linear processing and concrete thought which develop at the same age as the teaching of reading, writing and mathematics (ages seven to eleven years)[15,16,17]. This is also the phase when delayed visual perception can be identified and intervention is most beneficial, provided that the assessment indicates the appropriate intervention for achieving effective outcomes.

Academic performance for a Grade one to four learner (aged six to eleven years) is seen in the ability to read, spell, write, do maths, communicate and apply yesterday's lessons today[18-20]. The initial stages of learning or acquiring these academic skills, requires optimal development of basic perceptual concepts[21-25]. These perceptual concepts include, but are not limited to visual attention, visual and auditory discrimination and memory, and skills with shape/form recognition, part-whole processing, spatial orientation (to avoid reversals and inversions), understanding and retaining visual sequences, organising, and visual analysis and synthesis[14,21-36]. Demonstrating these skills may also be influenced by fine motor function and visual motor integration[30,34,37], as these skills impact on legibility.

Other literature expands this association between visual perception and academic learning by indicating that learners who make reversal errors show poor visual-motor skills and tend to make less progress in reading[38-40]. Letter and word recognition difficulties may indicate immature perception, however, studies have revealed a significant relationship between lateral awareness, visual spatial confusion, directionality, visual discrimination and academic achievement[38,40]. In contrast, other authors[23,26,40] found that letter reversals are primarily associated with language deficits, thus the learner confusing letters such as "b" and "d" is more likely to be able to perceive the visual differences between the letters, but has not learned which phoneme is associated with each letter.

Academic difficulty or learning disabilities on the other hand, imply that the learner's performance in specific areas such as visual perceptual deficits[24,28,41], spelling, grammar, following directions, spatial relations and numbers is lower than expected, based on tested intelligence[42-45]. These visual perceptual deficits related to learning difficulties are generally identified through occupational therapists conducting standardised assessments. However, previous research[23] indicates that the best measure of the learner's writing is the teacher's assessment of the writing product, as the teacher has a classroom full of children for comparison, years of experience and multiple samples of the child's work. This supports the trend for teacher observations and tests to be favoured above formal assessment.

Measurement tool review

The measurement tools used by occupational therapists to determine therapy requirements are chosen for various reasons such as appropriateness, availability, professional bias and time constraints[46,47]. The visual perceptual tests commonly used in South Africa have all been standardised in the United States of America. No correlative studies on South African learners have been published. The tests used in this research were The Developmental Test of Visual Perception – 2(DTVP-2)[7], Test of Visual Perceptual Skills (TVPS-R)[6] and the Jordan Test of Left-Right Reversals (JLRRT) [8].

The Developmental Test of Visual Perception -2 (DTVP-2): According to the authors[7], the DTVP-2 is unbiased relative to race, gender and handedness. It was standardised in 1993 on 1 972 children from 12 states in America, aged 4 to 10 years. Children with disabilities were included and made up 3% of the sample. Normative data are provided in terms of subtest standard scores, composite quotients, percentiles and age equivalents. The mean of 10 and the standard deviation of 3 were given for the subtests and a mean of 100 and standard deviation of 15 for composite scores. Age equivalents are to be interpreted with caution as interpolation, extrapolation and smoothing were used to create age equivalents. The reliability and validity of the test is reported as good.

Test of Visual Perceptual Skills Revised (TVPS-R): The TVPS-R[6], was standardised on 1032 subjects aged 4 years to 12 years 11 months. Only known normal-functioning subjects in regular classes were used in the standardisation process. The forms used in the test are as culture free as possible. Standard scores with a mean of 100 and a standard deviation of 15 are provided and a visual perceptual quotient can be obtained from the sum of the scale scores of the subtests. The validity and reliability of the total test scores are considered good.

The Jordan Left Right Reversal Test (JLRRT): The JLRRT[8] is aimed at assessing the presence of visual reversals of letters, numbers and words in learners from 5 years to adulthood. Jordan[8] claims that it is generally accepted that directional orientation in perception is dependent on learning and maturation. The revised norms were based on children with average intelligence (IQ 90 or above), and standardised scores are given up to the age of 12 years 6 months. The JLRRT[8] was administered to more than 3000 children aged five through twelve during the standardisation process. Norms are provided in developmental ages and percentiles, indicating adequate scores; as well as a borderline range and a range of scores indicating a more serious visual reversal problem.

Ethics

Ethics approval for this research was given by the University of KwaZulu-Natal, the South African Education Department and Livingstone Primary School. Informed signed consent was obtained from the South African Education Department, Livingstone Primary School and the parents of each participant.

Methodology

A descriptive, correlative research design was used. The hypothesis that none of the standardised tests would correlate with the teacher check list was tested with no manipulation of independent variables and no cause-effect relationship established, as proposed by Bailey[48]. The descriptive, correlative design allowed for visual perceptual abilities to be described by the teacher and recorded on the teacher check list (see *Appendix I on pages 15 and 16*).

The study was conducted at a remedial school in Kwa Zulu-Natal (South Africa). This short term remedial school was chosen for the research as all the learners had previously been identified as having difficulties in scholastic achievement prior to admission to the school. This study was conducted over a 13 month period. All learners had identified difficulty in at least one learning related task such as reading, writing, spelling or mathematics. Many of the learners had received previous occupational therapy intervention and this was ongoing, which may have influenced the validity of teacher check list as teachers may have had prior knowledge of the learner's visual perceptual difficulties. Questions on the check list were thus not placed in categories related to specific areas of visual perception. This meant that accuracy of assessment would prove useful in this setting as occupational therapy and visual perceptual training were deemed necessary for adequate academic achievement and eventual reintegration into mainstream schooling. All learners had an average or above intellectual ability as determined by a formal intellectual assessment carried out by psychologists.

Study population

A saturation sample was chosen, where every learner within the age range in the school was included in the research if the parents granted permission (see *Table 1*). The population consisted of an estimated 250 learners with 206 participating in this study. The sample consisted of:

1. Learners from Grade One to Four (aged six to eleven years, n = 206). Children who were eleven years and older were excluded from completion of the DTVP-2 due to age limits of the test.
2. Learners were excluded if the parents did not return the consent forms (63 learners).
3. Learners were also excluded if the teacher check list contained less than 70% of the required information, or was not completed within four weeks of the assessment.

A saturation sampling technique is related to convenience sampling, and cannot necessarily be generalised beyond learners in the remedial setting[48, 49]. However as this research is aimed at finding the relationship between the teachers' classroom observations and visual perceptual difficulties, the sampling method was purposeful and representative of the information sought for this research.

Table 1: Sample size

GRADE	POPULATION	INFORMATION INCOMPLETE	ACTUAL SAMPLE SIZE	MALE	FEMALE
1	47	6 (12.8%)	41 (23.7%)	28 (23.5%)	13 (24.1%)
2	45	5 (11.1%)	40 (23.1%)	27 (22.7%)	13 (24.1%)
3	70	12 (17.1%)	58 (33.5%)	40 (33.6%)	18 (33.3%)
4	44	10 (22.7%)	34 (19.7%)	24 (20.2%)	10 (18.5%)
TOTAL	206	33 (16.0%)	173 (100.0%)	119 (68.8%)	54 (31.2%)

Measurement tools

Learners were tested on the following visual perceptual tests as they became due for their annual occupational therapy assessment:

1. A check list for the teachers to complete was compiled by the author from numerous unreferenced teacher checklists in circulation and in consultation with expert occupational therapists in the field. This check list covered the visual perceptual skills of each child and had been shown in earlier research [29] to be an effective method of rating performance. To avoid bias to any specific area of visual perception, no visual perceptual terms were used for headings of categories on the form. Questions were allocated to categories according to the relevance the question had to the specific visual perceptual skill it identified, thus for example category A is relevant to Eye-Hand Co-ordination, Category B is relevant to Position in Space and Spatial Relations, Category C relates to Copying, Category D relates to Figure Ground, Category E is relevant for Visual Closure, Category F questions relate to Motor Speed, Category G relates to Form Constancy, Category H to Visual Discrimination, and, Category I and J are relevant to Visual Memory and Sequential Memory.

   The teacher was required to give a score between zero and three, with zero being poor and three being good.

   The teacher check list compared performance related to the grade rather than the age. Two categories of age were considered for this study: six years to eight years eleven months and nine years to eleven years eleven months. These age categories were chosen according to the visual perceptual developmental phases described by Hanneford [15].

   A small pilot study was conducted on the teacher check list, which involved four randomly chosen (by drawing names from a hat) teachers from a Primary School. They were asked to complete the check list and make comments on the ease of use, ambiguity and comprehensiveness of the questions. As a result, two questions were rephrased.
2. Visual perceptual scores were measured on the DTVP-2[7], the TVPS[6] and the JLRRT[8].
3. Teachers provided the results of the children's last 3 class tests in mathematics, spelling, dictation and comprehension. These tests were completed by the child prior to the teacher completing the teacher check list. These class test scores were used as classroom measures of academic performance.

Data Analysis

The Statistical Package for Social Sciences (SPSS) was used for data analysis. The results did not fall on a normal distribution curve and thus Spearman's rho was used to compare two sets of rankings. The outcome of the teacher check list related to visual perceptual skills was compared to the outcomes of the DTVP-2, TVPSR and JLRRT. In addition, the DTVP-2[7] and the TVPS-R[6] were correlated for the sub-tests with the same terminology i.e. Visual Closure, Figure Ground, Spatial Relations, Form Constancy as well as the general visual perceptual scores. Relationships between two variables were tested by calculating Spearman's rho correlation co-efficient.

To compare the outcomes in each subtest, the results were divided into assessment categories according to the subtests in the DTVP-2 and TVPS-R (see *Table II*). Correlations were considered significant if Spearman's rho correlation co-efficient was below the $p=0.05$ level and highly significant if the co-efficient was below $p=0.01$

The significance of the Spearman Rho and standard deviation were calculated to measure the accuracy of the assessments. Kruskal-Wallis Test was used as a non-parametric one-way analysis of variance to determine whether there was a significant difference between the mean group scores of the teacher check list and the three standardised tests and the subtests that related to both the DTVP-2 and the TVPS-R. The non-parametric Wilcoxon Signed Rank Test was used to compare individual paired scores of the teacher check list and the three standardised tests and the subtests

Table II: Correlation of Teacher check list to standardised visual perceptual subtests

Spearman rho correlations			
Standardized Test	**Category scores**		
	Correlation Coefficient	**Sig. (2-tailed)**	**N**
Eye Hand Co-ordination DTVP-2 / Category A	0.160(*)	0.039	167
Position In Space DTVP-2 / Category B First 6 Items only	0.201(**)	0.009	167
Copying DTVP-2 / Category C and item 2 of Category J	0.245(*)	0.001	167
Figure-Ground DTVP-2 / Category D, question 1 and 2 of Category C and question 3 of Category J	0.117	0.133	166
Figure-Ground TVPSR / Category D, question 1 and 2 of Category C and question 3 of Category J	0.105	0.196	153
Spatial relations DTVP-2 / Category B (questions 2 to 11 only) and questions 4 and 5 of Category A	0.184(*)	0.018	167
Spatial relations TVPSR / Category B (questions 2 to 11 only) and questions 4 and 5 of Category A	0.069	0.394	154
Visual Closure DTVP-2 / Category E and questions 1,2 and 4 of Category J	0.114	0.144	166
Visual Closure TVPSR / Category E and questions 1,2 and 4 of Category J	0.990(**)	0.000	170
Motor speed Category F	0.222(**)	0.004	167
Form Constancy DTVP-2 / Category G and question 1,2,3 of Category J	0.175 (*)	0.024	167
Form Constancy TVPSR / Category G and question 1,2,3 of Category J	0.139	0.085	154
Visual discrimination TVPSR / Category H and question 1 and 4 of Category J	0.154	0.056	154
Visual Memory TVPSR / Category I, question 3 of Category J and question 1 and 2 of Category C	0.242(**)	0.002	154
Visual Sequential Memory TVPSR / Category I, question 3 of Category J and question 1 and 2 of Category C	0.406(**)	0.000	154
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).			

Note: Each category relates to the group of questions related to the visual perceptual construct represented in the standardised tests (see Appendix I) of both the DTVP-2 and the TVPS-R for each Learner. EpiCalc 2000, version 1.02 was used to compare the grade sample numbers to determine whether there was a significant difference in the population distribution according to grade.

Results

The sample consisted of 173 learners, of which 119 (68.8%) were boys and 54 (31.2%) were girls, while 96 (55.5%) were in the age range six years to eight years eleven months and 77 (44.5%) were nine years to eleven years eleven months. Forty-one learners (23%) were in the first year at school, 40 (22%) in the second year, 58 (34%) in the third year and 34 (21%) in the fourth year (see *Table 1*).

Part 1: Teacher check list compared to subtests on the visual perceptual tests

➢ Eye – Hand Co-ordination (EHC)

A weak (r=0.160, r-values should aim to be close to + or - 1) but significant (p=0.039) correlation was displayed between the EHC subtest on the DTVP-2 (see *Table II*) and the relevant category of questions on the teacher check list, meaning that there is a 16:100 chance that this is a co-incidental significant correlation. The teachers' scores were generally higher than the scores on the DTVP-2, indicating that the teachers observed more difficulties in the classroom than the occupational therapists found in the DTVP-2. A significant correlation is apparent for eye-hand co-ordination scores and the teacher check list for the younger group (r=0.315, p=0.002), as opposed to the older group, meaning that the DTVP-2 is related to the teachers' observations in class for the younger learners.

➢ Position in Space (PIS)

In comparing the relevant questions in the teacher check list to the PIS subtest score of the DTVP-2, a significant (p=0.009) correlation was found (*Table II*). The confidence level of the correlation was however low (r=0.201).The teachers scored higher scores than did the DTVP-2 for PIS indicating that the teachers observed more difficulties in the class with regards to position in space than the occupational therapists found in the DTVP-2. A correlation (r=0.258, p=0.030) was found between the teacher check list and the PIS subtest on the DTVP-2 in relation to the younger child and boys.

➢ Copying

In the Copying subtest of the DTVP-2, a significant (p=0.001), but weak (r=0.245) correlation was found with the teacher check list (*Table II*). The teachers scored significantly higher than the DTVP-2 (p<0.001). This finding agrees with the finding on the EHC and PIS subtests, as the teachers observed greater difficulty in class than the occupational therapist observed in the DTVP-2. There was also a correlation to copying from a book or chalkboard and drawing of diagonal lines (r=0.506, p<0.000), as well as a correlation for both age groups (younger group r=0.216, p=0.340; older group r=0.258, p=0.030) and girls (r=0.384, p=0.007).

➢ Figure Ground (FG)

The teacher check list did not correlate significantly with the FG subtest on the DTVP-2 (r=0.117, p=0.113) or the TVPS-R (r=0.105, p=0.196). Both the DTVP-2 and the TVPS-R scored significantly higher than the teacher check list scores (*Table II*). Thus for FG, the DTVP-2 and TVPS appeared to identify difficulties that were not evident in the classroom. Neither the DTVP-2 (younger learner r=0.193, p=0.061; older learner r=0.178, p=0.137) nor TVPS-R (younger learner r=0.172, p=0.135; older learner r=0.038, p=0.742) showed a significant correlation with age, but the DTVP-2 correlated significantly for girls (r=0.283, p=0.038).

➢ Spatial Relations (SR)

In correlating the teacher check list and the SR subtest of the TVPS-R no significant relationship was found however, a weak (r=0.184) but significant (p=0.018) relationship was found for the SR subtest of the DTVP-2 (*Table II*). The DTVP-2 and the TVPS-R scored significantly higher than the teacher check list, thus the DTVP-2 and the TVPS appear to be more sensitive than the teacher check list at identifying difficulties with SRs. There were no correlations of data between the TVPS-R and gender, age or grade but the DTVP-2 correlated significantly for the younger child (r=0.343, p=0.002) and for boys (r=0.346, p=0.014).

➢ Visual Closure (VC)

A strong (r=0.990, p<0.001)) correlation was found between the relevant questions on the teacher check list and the VC subtest of the TVPS-R (N=170). The percentages of the TVPS-R VC scores and the related teacher check list scores are displayed on the scatter graph (*Figure 1*). The teachers scored significantly higher than the DTVP-2 (r=0.100, p=0.202), but significantly lower than the TVPS-R (r=0.997, p<0.000). The TVPS-R scores (r=0.108, p=0.168) were higher than the DTVP-2 scores, suggesting that the DTVP-2 is more sensitive to difficulties than the TVPS-R or the teacher check list.

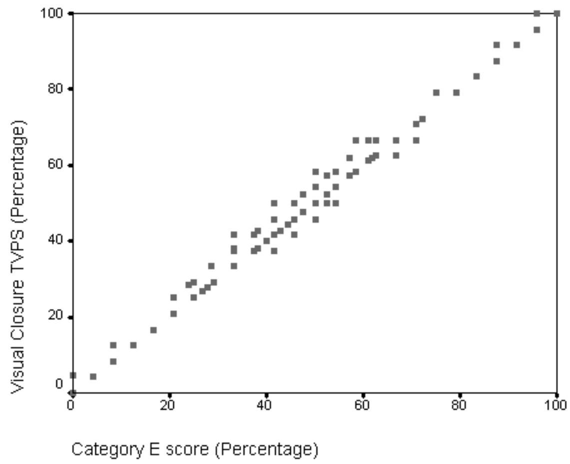

Figure 1: Scatter Graph Visual Closure TVPS-R Related to Teacher Check List

The DTVP-2 VC subtest showed no correlation with age or gender while the TVPS-R VC subtest showed a very strong relationship to age (younger learner r=0.996, p<0.000; older learner r=1.000, p<0.000), gender (Male r=1.000, p<0.000; Female r=0.993, p<0.000) and grades (*Table II*). Thus, the TVPS-R VC score was in strong agreement with the teacher observations, but the DTVP-2 agreed with neither the teacher observations nor the TVPS-R.

➢ Visual Motor Speed (VMS)

Although the correlation between the teacher check list and the VMS component of the DTVP-2 was weak (r=0.222) it still reached significance (p= 0.004). The DTVP-2 displayed higher scores than the teacher check list, but this was not significant. This suggests that the DTVP-2 and the teacher identify similar difficulties with regards to VMS. The correlation between the VMS subtest on the DTVP-2 and the teacher check list was stronger for the younger child (r=0.203, p=0.047) and girls.

➢ Form constancy (FC)

Form Constancy scores on the DTVP-2 were higher (but not significantly so) than those on the teacher check list, while check list scores were significantly higher (r=0.139, p=0.085) than the TVPS-R scores (*Table II*), suggesting that the TVPS-R may be more sensitive to difficulties seen in the class. The DTVP-2 Form Constancy correlated significantly with the younger child (r=0.238, p=0.020) only.

➢ Visual Discrimination (VD)

No correlation was found between the results for the VD subtest of the TVPS-R and the teacher check list (*Table II*).

➢ Visual Memory (VM) and Visual sequential memory (VSM)

The teacher check list correlated significantly (p=0.002) but weakly (r=0.242) with the (VM) score on the TVPS-R, however no significant correlation was found with the (VSM) subtest on the TVPS-R (*Table II*). The VM subtest and the VSM subtest on the TVPS-R displayed a strong correlation to each other (N=154). The TVPS-R scores were significantly higher than the teacher check list scores. There was a significant correlation for visual memory with the younger child (r=0.333, p=0.003) and for girls (r=0.353, p=0.012).

➢ The JLRRT

The JLRRT correlated weakly (r=0.237) with the teacher check list at a significant (p=0.004) level. A relationship was found to specific questions in the teacher check list relating to the learners' difficulty with place value in mathematics, and reversal or inverting of letters/numbers with similar structure but different orientation. The JLRRT was found to correlate weakly (r=0.240, p=0.023) with spelling for the entire sample group. Thus statistically, the JLRRT reflected the learners' academic performance (Observed by the teachers in the classroom), and reflected the spelling ability of the six to eleven year old learner.

Part 2: Composite score correlations with the teacher questionnaire

The DTVP-2 provides composite scores in the categories Visual Motor Integration (VMI), Motor Reduced Visual Perception (MRVP) and General Visual Perception (GVP). These composite scores were correlated with the total score of all the questions in the relevant categories on the teacher check list.

➢ VMI

The teacher check list correlated significantly with the DTVP-2 VMI score (p=0.032, r=0.166) (*Table III*), but no correlation was found between the DTVP-2 VMI score and mathematics, spelling, dictation or comprehension. There was also no correlation with age range or gender between the check list and the VMI composite score of the DTVP-2. Thus the results of the VMI score accurately reflected the observations of the teacher in general (*Table III*), but not according to subgroups.

Table III: Correlation of Composite Scores to the teacher questionnaire

	Correlation Coefficient	Sig. (2-tailed)	N
Visual Motor Integration DTVP-2	0.166(*)	0.032	166
Motor Reduced Visual Perception DTVP-2	0.228(**)	0.003	163
General Visual Perception DTVP-2	0.214(**)	0.006	166
Total Visual Perception TVPS-R	0.181(*)	0.025	154

- Correlation is significant at the .05 level (2-tailed).
- ** Correlation is significant at the .01 level (2-tailed).

➢ MRVP

There was a significant correlation (p=0.003, r= 0.228) of the MRVP score on the DTVP-2 and the teacher check list (*Table III*). Furthermore, significant correlations were found for MRVP and the teacher's score for boys (r=0.236, P=0.013) and the younger child (r=0.345, p=0.001). No correlation was seen between the MRVP score on the DTVP-2 and mathematics, spelling or dictation; however a relationship was displayed (r=0.287, p=0.026) between the MRVP and comprehension.

➢ GVP

The DTVP-2 composite score for GVP correlated significantly with the teacher's score (p=0.006, r= 0.216). Further correlations were found for the younger learner, reassessment, and dictation. The TVPS-R GVP component displayed a significant correlation (p=0.025, r=181) to the teacher check list. No correlation was found between GVP Score of the TVPS-R and mathematics, spelling, dictation or comprehension. There was a correlation of GVP of the TVPS-R with the younger learner (r=0.277, p=0.014).

Discussion

No consistent findings were found for correlations according to age range, gender, or grade with regards to the teacher check list in relation to the DTVP-2 and TVPS-R. Where correlations were evident they reflected a significance of relationship for the younger age group (six years to eight years eleven months).

The results of eye-hand co-ordination, position in space, form constancy, copying, spatial relations, and visual motor speed and the composite scores of the DTVP-2 correlated to the observations of the child by the teacher as manifested in the relevant components of the check list. There was no correlation between Figure Ground and Visual Closure and the check list.

The TVPS Visual Closure and Visual Memory subtests and the composite score corresponded to the observations of the child by the teacher as displayed in the teacher check list. The Jordan Left/Right Reversals test reflected the reversal tendency of the child as noted in the check list, particularly for the younger child.

In conclusion, it appears that using a teacher check list in the assessment of visual perception related to occupational performance in the classroom may be a useful method of screening learners for visual perceptual difficulties. However, the types of questions and the grading of the questions relating to academic performance still require further investigation.

These results reinforce the fact that visual perception is a complex concept for learners and observations by the teacher must be taken into account when diagnosing and treating a learner for visual perceptual difficulties. The co-operation between the teacher and therapist in order to achieve the optimum identification of learners requiring additional assistance in class or through occupational therapy is also reiterated in these results. The standardised methods set out in the test manuals should be adhered to in terms of the use of composite scores and the subtests should not be used in isolation for diagnostic purposes. This was borne out by the fact that the figure ground, visual closure and form constancy subtests did not correlate well with the teacher check list, but all the composite scores displayed adequate correlations.

The teacher check list could be very useful as a screening tool for initial identification of children in need of assistance and could be a forerunner to formal tests. It may also be completed periodically to monitor progress of therapy, however further refinement of the check list is needed prior to it being used for decision making.

Limitations of this research

The standardised tests were developed and standardised for populations in the United States of America, with no established validity and reliability of these norms for the South African population. Further limitations were due to the use of a convenient sample from a remedial school setting. These limitations included the following confounding variables: 93.6% of the sample had received or were receiving occupational therapy at the time of the study. The groups were not balanced as there were a statistically greater number of Grade three children when compared to other grade levels and statistically more boys than girls. The remedial setting further limited the study in that the sensitivity of the teacher check list for learners with minimal difficulties in mainstream education has not been tested. The class tests relating to spelling, mathematics, comprehension and dictation used as academic comparisons with the composite scores of the standardised tests were biased and unreliable as they were directed at the learner's level of ability and not at a typical grade level for mainstream education. Alternative methods to assess academic ability could be standardised educational tests such as a standardised reading, spelling and mathematics test.

As Grade ones (six to seven year olds) were still learning new skills, the teacher was often not able to answer sufficient questions to obtain a "perceptual score" (total sum of all the values allocated to the categories) on the teacher check list and these check lists had to be excluded. Despite these limitations, the study was considered useful as a first step towards developing a teacher-focused check list for identification of learners with visual perceptual difficulties.

In terms of the teacher check list (see *Appendix I* on pages 15 and 16), the items should be reorganised and refined in order to achieve a greater accuracy in answers with regards to specific categories (Figure Ground, Spatial Relations, Visual Closure and Visual Discrimination). Specific levels of functioning at each grade level on the teacher check list should be drawn up for easy reference by the examiner. The check list should be expanded further to include aspects of posture (muscle tone, balance) and medical diagnosis (e.g., visual problems), which may influence the learner's ability to learn and write successfully. Alternatively, a separate teacher check list for posture and gross motor skills could be formulated.

The reworked teacher check list should be applied to a broader sample of learners in order to test its sensitivity in terms of minor difficulties. A broader application of the check list would be necessary in order to evaluate the ease with which a teacher, who has no remedial training, can complete it.

Conclusion

Standardised tests should be used in conjunction with the teacher check list in order to purposely identify those learners requiring specific individualised input to assist them in their academic achievement. The teacher check list could be very useful as a screening tool for initial identification of learners in need of assistance and could be a forerunner to formal tests. It may also be completed periodically in lieu of constant, time-consuming standardised reassessments which are rendered invalid by repeated use (due to the effect of practice) in order to monitor progress of therapy.

Correlation of the teacher check list, standardised tests (composite scores) and academic performance should be pursued further with a sample of learners where regular class test results are available for comparison purposes.

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Appendix I

Teacher Checklist — Classroom Performance

Date: ....
Name of Learner: .... Date of Birth: ....
Age: .... Grade: ....
School: .... Teacher: ....

Please complete this form according to the learner's general performance, without using a fine tooth comb to find fault, but also without excusing obvious errors.

Is the learner on any medication?

Yes	No	Specify

	MOSTLY/ DAILY	OFTEN/ 1xWEEK	SELDOM	NEVER
CATEGORY A				
Incorrect pencil grip				
Presses very hard, holds pencil lightly, tremor				
Inconsistent rhythm; jerky, shaky letters				
Difficulty staying on the line				
Quality/size varies with sustained written output				
Poor desk posture/shifts around in chair				
CATEGORY B				
Reverses or inverts letters/numbers with similar structure but different orientation e.g. n/u, b/d, 2/S				
Difficulty with sequencing e.g. was/saw, of/for, 34/43 or phonic elements in incorrect order e.g. calm/clam, barn/bran				
Difficulty with place value in mathematics				
Poor/inconsistent spacing of letter or words				
Disorganised layout on page				
Difficulty with concepts of top, bottom, before, after, left, right				
Poor sequencing of events in story writing				
Confuses months, days, seasons, time of day				
Trouble observing the margin				
Difficulty seeing patterns and repeating them				
Difficulty seeing the link between ideas, pictures or events				
CATEGORY C				
Difficulty copying from book				
Difficulty copying from chalkboard				
Sees image is incorrect and keeps trying to correct it				
Difficulty with diagonal lines eg ✞, ✂, A				
CATEGORY D				
Skips lines/confusion when moving on to the next line				
Uses marker/finger to read				
Loses place on page or when copying				
Easily distracted by visual stimuli				
Reads slowly/hesitantly				
Unable to find individual detail in a picture or story				
Difficulty choosing relevant/important information (comprehension)				

	MOSTLY/ DAILY	OFTEN/ 1xWEEK	SELDOM	NEVER
CATEGORY E				
Does not complete words e.g. CRAC = CRACK, th = the				
Difficulty solving abstract problems involving analysis and synthesis skills				
Difficulty reading a word by the end of a line e.g. mis- on one line and -take on next line = mistake				
Sound out words correctly but unable to combine the letters to form the word				
Difficulty completing problems e.g. 3+ ____ = 11				
CATEGORY F				
Poor task completion/can't decide when a task is complete				
Qaulity of writing decreases with speed increase				
Writing/motor speed slow (not due to poor concentration)				
CATEGORY G				
Confuses similar letters e.g. r/n, n/m				
Does not always recognise a word just read				
CATEGORY H				
Poor discrimination e.g. car/cat				
Does not notice small differences in letters e.g. h/n				
Does not notice small difference in works or pictures eg. pin/pen				
Difficulty with sorting, matching and comparing information				
Does not pay attention to detail				
CATEGORY I				
Poor memory of learned spelling				
Difficulty writing from dictation				
Forgets what has just been read or seen				
CATEGORY J				
Guesses word from initial/middle/final letters				
Incorrect letter information: specify please				
Tends to omit letters				
Reads very slowly				

.... *continued on page 16*

.... Appendix 1 continued from page 15

Intelligence range					
	Below 80	81 - 90	91 - 110	111 - 120	120 plus
Verbal					
Performance					
Total					

Scores of last three tests in the following:				
SUBJECT	SCORE 1	SCORE 2	SCORE 3	AVERAGE
Mathematics	/	/	/	/
Spelling	/	/	/	/
Dictation	/	/	/	/
Comprehension	/	/	/	/
Learning subjects	/	/	/	/

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The relationship between developmental dyspraxia and sensory responsivity in children aged four years through eight years Part I

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ABSTRACT

Developmental Dyspraxia and Sensory Modulation Dysfunction (SMD) are disorders of Sensory Integration (SI) and widely known to occupational therapists who use a SI framework to guide clinical practice. These disorders have been widely researched and documented as separate disorders of deficient sensory processing. The co-occurrence of these disorders has also been reported as concomitant and described as such. SMD is viewed as the tendency to over or under respond to sensory information and Developmental Dyspraxia has a confirmed relationship with inefficient sensory discrimination. The aim of this article is to determine if a relationship exists between Developmental Dyspraxia and sensory responsivity. This was accomplished by correlating data from the Sensory Profile and Sensory Profile School Companion with data from the Sensory Integration and Praxis Tests. The results of the study did not confirm a relationship, but yielded interesting correlations that add value to the interpretation of children's sensory responsivity tendencies in the presence of Developmental Dyspraxia.

Key words: Developmental Dyspraxia, sensory responsivity, relationship, Sensory Profile, Sensory Profile School Companion, Sensory Integration and Praxis Tests

Introduction

Many occupational therapists who practise in the paediatric field make use of a Sensory Integration (SI) frame of reference to guide clinical reasoning during assessment and treatment of children. Developmental Dyspraxia and Sensory Modulation Dysfunction (SMD) are two disorders of deficient Sensory Integration and are well documented in occupational therapy literature[1,2,3]. Developmental Dyspraxia was first described by Jean Ayres who pioneered the theory of SI. Ayres stated that children with Developmental Dyspraxia often have trouble coping with life situations including childhood occupations like play, academic learning and social behaviour[1]. This disorder therefore has a profound impact on children and their daily life occupations.

Developmental Dyspraxia was first identified with a measurement instrument developed by Ayres in 1972, the Southern California Sensory Integration Test (SCSIT) and later the Sensory Integration and Praxis Tests (SIPT) in 1989[2]. Through development of the SCSIT and the SIPT, Ayres[2] and later Mulligan[4] were able to link poor discrimination of tactile, vestibular and proprioceptive input with dyspraxia[4,5]. This confirmed association between Developmental Dyspraxia and sensory discrimination contributed to the development of treatment protocols for Developmental Dyspraxia.

SMD is a pattern of Sensory Integration Dysfunction (SID) in which a person under-or over-responds to sensory input from the body and environment[5] and is identified through self-report measures like the Sensory Profile (SP) and the Sensory Profile School Companion (SPSC). Dunn[6] is the author of the SP and based her model for evaluating children's sensory responsiveness on neurological thresholds and behaviour of responding to sensory experiences. Sensory Modulation is also referred to as sensory responsiveness.

Continuous research in the field of SI locally and specifically in the United States of America (USA) has resulted in an abundance of information published on the subject of SI[7-11]. However, it also resulted in terminology related to SI being used interchangeably and has led to confusion. Efforts to reach consensus and uniformity when describing SID culminated in a proposed nosology for classifying Sensory Processing Disorders (SPD) which views Developmental Dyspraxia as a sub-pattern of sensory-based motor disorder while SMD is viewed as a pattern of SPD[2]. The literature further states and accentuates the relation between SMD and Developmental Dyspraxia as concomitant[12].

The relationship between sensory discrimination and Developmental Dyspraxia is supported in literature and has been clinically