CHAPTER 2
LITERATURE REVIEW

The review in this chapter starts with the influence of culture and socio-economic status on the development of visual-motor integration and the important link between this skill and the development of scholastic skills needed for academic achievement. A discussion follows on the reason for the selection of this specific test for the study.

The chapter concludes with a brief overview of the VMI test and supplemental visual perceptual and motor co-ordination tests. Since this is the fourth edition of the test, the changes made to this edition are briefly discussed and the validity and reliability of the test are outlined with specific reference to evidence regarding bias. The test booklets are included in Appendix E, F and G. The test procedures and scoring are discussed in chapter 3. The appropriate literature available for this review dates from 1957 to 1990 when the previous work on the reliability and validity on this test was concluded.

2.1 THE INFLUENCE OF CULTURE AND SOCIO-ECONOMIC STATUS ON VISUAL-MOTOR INTEGRATION

The discussion will start with defining visual-motor integration. The influence of culture and socio-economic status on visual-motor integration will then be explored through the literature reviewed.

In early research done in the area of visual-motor integration it was suggested that the visual-motor connection may be the first sensory integration response to develop\(^4\). Kephart noted that a child might have difficulties with the integration process, while visual and motor skills could be intact\(^2\). There is indication in the literature that integration might happen on a sub-cortical level such as in the brainstem, but other readings also link visual-motor integration to the cortex\(^2\).\(^,\(^2\).\(^5\).

Montgomery and Richter define perceptual-motor integration as
"the ability to combine discrete stimuli into a meaningful whole, generally on a cognitive (cortical) basis"(25). (p. 241)

Perception has a cortical link and this is described by using various terms such as cognitive-perceptual-motor dysfunction or cognito-perceptual-motor dysfunction(25).

Hubel and Weisel indicate that abilities are not only essentially inborn, but are modified by experience as at least part of the visual system is plastic and can be modified.(26). Visual-motor integration is therefore an end-product of interaction between inborn abilities and environmental factors, illustrating the importance of the child’s interaction with the environment. It is thus important to also consider culture and socio-economic status, since these would both influence the child’s environment.

Most assessments used for motor proficiency were developed in North America, Australasia or Europe and are not always completely culture-free(27). Findings of researchers about the influence of ethnic differences are often contradictory. Dunn, Loxton and Naidoo identified significant ethnic differences on the visual-motor integration performance of South African preschoolers whereas Schlodder did not find any on the five-year old non-African group she studied(28, 29). The influence of culture on test results is complicated. It is important to consider how culture could influence a child’s familiarity with the entire testing situation. As cited in “Human development, a lifespan view” (23), Anastasi, Herrnstein and Murray found that when assessing children on culture-fair intelligence tests, group differences between European and African Americans occurred. It was therefore posed that the child’s specific culture could

"encourage children to solve problems in collaboration with others and could discourage them from excelling as individuals"(23). (p. 214)

Children in certain cultures were found to be wary of answering questions posed by unfamiliar adults and as cited in “Human development, a lifespan view”, Boykin, Zigler and Finn-Stevenson found that especially African American and economically disadvantaged children would often answer questions by saying “I don’t know” but when given extra time, would improve their test scores(23). This is relevant to the STVP where a response is required from the child within a certain time limit.
Defining and describing socio-economic status is also fraught with problems. The United States of America's poverty thresholds linked to a dollar figure to determine socio-economic status have been severely criticized in literature but despite the criticism, this method, devised more than 40 years ago, is still used to distinguish the poor from the non-poor. A different way to classify socio-economic status proposed for South Africa is by using the breadwinner's occupation and highest level of education to determine low, middle or high socio-economic status. Various research studies found that

"poor children receive lower grades, receive lower scores on standardized tests, are more likely to experience learning disabilities and developmental delays, are less likely to finish high school, and are less likely to attend or graduate from college than are non-poor youth." \(^{(30)}\) (p.60)

Results from South Africa are contradictory, with Dunn et al identifying the performance of the higher socio-economic group as being significantly different from low and middle, but Lotz found in her research study that differences where the lower socio-economic group consistently got lower scores were not significant.\(^{(28,32)}\)

For this reason it is important to also investigate the effect of socio-economic status on the results achieved on the tests used in this study.

2.2 THE LINK BETWEEN VISUAL-MOTOR INTEGRATION AND SCHOLASTIC SKILLS  In the literature reviewed, a strong link between visual-motor integration and academic achievement has been identified.\(^{(4)}\) Occupational therapists are involved in the assessment of visual-motor integration as part of the battery of tests carried out on children with learning problems and remediation of the skill is usually recommended in the hope that it will have an overflow effect on their school achievement. Due to the complex nature of this skill, it is important to carefully analyse reasons for difficulties in this area of perceptual processing. Literature attributes difficulties with visual-motor integration to various factors such as visual-cognitive deficits including visual discrimination, poor fine motor ability, the inability to integrate visual-cognitive and motor processes, or a combination of these.\(^{(5)}\)
Specific links between visual-motor integration and the development of reading and writing, especially in younger grades has been well researched \(^6,\ ^{33}\). A study by Sortor and Kulp found a link between the VMI test, STVP and STMC results, and achievement in reading and maths in 7 to 10 year old children\(^{34}\). A significant link was also found between VMI test results and teachers' ratings of reading, maths, writing and spelling in kindergarten children\(^{35}\). Rosner and Rosner identified visual-motor integration as a problem in 78% of learning disabled children in their study, again confirming the link between this skill and academic achievement\(^{36}\).

Handwriting particularly requires visual-motor integration, which allows for the integration of the visual image of letters and shapes with an appropriate motor response. A study done by Tseng and Murray found that visual-motor integration was the best predictor of handwriting legibility\(^5\). Weil and Amundson found that children who could successfully copy the first 9 figures of the VMI test could copy significantly more letters of our alphabet without any formal instruction, than those who could not \(^{33}\). These results also support the findings by Beery(1982) and by Benbow, Hanft, and Marsh(1992), cited in “Occupational therapy for children”, suggesting that formal handwriting instruction should not start before children can master the first nine figures of the VMI test\(^{33}\). This further emphasises the strong link between visual-motor integration and handwriting and the importance for therapists to assess the visual-motor integration skill in young children.

Since literature emphasises the link between the visual-motor integration skill and various scholastic skills such as handwriting, reading, maths and spelling it underlines the importance of ensuring the correct standardization of this specific test for the population it is used for.

**2.3 SELECTION OF THE VISUAL-MOTOR INTEGRATION TEST**

Increasing demands are made by insurance companies, professional codes of practice and government legislation for professionals working in the health and educational sectors to provide evidence and rationale for their service delivery\(^{27}\).
Tests listed to be used for the assessment of visual-motor integration are the Bender Visual motor gestalt (1963), the Benton visual retention test(1974), the VMI test(1989), the test of visual analysis skills(1960) and the memory for design test(1960)\(^\text{(5)}\). The VMI test was updated in 1989 while all the other assessments stated in this source dated back to the 1960’s and 1970’s, indicating it is a more current assessment. Surveys done by Rodger in 1994 and Wallen & Walker in 1995, found the VMI test to be frequently used and a very popular tool used worldwide\(^\text{(27)}\). The VMI test is quick and easy to administer and provides a more detailed measure of graphic skill than other tests\(^\text{(27)}\).

In his manual, Beery cleverly states that the VMI test “is designed to measure the hyphen in the term visual-motor integration”\(^\text{(4)}\). (p.19) The two standardized supplemental tests, the STVP and STMC provide a more detailed examination of the child’s visual-perceptual and perceptual-motor skills\(^\text{(27)}\). Some children might be resistant to the development of their visual-motor abilities and in those cases the three parts of this test are useful as a screening tool to assure service provision to children who appear at risk\(^\text{(4)}\).

The VMI test is often used for research purposes to evaluate the effectiveness of various therapeutic, educational or medical interventions\(^\text{(4)}\). With AIDS becoming an increasing threat in South Africa and one of the top 10 causes of death in children between the ages of 1 and 5, it is also important to note the successful use of the VMI test for tracking progress in fine motor skills during antiretroviral therapy\(^\text{(37)}\). This makes the VMI test even more appropriate for this study and for future visual-motor integration norms on a South African population.

The VMI test’s fifth edition has been released in 2004, but at the time of data collection for this study the fourth edition was the most current.
2.4 THE BEERY-BUKTENICA DEVELOPMENTAL TEST OF VISUAL-MOTOR INTEGRATION (VMI) (4TH EDITION REVISED) AND SUPPLEMENTAL VISUAL AND MOTOR TESTS

2.4.1 Overview of changes to the fourth edition

The VMI test was first published in 1967 and after a revision in 1982 and 1989 the fourth edition was published in 1997, which is the edition used in this research. The 1997 edition is the first to include two supplemental standardized tests, the VMI test for visual perception and VMI test for motor coordination. To compare results between the VMI test and the two supplemental tests, the scoring system of the fourth edition was changed from weighted scoring (1 to 4 points per form) used in the 1989 edition back to the original one-point-per-item scoring that was initially used prior to the 1989 edition\(^4\). The VMI test standard scores are now presented in 2 month intervals because young children tend to develop rapidly while the supplemental test results are presented in 4 month intervals in ages ranging from 3 years to adult. Age norms are included for children as young as 28 weeks\(^4\).

The VMI test consists of 27 shapes and drawings graded in complexity that are copied. When scoring the 1997 edition, it is important to note that the 3 imitated drawings are now included in the total score and in the standardized norms. There are now 27 possible raw score points and not only 24 as in previous editions. The VMI test was originally designed for preschool and elementary school age levels and normative studies done on the different editions of the VMI test indicated almost perfect correlations among various norms and their scoring systems\(^4\). For this reason, studies of the VMI test done prior to the 1997 edition are still relevant and the different editions could be compared if needed\(^4\).

2.4.2 The aim of the VMI test and supplemental tests

The VMI test was developed for the primary purpose of identifying difficulties children have with the integration or coordination of visual perceptual and motor abilities. The aim of the test is to screen children early by using this assessment and then to assist them to either develop this ability, or if the ability is resistant to development, to develop other modalities\(^4\).
Although the supplemental tests are recommended for individual testing of those who scored below average on the VMI test\(^4\), it was done on all the children in the sample, for the purpose of this study.

### 2.4.3 Reliability

For a test to be reliable and useful there should be consistency in the content of the test items (Content sampling), individuals’ performances (Time sampling) and scoring performed by different examiners (Interscorer)\(^4\). For research purposes, the overall reliability of a test, made up of these three aspects, should be at least .70. For screening tests it should be .80 and for making more important decisions about an individual .90.\(^4\) Table 2.1 summarizes the reliability of the VMI test and supplemental tests and indicates a high reliability of .92, .91 and .89 for the VMI test, the STVP and the STMC respectively\(^4\).

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<th>VMI test</th>
<th>STVP</th>
<th>STMC</th>
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<tbody>
<tr>
<td>Content Sampling</td>
<td>.96</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Time Sampling</td>
<td>.87</td>
<td>.84</td>
<td>.83</td>
</tr>
<tr>
<td>Interscorer</td>
<td>.94</td>
<td>.98</td>
<td>.95</td>
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<tr>
<td>Average</td>
<td>.92</td>
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### 2.4.4 Validity

In addition to reliability, the VMI test and supplemental tests also demonstrate validity. Content validity, concurrent validity and construct validity were the aspects considered\(^4\).

Content validity demonstrates that the test assesses what it is designed to assess. The content validity was strongly supported by the Rasch-Wright and other item analysis methods used by Beery and described in the manual\(^4\).

To establish concurrent validity the tests are compared with similar tests measuring similar abilities. Studies comparing the VMI test results with the Bender-Gestalt indicated moderate correlations of .56\(^4\).

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The part of construct validity that would be important to discuss in relation to this study is the evidence regarding bias. It is postulated in the manual that the VMI test and supplemental tests are not influenced by gender, ethnicity, socio-economic status or residence\(^4\). Although statistically significant differences were found due to ethnicity, socio-economic status and residence, Beery argued that the large samples used in the research for example studies done by Nye with 3766 children, could result in very small differences becoming statistically significant. Although this argument could be valid, the statistically significant differences found cannot be completely ignored and further research is warranted. It is stated in the manual that in comparison to many other types of tests, the VMI test for example still "appears to be essentially culture free"\(^4\). (p. 122)

2.5 CONCLUSION

In the literature reviewed it was evident that visual-motor integration is an important skill, linked to academic achievement and well assessed by the VMI test. The VMI test and supplemental tests have proven reliability and validity for the sample on which it was standardized. The candidate could not find recent studies done in South Africa that included the Visual and STMC as part of the research results. Many local and international researchers used the VMI test in their studies, but did not include the two Supplemental tests\(^{28, 38, 39}\). It was suggested by Beery that further research should include the STVP and STMC, since these tests would shed light on the development of visual perception and motor coordination when separated from the integration of the two\(^4\). It was clear in the literature that the influence of culture and socio-economic status on children’s test results could not be ignored. Normative data would not automatically apply to a different population. Beery suggested:

"Ideally, every test would be locally normed on every population for which it will be used. Since such extensive local norming is not practical, the next best norming population is one that is as representative as possible of the state or national population in which it will be used. Locally normed tests should not be used nationally. Test selectors should always compare the average performance levels of

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even nationally normed tests with those of other well-established and nationally normed tests
"(4). (p. 93)