THE EFFECTS OF LEVEL AND QUALITY OF EDUCATION ON A SOUTH AFRICAN SAMPLE OF ENGLISH AND AFRICAN FIRST LANGUAGE SPEAKERS, FOR WAIS-III DIGIT SYMBOL—INCIDENTAL LEARNING

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Note

This mini-thesis has been written, as mandated, in an appropriate journal format and length.

ABSTRACT

This study examined the effects of *level* and *quality* of education on WAIS-III Digit Symbol—Incidental Learning performance. The Pairing and Free Recall measures were administered to a South African sample (N = 68, age range 19-30), which was stratified for English and African language, level of education attained (Grade 12s and Graduates) and quality of education (advantaged and disadvantaged schooling). Results yielded no significant main or interaction effects between acculturation factors of level and quality of education. Normative guidelines of 13 or more pairs and 8 or more free recall symbols, appropriate to a non-clinical sample in a multicultural setting, are provided. Digit Symbol—Incidental Learning proved to be a culture-fair test, which contributes to its clinical utility as a sensitive memory screening tool.

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Chapter 1: LITERATURE REVIEW

1.1 Introduction

The digit symbol substitution tests have been used in psychological batteries for decades, and a Digit Symbol (or Coding) subtest features in every edition of the Wechsler intelligence scales (Joy, Fein, Kaplan, & Freedman, 2000). Using a key, the examinee writes in a series of hieroglyphic-like symbols, each of which is paired with its own number (e.g. Wechsler, 1955, 1981, 1997). Identified as the most sensitive indicator of brain dysfunction of the Wechsler subtests (Lezak, 1995), Digit Symbol has been found to be depressed with a range of neuropathological conditions, ranging from hydrocephalus and tumours, to closed head injury, Alzheimer's dementia and alcohol dementia (Correll *et al.*, 1993, Crawford *et al.*, 1997, Larrabee *et al.*, 1985, Russell, 1979, Walsh, 1991, as cited in Shuttleworth-Edwards, Border, Reid, & Radloff, 2001a). Although primarily a measure of processing speed, the test also taps short-term memory and learning (Joy *et al.*, 2000).

In order to isolate the effects of the memory component on digit symbol performance, an additional incidental (i.e. unwarned) learning procedure was developed by Edith Kaplan and her colleagues (Kaplan, Fein, Morris, & Delis, 1991), and incorporated into the Wechsler Adult Intelligence Scale-Revised as a Neuropsychological Instrument (WAIS-R-NI). It comprised paired associate recall and free recall, which have been included under the labels Pairing and Free Recall in the optional procedures of the latest Wechsler Adult Intelligence Scale 3rd edition (WAIS-III) (1997). Incidental learning has proved to be a valuable memory screening tool (Joy *et al.*, 2000). For example, Hart, Kwentus, Wade, and Hammer (1987) found that it effectively distinguished between normal controls, depressed patients and patients with mild dementia of the Alzheimer's type.

The utility of Digit Symbol—Incidental Learning in a cross-cultural setting was examined in this study. Cognitive assessment in cross-cultural settings with current neuropsychological tests is inherently problematic, if one considers the role the culture plays in learnt cognitive abilities. Ardila (1995) states that test performance is influenced by various factors, notably cultural beliefs, behaviours and elements, ecological demands, language, and educational level. He stresses the need inter alia for appropriately standardised normative data and analysis of educational and subcultural factors, as well as the search for commonality in test performance among existing groups. Furthermore, while much research has explained resulting racial differences by attributing them to homogenous sets of socio-cultural factors, acculturation trends in globalised urban settings are causing marked socio-cultural variations *within* race groups (Shuttleworth-Edwards *et al.*, 2001b).

South Africa's complex socio-political history has produced both cultural diversity and educational disparities in the population, which make the application and valid interpretation of neuropsychological tests a challenging task. Under the discriminatory Apartheid government prior to 1991, black learners in the Department of Education and Training (DET) system had access to a mere 5% to 25% of the resources to which their white counterparts were privy (Claasen, Krynauw, Hotzhausen, & Mathe, 2001). This considerable discrepancy translates into a significant inequality in education received by those groups, and its potentially deleterious effects on cognitive test performance cannot be overlooked. Subsequently, gradually increasing numbers of black learners have access to a better quality private or equivalent model C education. Within the black population group alone therefore, the acculturation variable of quality of education is evidently crucial (Shuttleworth-Edwards *et al.*, 2001b).

The Human Science Research Council (HSRC) recently undertook to standardise the WAIS-III for use in South Africa (Claasen *et al.*, 2000, 2001). However, adequate control of the quality of education variable within the black sample has not been ensured. Nell (1999) notes that this factor could seriously effect the use and interpretation of the data. A broad project, of which the current study is a part, was thus initiated by the Rhodes University Psychology Clinic, to supplement the HSRC standardisation. The project comprised an investigation of normative indications on the standard WAIS-III test performance and its optional procedures, in a sample of young adult English and African first language participants, stratified for level and quality of education, specifically to explore the sequelae of the educational disparities highlighted above. Four investigations into the standard WAIS-III have already been completed. They are: (1) analysis of the WAIS III towards the development of a short-form, (2) the effects of gender on test performance, (3) the effects of socio-economic circumstances and quality and level of education on test performance, and (4) the effects of language of origin on test performance.

The present fifth study is an investigation into the effects of level and quality of education on the WAIS-III optional procedure of Digit Symbol—Incidental Learning Pairing and Free Recall, which has not been analysed or reported. In addition, the need for accurate normative data for this widely used test, standardised appropriately for a South African setting, is paramount. To begin with, a description of Digit Symbol—Incidental Learning and its historical development is presented.

1.2 Digit Symbol—Incidental Learning

Incidental memory, or recall without warning, as measured in the WAIS III Digit Symbol—Incidental Learning procedure, is a form of recent or short-term memory which must be distinguished from intentional memory, or recall following the instruction to memorise material. Lezak (1995) notes that "when the declarative memory is intact, much information is also acquired without directed effort, by means of incidental learning" (p.30). A deficit in recent memory functioning is generally a symptom of diffuse cerebral pathology.

With the addition of the Digit Symbol—Incidental Learning Pairing and Free Recall procedures to the current WAIS-III, the value of including a measure of incidental memory is highlighted. Indeed it is the only direct measure of non-verbal recent memory of the WAIS-III, and thereby significantly enhances the battery's deficit screening potential (Shuttleworth-Jordan & Bode, 1995b). While not used in the computation of IQ or Index Scores, it is designed to help the examiner determine whether or not a low score on Digit Symbol—Coding is due to the examinee's inability to remember the stimuli without constantly referring back to the key (Wechsler, 1997). The alternative hypothesis, that a poor Digit Symbol—Coding score is due to slowed perceptual and graphomotor speed is separately assessed in the other optional procedure of Symbol Copy (Wechsler, 1997), and not within the scope of this research. The relationship between Digit Symbol and memory (versus speed) has been contentiously debated in the past decade. However, two seminal recent studies (Joy *et al.*, 2000; Kreiner & Ryan, 2001) equivocally demonstrate that speed is more significant than memory in explaining differences in Digit Symbol performance. In both studies, incidental learning accounted for a mere 1-3% of variance of Digit Symbol scores when entered into a multiple regression with the speeded Symbol Copy test (Joy *et al.*, 2000; Kreiner & Ryan, 2001). This finding however is separate from the fact that Incidental Learning makes a valuable contribution to cognitive assessment as a measure of recent memory.

The optional Incidental Learning procedure comprises two tasks: (1) Pairing, which measures the ability to attend to, process, and remember the symbols and to pair them with the correct numbers; and (2) Free Recall, which requires the examinee to recall as many of the symbols as possible, independently of the numbers. It measures the ability to remember symbols, as well as their incorrect recall, evident in the inversion, rotation or other distortion of the symbols (Wechsler, 1997).

At present there are three variants of the administration of the Digit Symbol incidental learning procedure, which evolved as follows:

1) The incidental learning task was first incorporated into the WAIS-R-NI (Kaplan *et al.*, 1991) as a neuropsychologically sensitive measure, and employed in this format in recent research (Joy *et al.*, 2000). Examinees are called to complete the first three rows (up to 68 pairs) of the WAIS-R Digit Symbol subtest, during which their position at 90 seconds is noted for the Digit Symbol score. The fourth row must then be filled in from memory. The number of symbols correctly matched with each of the nine digits produces the paired associates score (out of nine). After this, recall of the symbols alone is requested for the free recall score (out of nine).

2) Next, utilising the South African WAIS (SAWAIS), Shuttleworth-Jordan & Bode (1995a, 1995b) developed a digit symbol short form, requiring examinees to complete the first two rows (up to 42 pairs) with the 90-second administration of the SAWAIS Digit Symbol subtest, followed by the third row from memory. This version similarly yields a paired associate score (out of nine). Free recall is not included. Given the potential for fatigue

among older adults, it was developed for economical use in the context of normative data collection across the adult age range (Shuttleworth-Jordan & Bode, 1995a).

3) Finally, both the WAIS-R-NI and SAWAIS tests have been succeeded by the current WAIS-III. The modified Digit Symbol—Coding has larger symbols, and the space between the key and the stimulus items has been increased (Wechsler, 1997). The practice requirement for the longer 120-second administration is expanded to the end of the fourth row (73 pairs), and the recall phase extended to two sets of 9 pairs, which results in a Pairing score (out of 18). Similar to the WAIS-R-NI, the recall of symbols follows to ascertain a Free Recall score (out of 9).

Although the essential dynamics of the three versions of the incidental learning measures remains similar, variation in the time length and total scores impacts on the compatibility of normative comparisons, as well as raising other issues. The WAIS-R-NI method was developed prior to the publication of the WAIS-III, the current industry standard. However, with the advent of the longer WAIS-III format (120s rather than 90s), which also calls for an extended practice requirement (5 extra pairs) and has a Pairing score out of 18 (rather than 9), comparisons of normative data between the tests cannot be made. This limits the application of research data to scores obtained with the same test instrument. Shuttleworth-Edwards *et al.* (2001a) argues that her abbreviated method is not rendered obsolete, but should rather be preserved for use, to prevent fatigue when testing older or debilitated persons, or where time is limited in research with large samples. In comparison, the intended advantage of the longer WAIS-III version is that in addition to measuring retention, it allows a qualitative analysis of incorrectly recalled symbols (Wechsler, 1997). The indication for using the most current clinical tool (in this case the WAIS-III) to gather new normative data is maintained, although the usefulness of other versions (such as the abbreviated Shuttleworth-Jordan method) may be argued for specific research scenarios.

A survey is now presented of published trends in digit symbol incidental learning research to date, indicating the relevance of its utilisation.

1.3 Clinical research findings

Hart *et al.* (1987) demonstrated the diagnostic utility of incidental learning, which proved effective in distinguishing between normal, depressed and mild dementia patients in an older age-matched group. While the standard digit symbol scores were equivalent, depressed patients recalled more pairs and free recall symbols than patients with mild dementia of the Alzheimer's type; similarly the normal subjects recalled more pairs than the depressed patients, though both obtained a similar free recall score. This is ascribed to the greater effort, lacking in unmotivated depressed patients, required to recall pairs than for free recall (Hart *et al.*, 1987).

Massman and colleagues report that Digit Symbol paired recall was one of only three tests (along with Digit Symbol and Trail Making B) in a battery to distinguish depressed Huntington's disease patients (who scored fewer pairs) from depressed normals (Massman, Delis, Butters, Dupont, & Gillin, 1992). Most recently, Demakis, Sawyer, Fritz, and Sweet (2001) found that incidental recall discriminated between Alzheimer's and Parkinson's diseases, with Parkinson's patients recalling significantly more symbols and symbol-number pairs than Alzheimer's patients. Discriminate function analysis correctly classified 76% of these patients on the free recall measure. Furthermore, the number of symbols recalled was consistently and strongly related to other measures of memory, which highlights the clinical relevance of incidental recall in the detection of memory impairment (Demakis *et al.*, 2001).

Incidental learning is part of the Wechsler battery, which is itself a general assessment tool, from which further more specific neuropsychological investigations may ensue. Certainly the incidental learning measure requires immediate recollection of visual information, though the symbols may also be associated using auditory memory (Kreiner & Ryan, 2001). Incidental Learning is then a face-valid indicator of visuospatial memory (Joy *et al.*, 2000), which has been shown to be sensitive to memory impairment (Demakis *et al.*, 2001; Hart *et al.*, 1987). In support of this, Kreiner and Ryan (2001) recently published the first study to verify that Incidental Learning is a valid measure of memory. They successfully corroborated WAIS-III Incidental Learning scores with independent measures of Immediate Memory and General Memory from the Wechsler Memory Scale-III (Kreiner & Ryan, 2001). This study was closely followed by that of Demakis *et al.* (2001), whose commensurate findings showed that WAIS-R incidental learning was more strongly related to established memory measures (e.g. WMS-R Logical Memory and Visual Reproduction) than to measures of cognitive efficiency.

While the efficacy of incidental learning as a screening instrument has been established, there is consensus that caution should be exercised in the interpretation of poor scores (Joy *et al.*, 2000; Shuttleworth-Jordan & Bode, 1995a, 1995b). While average Incidental Learning scores suggest grossly intact memory, as measured by the test, abnormal scores may not be used as stand-alone evidence of impairment. Rather an inferred hypothesis of memory deficit justifies further assessment in these domains (Joy *et al.*, 2000; Shuttleworth-Jordan & Bode, 1995a, 1995b). In order to determine the suggested boundaries of normal and impaired test performance, a summary of the normative studies conducted thus far will be offered.

1.4 Normative guidelines

Available normative data for incidental learning in the 19-30 age group, which forms the focus of this study, is limited to predominantly white samples, with no stratification for educational differences. Lezak (1995) gives a pairing guideline without age differentiation of **6 pairs** being "at the low end of the range of normal recall" (p.463) for the WAIS-R-NI, and Shuttleworth-Jordan and Bode (1995b) suggest **7 pairs** for the 20-39 age group on the abbreviated test form. In earlier studies, Burik's (in 1950) 50 female high school students recalled a mean of **7.1 pairs**, while Murstein and Leipold's (in 1971) 15 college students recalled a mean of **6.2 pairs** (*SD* = 1.76) (cited in Joy *et al.*, 2000).

For the longer WAIS-III Incidental Learning, normative data in both the American and British standardisations offers no stratification according to education, providing only cumulative percentages up to the 50^{th} percentile. For the 20-29 age group, a Pairing score of around **14 pairs** out of 18 at the 50^{th} percentile is given (Wechsler, 1997). This may be equivalent to half the earlier format, i.e. **7 pairs** out of 9, although direct comparison of the two versions has yet to be validated. For Free Recall, **8 symbols** out of 9 at the 50^{th} percentile are reported for the 20-29 age group. Higher levels of performance for the WAIS-III are not described, nor are means or standard deviations supplied. No data for either versions of this test are presented in the two most recent compilations of neuropsychological test norms, i.e. Mitrushina, Boone, and D'Elia (1999), and Spreen and Strauss (1998).

The only available culturally stratified data are reported for paired recall in Shuttleworth-Jordan (1996), on a sample of university students in the 18-25 age range. The English language group obtained a mean scored of **7.32 pairs** (*SD*=1.68), while their African language counterparts attained a marginally lower mean score of **6.59 pairs** (*SD*=2.4), essentially suggesting a normative average of **7 pairs** for both groups. The difference in means was tentatively attributed to non-equivalence in the quality of the participants' prior education, despite their equivalent current university level of education (Shuttleworth, 1996). Analysis of possible statistical significance was not recorded.

Though not within the same age range or focus of the current study, a limited number of other studies have examined older age groups. In the Hart *et al.* study (1987), the 19 normal subjects with an average age of 70 recalled a mean of **6.4 pairs** and **6.9 free recall symbols** respectively. Although the Hart *et al.* data do not suggest an ageing effect, two recent studies have found significant age-related decline in incidental learning performance. Shuttleworth-Jordan and Bode (1995b) reported a recall of **5-6 pairs** for the 40-69 age group, and only **3-4 pairs** for the 70-89 age group. Joy *et al.* (2000) suggest a guideline of **at least 3 pairs and 6 free recall symbols** for middle-aged and older adults, which as noted by the authors is lower than previously predicted. Commensurate with Shuttleworth-Jordan and Bode (1995a), a significant ageing effect was observed in the Joy *et al.* (2000) research.

The paucity of normative data appropriate to a culturally diverse South African context, clearly suggests the need for the current study. First, a clearer understanding of cultural factors and the notion of acculturation must be secured.

1.5 Culture and acculturation

The potential for factors of cultural heterogeneity to influence performance on cognitive tests, especially Digit Symbol—Incidental Learning, requires further scrutiny. This is particularly relevant in a South African context, where the population was previously segregated and educated separately on grounds of racial differences. The Apartheid structures of "separate development" (euphemistically termed) were dissolved with the advent of democracy, and increasing shifts toward integration, urbanisation and westernisation have resulted. The need for valid cognitive assessment in this complex population makes rigorous demands for culturally relevant test usage. Whereas there has in the past been pressure to abandon tests that originate in North America and the United Kingdom for fear that they are culturally irrelevant, there is new impetus to understand the complexities of test performance and to adjust and standardise such measures appropriately. The current HSRC standardisation of the WAIS-III constitutes a prevalent example of this process (Claasen *et al.*, 2000, 2001)

In the consideration of cultural test influences, a distinction should be made between racial differences, and often associated socio-cultural factors. Whereas previously, race or ethnicity has in itself been considered to effect test performance, many racial differences found in recent comparative studies have been ascribed to homogenous sets of socio-cultural factors which characterise a particular race (Shuttleworth-Edwards *et al.*, 2001b). These have been operationalised by various researchers as attitudes, beliefs, expectations, geographic region, ideologies, language of origin, level and quality of education, literacy including reading level, home/schooling/occupational socialisation experiences, socio-economic status, test-wiseness, urbanisation, and values (Ardila, 1995; Ardila & Moreno, 2001; Gonzales & Roll, 1985; Manly *et al.*, 1998a, 1998b, 2000; Nell, 1999; Olazaran, Jacobs, & Stern, 1996; Shuttleworth-Edwards *et al.*, 2001b; Shuttleworth-Jordan, 1996).

The process of acculturation, defined as "the level at which an individual participates in the values, language, and practices of his or her own ethnic community *versus* those of the dominant culture" (Manly *et al.*, 1998b, p.292), unites many of these factors impacting on cognitive testing. If one considers that most neuropsychological measures originate from the dominantly North American and European cultures, the extent to which a person has been acculturated to this dominant western culture determines their measured neuropsychological test performance. It follows that members of the same racial group may have been exposed to vastly differing degrees of acculturation, and may therefore not possess socio-culturally homogenous characteristics (Gasquoine, 2001; Manly *et al.*, 1998b, 2000; Shuttleworth-Jordan, 1996).

The Wechsler Intelligence Tests have been administered in many cross-cultural settings, where both equivalent and significantly different findings have resulted on the various factors and subtests, for a range of population samples. The universalist notion holds that the same instrument can be used in different cultures to measure intelligence. This has been supported by cross-cultural congruence demonstrated on the factor structure of the Wechsler scales. This was shown in comparison between the predominantly English speaking white US sample, and the following groups respectively: American blacks (e.g. Kaufman, McLean, & Reynolds, 1991), Spanish-speakers (Demsky, Gass, & Golden, 1998), Argentinians (Insua, 1983), Italians (Orsini & Laicardi, 2000) and Chinese (Lynn & Dai, 1993) samples. However, the differences in reported subtest data and need for significant item adjustment (especially for Vocabularly, Information, Comprehension and Arithmetic) in various cross-cultural settings, indicates otherwise (e.g. Ardila & Moreno, 2001; Insua, 1983; James & Dalton, 1993; Kaufman, McLean, & Reynolds, 1988; Manly *et al.*, 1998b; Marcopulos, McLain, & Giuliano, 1997; Melendez, 1994). In southern African settings, the application of Wechsler tests has been especially problematic (e.g. Avenant, 1988; Skuy, Schutte, Fridjhon, & O'Carroll, 2001; Zindi, 1994). Large discrepancies between low-scoring African samples versus standard US/UK samples have consistently been noted.

The predominance of incidental learning research has been limited to white English-speaking samples. As described previously the only culturally stratified data were reported by Shuttleworth-Jordan (1996) for a sample of university students in the 18-25 age range. A small distinction showed the African language group scoring 0.73 pairs below their English counterparts. This was supported by slightly lower scores in the African language group for Wechsler Memory Scale Visual Reproduction Test (Immediate and Delayed) for the same sample (Shuttleworth-Jordan, 1996). As with many of the studies referred to above, the influence of education was cited as a key factor of socio-cultural difference.

Nell (1999) highlights the concept of test-wiseness as "the most fundamental difference between westernised subjects and those from nonwestern cultures" (p.129). This includes the ability to concentrate intensely, balance accuracy with speed, use a pencil adroitly, know the alphabet well, complete copy tasks, and remain self-confident and motivated (Anastasi, 1982; Nell, 1999). These skills are learned in the classroom, and in cumulative experiences of test-taking and examinations. Test-wiseness is determined by the crucial acculturation factor of education, which is a major focus of this study.

1.6 Level and quality of education

The effect of education on testing is separately appraised under influences of level of education, and quality of education. The relationship between level of education achieved and IQ is well established. Significant correlations were reported between years of education attained and FSIQ for the Wechsler-Bellevue (0.64), WAIS (0.69-0.72), and WAIS-R (0.62-0.63) batteries (Matazarro & Herman, 1984). Similarly, in a study of the WAIS-R standardisation sample, Kaufman *et al.* (1988) demonstrated significant main effects for education for all four age groups. In an extensive review of nearly 200 studies, Ceci (1991) presents a strong argument for the role which quantity of schooling plays in "the development of cognitive processes that underpin performance on most IQ tests" (p. 703). Several studies have shown that IQ increases by 2 to 4 points per year of education received (Harnqvist, 1968; Lund & Thrane, 1982; Winship & Korenman, 1997). Whether it is that individuals with higher intelligence proceed to higher levels of education, or that education accelerates IQ development is a moot point distinct from the assertion of their strong correlation.

In terms of Digit Symbol—Incidental Learning, only Joy *et al.* (2000) present their data stratified for a relatively low (high school), and a relatively high (university) education group. They report a main effect for education level on both pairing and free recall, although this was influenced by the low (high school) group in their 80s, who produced significantly lower scores. This highlights the protective effect of higher education, or greater reserve capacity, for those who attended university (Joy *et al.*, 2000). Among the younger 50-59 age group, there was minimal difference between the relatively low and high levels of education for Pairing (0.46 pairs) and Free Recall (0.76 symbols).

An under-researched and vital influence on neuropsychological performance is the variable of the quality of education which an individual has access to (Gasquoine, 2001; Manly *et al.*, 1998a; Nell, 1999; Shuttleworth-Jordan, 1996). While Ceci (1991) discounts this factor for western nations, Nell (1999) states that "in developing country settings schooling alone is a crude indicator because it says nothing about those aspects of school quality that are taken for granted in western settings" (p.133). The level of teacher training, the teacher-student ratio, and the extent and quality of resources such as heating, electricity, desks, writing and reading materials, and library and laboratory facilities can be questioned (Nell, 1999). With its mixed developed-developing country status, and history of racial discrimination, South Africa exemplifies this factor of educational discrepancy.

Prior to the lifting of the discriminatory Apartheid political system in 1991, black learners under the Department of Education and Training (DET) had access to between 5% and 25% of the resources which the white learners were guaranteed (Claasen *et al.*, 2001). This considerable inequality in the educational systems and its potentially detrimental effects on cognitive test performance for black versus white South Africans cannot be disregarded. Since 1991, gradually increasing numbers of black learners (typically of higher socio-economic status in urban settings) have accessed a better quality private or equivalent state model C education. Within the black population group alone therefore, the acculturation variable of quality of education must be expected to yield significant differences on cognitive testing (Shuttleworth-Edwards *et al.*, 2001b).

Indeed the results from the broader project, of which this study is a part, show the prevalent influence of the factors of level and quality of education as described above, *for the same participant sample*. There is consistent lowering of performance on the WAIS-III for lower *level* of education across both English and African language groups. The English language participants produced significant differences at the $p < 0.01$ level for four subtests (Vocabularly, Arithmetic, Information and Comprehension), the Verbal Communication and Working Memory Indexes, and Verbal and Full Scale IQs. Two further subtests (Similarities and Letter-Number Sequencing) were significant at the $p < 0.05$ level. Similarly for the African language participants, six subtests (Vocabulary, Similarities, Information, Picture Arrangement, Comprehension and Symbol Search), the Verbal Communication, Perceptual Organisation, and Working Memory Indexes, and Verbal, Performance and Full Scale IQs were significant at the $p < 0.01$ level, while a further three subtests (Picture Completion, Block Design and Digit Span) and the Processing Speed Index followed suit at the $p < 0.05$ level. All significant differences favoured Graduates over Grade 12s (Kemp, 2000).

For *quality* of education, a comparison between individuals who received the disadvantaged DET schooling and those with advantaged Private/Model C schooling yielded significant differences for *all* subtests, Indexes and IQs, except the Block Design subtest, in favour of the advantaged Private/Model C schooling. Within the African language group, significant difference for quality of education was observed for *all* subtests, Indexes and IQs without exception, with the disadvanted DET schooled individuals achieving significantly depressed scores. A telling comparison within the African language Grade 12 group was that the Private/Model C participants yielded a Full Scale IQ in the Average range, while the DET participants fell within the Borderline mental retardation range (Shuttleworth-Edwards *et al.*, 2001b).

Of relevance to this study, the Digit Symbol subtest yielded no significant difference for level of education, but a significant effect for quality of education, especially within the African first language Grade 12 group. It is noteworthy that Digit Symbol was the only subtest to produce an interaction effect between level and quality of education, at the $p < 0.05$ level.

From these discrepant findings on Wechsler tests in various cultures, such as in the uniquely complex South African setting, Ardila (1995) calls for appropriately standardised normative data and analysis of education factors (among other cultural factors), as well as the search for commonality in test performance among existing groups.

1.7 Rationale for the present study and research question

It has been shown that the Digit Symbol—Incidental Learning measure, while an optional component of the WAIS III, is a clinically discriminatory tool useful for screening short-term incidental memory. However, as with all neuropsychological tests originating in the western culture, its validity in a cross-cultural setting like South Africa must be evaluated, and appropriate normative guidelines established. The key acculturation factors of level and quality of education have been identified for investigation.

This study will attempt to examine the effects of level and quality of education on a sample of English and African First Language speakers, on the WAIS-III Digit Symbol—Incidental Learning Pairing and Free Recall test performance. While previous studies have examined the effects of age and level of education in a culturally homogenous sample, no previous study has investigated Pairing and Free Recall performance for a culturally stratified sample, with differing quality of education

The aim is twofold: (1) To examine the hypothesis that results will be depressed relative to participants' lower level and poorer quality of education; and (2) To provide appropriate Southern African norms, by which clinicians may evaluate WAIS-III Digit Symbol—Incidental Learning performance.

Chapter 2: METHOD

As detailed in the Chapter 1 (p.3), this study formed part of a larger research project, of which four investigations into the standard WAIS-III have already been completed. The present study constitutes a fifth focus of analysis, being an investigation into the effects of quality of education and level of education on the WAIS-III optional procedure of Digit Symbol—Incidental Learning Pairing and Free Recall. The data for the study were extracted from the overall WAIS-III normative data collection.

2.1 Research participants

Participants for the broader project comprised 68 volunteers, aged 19 to 30 years ($M = 24.06$). The age range of 19 to 30 years was selected so that African first language participants, for whom DET schooling was compulsory prior to 1991, could have had the opportunity to receive a private or model C and possibly tertiary education. A one decade normative age group was also chosen to minimise and control for age effects. Sampling was purposive in nature, and participants were obtained through several sources, namely personal contacts of the researchers, through schools, universities, and places of employment. The participants were primarily drawn from the Eastern Cape area, though two were sourced in the Western Cape, and one in Gauteng. Exclusion criteria comprised a past history of any serious head injuries, learning difficulties, neurological or psychiatric disorders. Participants were stratified according to four main dimensions (Table 1).

Table 1: Participants stratified according to first language, gender, and level and quality of education

	Grade 12		Graduate	
	Male	Female	Male	Female
African First Language – DET School Education	$n = 5$	$n = 5$	$n = 5$	$n = 5$
African First Language – Private/Model C School Education	$n = 5$	$n = 5$	$n = 5$	$n = 5$
English First Language – Private/Model C School Education	$n = 7$	$n = 7$	$n = 7$	$n = 7$

(1) **Gender**. The male (n = 34) and female (n = 34) participants were equal in number.

(2) **First Language**. Participants comprised English first-language speakers (n = 28), and African first-language speakers (n = 40). As the test was administered in English, both groups were required to be fluent in the English language and were either working or studying in the English medium. First language was determined by self-report, and English competency confirmed via observation at the time of testing. The delineation of *African first language speakers* is preferred to *blacks* because it excludes blacks whose first language might be other than an African language.

(3) **Quality of Education**. As previously described white South Africans attended elite private schools or well-funded Model C government schools, while blacks were consigned to poorly-funded Department of Education and Training (DET) government schools. DET schools had their own syllabi and examinations, and inferior resources, compared to the white schools (Claasen *et al.*, 2001). The demise of Apartheid led to the abolition of separate education systems in 1991, and as a result blacks are being increasingly integrated into the previously white private and model C schools. However, the legacy of the educational inequalities in former DET schools remains. In addition, while English is advocated as the medium of instruction, learners' African home language is frequently

used. Therefore, individuals who received a DET school education are likely to be less proficient in English, and to have benefited less in terms of acquired knowledge and test-taking skills, than those who attended private or model C school. Research participants were therefore educated in a private or model C school (*n* = 48), representing an advantaged quality of education, or in a DET school (*n* = 20), representing a disadvantaged quality of education (Kallaway, 1984). For sampling purposes, three groups were stratified for quality of education: (i) African first language individuals who received a poor quality DET (*n* = 20) high school education; (ii) African first language individuals who received a good quality private (*n* = 14) or model C (*n* = 6) high school education; and (iii) English first language individuals (*n* = 28), who received a good quality private (*n* = 18), or equivalent model C (*n* = 10) high school education. Participants were required to have received four years of education and to have completed Grade 12 in the respective system.

(4) **Level of Education**. Participants were divided equally according to the level of education achieved (*M* = 14.50) between those with only a Grade 12 education (*n* = 34), and Graduates (*n* = 34) with at least a three-year tertiary degree or diploma. Years of education was obtained according to the number of years expected to attain that level, rather than the actual years taken. Therefore, Grade 12 constituted 12 years of education, a degree or diploma 15 years, an honours degree 16 years and a masters degree 18 years. Individuals were attributed with one or two year diplomas gained in addition to Grade 12, but included in the Grade 12 level group, as their education was not deemed equivalent to university graduate level.

Participant numbers were restricted according to the availability of participants needed to balance the numbers in each subgroup. African first-language speakers with private or Model

C schooling proved difficult to locate, as did private schooled individuals with Grade 12, who tend to continue with tertiary education. While the number of participants in each cell is small (Table 1), cells were combined for analysis. As male and female participants were equal and are not being compared in this study, their cells were summed. Furthermore, for example, where the level of education was being analysed, all Grade 12s (n = 34) were compared with all Graduates (n = 34).

2.2 Instruments and procedure

The data were collected by four intern psychologists trained in the administration of the WAIS-III and supervised by an experienced clinical neuropsychologist. The test protocols for the overall project, which required approximately three and a half hours to administer to each participant, included the following:

(1) An Initial Contact sheet (Appendix A), which ensured that the stratification and exclusion criteria were satisfied, and reflected contact details and testing arrangements.

(2) The aims and background of the project, which were verbally explained to participants, who were then requested to sign an Informed Consent Form (Appendix B) detailing the need for the research and guaranteeing confidentiality.

(3) The Demographic Data Sheet (Appendix C), which included information about participants' age, gender, first language, quality of schooling received, Grade 12 symbol and level of education attained, as well as an outline of activities followed since school.

(4) A Socio-Economic Questionnaire was administered to participants to ascertain details about caregivers, the type and quality of home, basic home facilities, and educational facilities in the home. A pencil and paper English Language Proficiency Test, devised by

the HSRC for use in the WAIS-III standardisation study, was also conducted. Neither measures are included in the present study.

(5) The standard WAIS-III Test materials comprised an Answer Booklet (Appendix D), and a Response Booklet (Appendix E), which contained the Digit Symbol, Incidental Learning, Symbol Copy, and Symbol Search tests. Specifically, the Incidental Learning data, which were recorded in the Response Booklet (Appendix E), were extracted for the current study. In addition, a language proficiency test was included.

All thirteen WAIS-III subtests and the optional procedures, which include the Incidental Learning Pairing and Free Recall measures, were administered, with minor alteration to the Arithmetic subtest (with appropriate currency terms). Additional items were included on the Vocabulary, Information and Comprehension subtests as part of the HSRC standardisation study, although they did not form part of the present analysis or larger project. They are intended however to form culturally appropriate replacement items in the future.

In terms of the focus of this study, the administration procedure of the Digit Symbol—Incidental Learning, as per the WAIS-III Administration and Scoring Manual (Wechsler, 1997), was as follows. After the 120 seconds allotted to Digit Symbol—Coding, participants were allowed additional time, as required, to code the symbols to the end of the fourth row, to ensure that sufficient exposure was gained to all of the stimuli. The Incidental Learning Pairing (P) and Free Recall (FR) page in the Response Booklet (Appendix E) was then placed before participants, who were instructed: *"Now I want you to fill in all of the symbols you can remember that go with these numbers, one after another, across both rows. Tell me when you're finished."* (Wechsler, 1997:97). After covering the completed Pairing items with blank paper, the Free Recall task was presented thus *"In this area* (point*), I'd like you to write down* *all the symbols you can remember, in any order. Tell me when you're finished."* (Wechsler, 1997:97). One point was scored for each correct Pairing response (maximum of 18 points) and one point for each correct Free Recall response (maximum of 9 points). Except for one participant whose Pairing score was excluded because he did not complete the Pairing test, all scores are available for all participants.

Participants were tested individually in various settings, including their homes and places of work, the researchers' homes, the Psychology Department and the Psychology Clinic at Rhodes University. Most importantly, a quiet environment was selected to ensure optimal testing conditions. Participants who requested feedback were informed of the general range of their performance, rather than IQ scores. In addition, their strengths were highlighted.

2.3 Data analysis

The test protocols were scored according to the WAIS-III manual scoring criteria, described above. The demographic information and Incidental Learning results were coded, entered into a spreadsheet (Microsoft Excel), and imported into a suitable statistical program (Statistica). The coded data were subjected to descriptive analyses. The two factors of level and quality of education were analysed using a 2X3 two-way Analysis of Variance (2xANOVA) for each of the Pairing and Free Recall tasks respectively (see Table 2 below), to compare the differences between (1) the African first language group with a DET school education, (2) the African first language group with a Private/Model C school education, and (3) the English First Language group with a Private/Model C school education. Each group was analysed across two levels of education, Grade 12 and Graduate. The results passed Levene's Test for Homogeneity of Variances ($p > 0.10$) as well as the Kolmogorov-Smirnov Test for Normalities ($p > 0.02$).

Test results are presented according to the level and quality of education groups, to provide clinicians and researchers with norms, against which to compare findings for individual cases and study cohorts.

Table 2: Two factors of level and quality of education analysed using a 2X3 two-way ANOVA for the Pairing and Free Recall tasks

	WAIS-III Digit Symbol—Incidental Learning			
	Pairing		Free Recall	
	Grade 12	Graduate	Grade 12	Graduate
African First Language – DET School Education	$n = 10$	$n = 10$	$n = 10$	$n = 10$
African First Language – Private/Model C School Education	$n = 10$	$n = 10$	$n = 10$	$n = 10$
English First Language – Private/Model C School Education	$n = 14$	$n = 14$	$n = 14$	$n = 14$

Chapter 3: RESULTS

3.1 Demographics

The following is the descriptive demographic data for the study sample, categorised by age and years of education (Table 3), and further detailed according to participants' level and quality of education (Tables 4 and 5).

Table 3: Participants age, and years of education for the entire sample

	N	*M*	Min.	Max.	*SD*
Age	68	24.06	19.00	30.00	2.95
Years of Education	68	14.50	12.00	20.00	2.29

The mean age for the entire sample was 24.06 (*SD* = 2.95), and the mean number of years of education 14.50 (*SD* = 2.29) (Table 3).

Table 4: Participant's mean age stratified by level and quality of education

	Grade 12		Graduate	
	M	*SD*	*M*	*SD*
African First Language – DET School Education	25.60	3.86	27.40	3.86
African First Language – Private/Model C School Education	21.40	1.58	24.00	2.79
English First Language – Private/Model C School Education	23.64	2.41	22.93	1.33

Some differences in participants' age are noted (Table 4), with the African First Language, DET school group being older than the other groups, falling above the overall mean age by 1.54 and 3.34 years for the Grade 12 and Graduate groups respectively. The mean age of the African First Language, Private/Model C group falls below the overall mean age, with the

Grade 12 group in particular being younger by 2.61 years. Finally, the English Private/Model C group fall slightly below the overall mean age.

Table 5: Participant's mean years of education attained stratified by level and quality of education

	Grade 12		Graduate	
	M	*SD*	*M*	*SD*
African First Language – DET School Education	12.20	0.42	16.50	1.58
African First Language – Private/Model C School Education	12.60	0.70	16.30	1.16
English First Language – Private/Model C School Education	12.57	0.51	16.71	1.38

The mean number of years of education show no substantial differences for each level of education (Table 5), with the Grade 12 group ranging from 12.20 to 12.60, and the Graduate group ranging from 16.30 to 16.71.

3.2 Test results of descriptive analyses

The full descriptive analysis of the Pairing and Free Recall measures is reported first, followed by the comparative analysis of effects between subgroups.

Table 6: Mean scores for Pairing and Free Recall for the entire sample

	N	*M*	Min.	Max.	*SD*
Pairing	67	15.28	7.00	18.00	2.80
Free Recall	68	8.29	6.00	9.00	0.86

The mean score for Pairing was 15.28 (SD = 2.80), and the mean score for Free Recall was 8.29 (SD = 0.86) (Table 6).

Table 7: Frequency data for Pairing and Free Recall scores for the entire sample

Pairing ($N = 67$)			Free Recall ($N = 68$)		
Score	No. participants	%	Score	No. participants	%
7	1	1.5	0	0	0.0
8	0	0.0	1	0	0.0
9	1	1.5	2	0	0.0
10	1	1.5	3	0	0.0
11	5	7.4	4	0	0.0
12	5	7.4	5	0	0.0
13	5	7.4	6	4	5.9
14	6	9.0	7	6	8.8
15	6	9.0	8	24	35.3
16	11	16.4	9	34	50
17	0	0.0			
18	26	38.8			

The frequency data for each test is included (Table 7) to assist clinicians in the interpretation of individual results, according to the percent of participants obtaining different scores. It is noteworthy that 38.8 % of the entire sample obtained a perfect Pairing score of 18 pairs, while exactly 50 % or half of the entire sample scored a perfect 9 Free Recall symbols.

Table 8: Pairing norms stratified by level and quality of education

	Pairing ($N = 67$)					
	Grade 12		Graduate		All levels	
	M	*SD*	*M*	*SD*	*M*	*SD*
African First Language – DET School Education	14.50	3.24	15.11	2.57	14.79	2.88
African First Language – Private/Model C School Education	16.60	1.96	16.00	2.16	16.30	2.03
English First Language – Private/Model C School Education	15.14	3.28	14.64	3.00	14.89	3.10
All groups	15.38	2.97	15.18	2.64	15.28	2.80

The Pairing results (Table 8) show that for the quality of education factor, the similar African First Language DET (M = 14.81) and English First Language Private/Model C (M = 14.89) results fell approximately 1.5 points below the African First Language Private/Model C group (M = 16.30). For the level of education factor, the Grade 12 (M = 15.38) and Graduate (M = 15.18) findings were virtually equivalent across the entire sample.

When the interaction of the two factors are considered, the African First Language Private/Model C participants had the highest scores across both the Grade 12 (M = 16.60) and Graduate (M = 16.00) levels of education. In contrast, the African First Language DET Grade 12s yielded a lower score (M = 14.50), similar to that of the English First Language Private/Model C Graduate subgroup (M = 14.64).

Table 9: Free Recall norms stratified by level and quality of education

	Free Recall (N = 68)					
	Grade 12		Graduate		All levels	
	M	SD	M	SD	M	SD
African First Language – DET School Education	8.30	0.82	8.60	0.70	8.45	0.76
African First Language – Private/Model C School Education	8.50	0.97	8.20	0.92	8.35	0.93
English First Language – Private/Model C School Education	8.21	0.70	8.07	1.07	8.14	0.89
All groups	8.32	0.81	8.26	0.93	8.29	0.86

The Free Recall results (Table 9) fall closely together, and are all above a score of 8 out of 9 symbols. The highest mean score was obtained by the African First Language DET Graduate group (M = 8.60), and the lowest by the English First Language Private/Model C Graduate group (M = 8.07). Overall the Grade 12s (M = 8.32) achieved a marginally greater score than the Graduates (M = 8.26).

3.3 Test Results of comparative analyses

The two factors of level and quality of education were analysed using a 2X3 two-way Analysis of Variance (2xANOVA) for each of the Pairing and Free Recall tasks respectively, to examine whether differences exist between the stratified groups.

Table 10: Pairing main and interaction effects

Effects	F value	p-level
Main – Level of Education	0.05	0.82
Main – Quality of Education	1.86	0.16
Combined Interaction Effect	0.29	0.75

Table 11: Free Recall main and interaction effects

Effects	F value	p-level
Main – Level of Education	0.05	0.83
Main – Quality of Education	0.77	0.47
Combined Interaction Effect	0.64	0.53

On both the Pairing and Free Recall Incidental Learning measures, no significant main or interaction effects ($p > 0.05$) were found between any of the three quality of education subgroups, nor between Grade 12 and Graduate levels of education (Tables 10 and 11). When one-way ANOVAs were employed to investigate each factor further, the results did not yield a single trend towards significance.

These findings were unexpected, in terms of the predicted influence of quality and level of education factors, as reported for the same cohort for the whole WAIS-III including the standard Digit Symbol subtest (Shuttleworth-Edwards et al., 2001b). Essentially the two Digit Symbol—Incidental Learning measures yielded roughly homogenous scores respectively (with insignificant differences) for all stratified subgroups across the entire sample. A discussion of these results ensues in the following chapter.

Chapter 4: DISCUSSION

4.1 Introduction

This study has pioneered the measure of WAIS-III Digit Symbol—Incidental Learning performance in a culturally heterogeneous sample. A review of pertinent literature indicated this test's utility as a valuable memory screening tool. The notion of cultural variability in cognitive testing, as is inevitable in a diverse South African setting, was operationalised in terms of the vital acculturation factor of education. It has been established that an individual's lower *level* of education is likely to negatively effect test performance (Kaufman *et al.*, 1988; Matazarro & Herman, 1984). Furthermore the influence of a poorer *quality* of education has been seen to produce significantly lower scores on cognitive testing (Shuttleworth-Edwards *et al.*, 2001b). As may be expected, where vastly differing educational resources are found between schooling systems, as exemplified in the history of segregation in South Africa, neuropsychological data stratified for quality of education has revealed significant difference (Shuttleworth-Edwards *et al.*, 2001b). Thus the current study sought to make descriptive and comparative analysis of the Digit Symbol—Incidental Learning measure in a sample stratified for both level and quality of education. Lower scores for lower level and disadvantaged quality of education were anticipated

While the normative findings correlate favourably with previous investigations, the comparative analyses, which yielded non-significant differences, represent new data in the research arena. It is hoped that these findings will augment our understanding and application of Digit Symbol—Incidental Learning by providing vital and appropriate normative data for a setting such as South Africa. Finally, the clinical implications must be integrated with the growing complexities of accurate cognitive assessment in multicultural settings, and identifies the directions for future research.

4.2 Normative guidelines

Guidelines are first offered, for the age group 19-30, in response to the demand for appropriate South African norms (Table 12). The guidelines apply to *all* English and African first language Grade 12s *and* Graduates, from a private/model C *and* former DET educational background. Nevertheless, the stratified means and standard deviations for each subgroup, as well as the frequency data, for both Pairing and Free recall tests, are available in Tables 7-9 of the Results section (p.27-28).

Table 12: Pairing and Free Recall normative guidelines

	Pairing (N = 67)	Free Recall (N = 68)
Normal	13 or more	8 or more
Somewhat indicative of dysfunction	10 – 12	7
Strongly indicative of dysfunction	7 – 9	6
Abnormal	6 or less	5 or less

For Pairing, a mean of 15.28 pairs (SD = 2.80) was recorded. While the detailed norms for each subgroup may be found in Table 8 (p.27), a broad guideline of **13 or more pairs** is therefore proposed as normal (1 SD > 12.48, which was obtained by more than 80% of the sample). While a lower result should always be investigated, a score of 10 - 12 pairs may be considered somewhat indicative of an impaired performance (2 SDs > 9.68). A score of 7 - 9 pairs is strongly indicative of dysfunction, but only 6 or less pairs is definitely abnormal as the entire sample of screened participants achieved a score of 7 or more pairs. It may be noted further that approximately 40% of the participants yielded a perfect score of 18, though the mean scores for the different sub groups ranged from 14.50 to

16.60 pairs (with a total sample range of 7 to 18). For purposes of comparison with the WAIS-III sample, a Pairing score rounded to 16 pairs was obtained at the 50th percentile.

Scores for the Free Recall of symbols were closely equivalent. A mean of 8.29 symbols (*SD* = 0.86) was achieved. The more detailed subgroup norms are contained in Table 9 (p.28). A broad guideline of **8 or more symbols** may therefore be regarded as normal (1 *SD* > 7.43, which was obtained by more than 85% of participants). A score of 7 symbols may be construed as somewhat indicative of an impaired performance (2 *SD*s > 6.57), while 6 represents strong indication of dysfunction. Only a score of 5 or less symbols may be considered definitely abnormal, owing to the entire screened sample achieving 6 or more symbols. Exactly half (50 %) of the entire sample yielded a perfect score of 9, though the mean scores for the different sub groups ranged from 8.07 to 8.60 symbols (with a total sample range of 6 to 9). At the 50th percentile, a Free Recall score of 8 symbols was noted.

These normative guidelines were further examined in the context of other normative studies for a comparable age range (Table 13). Both broad guidelines and scores at the 50th percentile are tabulated, in order for comparison with the WAIS-III and other formats.

Table 13: Comparison of normative data between recent studies

Study, Test version, Age group	Pairing		Free Recall	
	Guideline	50th %	Guideline	50th %
Current study, WAIS III, 18-30 (*N* = 68)	**13 ≈ 6.5***	**16**	**8**	**8**
Wechsler US standardisation (1997), WAIS III, 20-29 (*N* = 2450)	-	14	-	8
Lezak (1995), WAIS-R-NI, none specified	6	-	-	-
Shuttleworth-Jordan & Bode (1995b) SAWAIS, 20-39 (*N* = 131)	7	-	-	-

* the symbol ≈ represents *approximately equal to*, based on the proposed halving of the extended WAIS-III format to obtain a score comparable to the WAIS-R / SAWAIS format.

Norms for middle-aged and older adults (e.g. Joy *et al.*, 2000) were not deemed appropriate for comparison with the current study sample, which has an age range of 19-30. Although the vexing question of compatibility between the previous WAIS-R / SAWAIS format comprising 9 pairs and the current WAIS-III format of 18 pairs (2 sets of the same 9 pairs) remains, the possibility of comparison is forwarded. Simply by calculating the mean number of pairs out of 9 (i.e. score out of 18, divided by two) in the extended WAIS-III version, an equivalent score might be gained. The validity of this procedure has yet to be investigated by future research. Nevertheless, when this adjustment was implemented, it is noteworthy that the normative guidelines that emerged in the current study were highly commensurate with Lezak (1995) and Shuttleworth-Jordan & Bode (1995b). At the 50th percentile, the Pairing score of 16 pairs was marginally higher than the US standardisation sample's 14 pairs.

It is expedient to compare the data from the current study with the only other pre-existing data stratified for acculturation factors (Table 14), operationalised as English and African first language speakers (reported in Shuttleworth, 1996).

Table 14: Comparison of current data with Shuttleworth (1996) data

	Pairing (mean scores)	
	English language	African language
Current study, WAIS III, 18-30 (*N* = 67)	**14.64 ≈ 7.32***	**15.55 ≈ 7.76***
Shuttleworth-Jordan (1996), SAWAIS, 18-25 (*N* = 45)	7.32	6.59

* the symbol ≈ represents *approximately equal to*

For the Shuttleworth sample of university students in the 18-25 age range, the English first language group obtained a pairing mean scored of **7.32 pairs**, while their African first language counterparts attained a marginally lower mean score of **6.59 pairs** (Shuttleworth, 1996). The African language group were however not stratified according to quality of education. In the current study, the analogous Graduate English and African first language participants in turn obtained a pairing mean score of **14.64 pairs** and **15.55 pairs** respectively (the latter obtained by combining the DET and private/model C quality subgroup means of 15.11 and 16.0). The conversion to a score out 9 pairs yields a score of **7.32 pairs** and **7.76 pairs** for the English and African language groups respectively, which is remarkably close to Shuttleworth's (1996) findings of 7.32 and 6.59 pairs for the same groups. Of note is that the African language group in the current study obtained a slightly higher mean score, which runs counter to Shuttleworth's higher scoring English language group.

4.3 Clinical implications of findings

Contrary to the indications from the larger project for the same participant sample, the proposed hypothesis that disadvantaged quality and/or relatively low level of education would yield significant deficits in the Digit Symbol—Incidental Learning scores must be rejected. This finding of *no significant difference* suggests that both the Pairing and Free Recall tests of Digit Symbol—Incidental Learning stand independently of the influence of these variable factors of acculturation. The fact that no main or interaction effects resulted submits that the Pairing and Free Recall measures may be viewed as valid and robust measures of incidental learning and short-term memory across these diverse groups. It may further be construed that this sensitive screening tool is culture-fair for the population under consideration, and potentially in other multicultural contexts.

A primary practical inference which may prove its utility in clinical settings is that whatever depressed scores an individual obtains on the Pairing and/or Free Recall measures should not be ascribed to the examinee's low level or poor quality of education, but should be investigated further, mindful of the test's established capacity to tap for cerebral dysfunction with equal validity across the groups stratified in this study. It is of clinical and diagnostic utility that Incidental Learning's sensitivity to memory impairment has been augmented with confidence in its culture-fair status.

While the trends in the literature identified the significant impact of the factors of level of education (e.g. Ceci, 1991), and quality of education (e.g. Nell, 1999), the contradictory findings on the Incidental Learning measures prove to be a strong exception to these trends. There is *no other* appropriately stratified study of this specific test with which to make direct comparison. While literature searches for cross-cultural short-term and incidental memory yielded research nothing of valid comparable relevance, tentative comment on the evident subgroup differences (though non-significant) is forwarded.

Of note is that the most advantaged participants, in terms of level and quality of education, i.e. the English Private/Model C Graduates, obtained the lowest means for both Pairing and Free Recall. It is hypothesised that factors interrelating with cultural issues and test-wiseness may be implicated. In preliterate cultures with a rich oral tradition, immediate and delayed verbal memory has been shown to be of particular strength (e.g. Dube, 1982 cited in Shuttleworth-Jordan, 1997). This oral tradition remains in current African cultures, despite the growing levels of literacy and urbanisation with acculturation. It is posited therefore that an as yet uninvestigated memory strength may therefore play a role in the Incidental Learning performance of the African language participants in the study, as a result of cultural factors. Furthermore, the element of test-wiseness may have negative influence on Incidental Learning performance. Clinical observations reveal that the highest Digit Symbol—Coding scores (obtained by the English Private/Model C participants with the greatest educational advantages, and therefore *most test-wise*) employed a rapid visual scanning between the key and stimulus items (Ann Shuttleworth-Edwards, personal communication). It is proposed that while such a test-taking skill is adaptive for the speed-weighted Digit Symbol—Coding performance, the incidental learning which occurs may consequently be hindered, in comparison with a less test-wise individual who employs a slower, more considered approach to the digit-symbol pairs. The combination of these fine influences of possible culture-related memory strength and a lower level of test-wiseness offers some explanation of the higher scores obtained by African language participants. Focussed investigation and validation of these hypotheses is indicated for future research.

4.4 Digit Symbol—Incidental Learning and Digit Symbol—Coding

The equivalence of Incidental Learning performance between groups in this study invites comment on the relationship between Digit Symbol—Incidental Learning and Digit Symbol—Coding. Statistically significant variation of scores recorded for the quality of education factor on the Digit Symbol—Coding subtest in the broader project (see Shuttleworth-Edwards, 2001b), was not accounted for in the current study by variations in the proposed memory component of the test, i.e. as measured by Digit Symbol—Incidental Learning. Commensurate with findings from recent research endeavours (Demakis *et al.*, 2001; Joy *et al.*, 2000), this data (by process of elimination) supports the conclusion of Joy *et al.* (2000) that "speed is clearly far more important than memory to Digit Symbol [Coding] performance" (p. 778).

Finally, it is necessary to comment on the validity and reliability of these tests. The *validity* of Pairing and Free Recall as measures of memory has recently been shown by Kreiner and Ryan (2001) and Demakis *et al.* (2001), who found that external memory measures from the WMS-R and WMS-III respectively were, like Incidental Learning, a poor predictor of Digit

Symbol—Coding performance. This finding has been demonstrated across both a clinical (Kreiner & Ryan, 2001) and non-clinical (Joy *et al.*, 2000) population, representing strong external validity. The brief nature of the tests does imply truncated *reliability* (Joy *et al.*, 2000), and the cautionary recommendation warranted: that incidental learning be utilised as a screening tool en route to further investigation, rather than conclusive evidence of deficit.

4.5 Limitations of the research

Two limitations of this research must be acknowledged. Firstly, sample size was restricted due to availability of participants. For example, there was a scarcity of African first language participants with Private/Model C education, who had not pursued tertiary education. As a result the size of the various subgroups, which were numerically balanced, was limited proportionately. However, the sample was carefully controlled with respect to age, gender and language of origin. Thus despite relatively small subgroup numbers, the investigated factors of level and quality of education were isolated. Furthermore, it is pertinent that the sample were all proficient in the English language, and relatively highly educated (12+ years).

Secondly, the age group was restricted to 19-30 years in order to minimise age effects. While prior incidental learning research has investigated the age-related decline of scores across the adult years, this was not the focus of the current study. Though level of education has been shown to have a significant interaction effect with age (Joy *et al.*, 2000), and the sequelae of a poor quality of education with ageing are unknown, the relevance of concentrating on this younger sample may be emphasised. Nell (1999) highlights that the 18-29 age group is the most at risk group for traumatic brain injury in South Africa. He also notes that ability assessment is likely to have the most impact for young adults entering tertiary education or the labour market (Nell, 1999).

4.6 Recommendations for future research

This study of necessity focussed on a non-clinical relatively educated sample of the population. As construct validity is initially established for healthy, more educated, and increasingly acculturated individuals, it is recommended that future WAIS-III Digit Symbol—Incidental Learning research expand to investigate:

(1) specific clinical populations where cognitive impairment overlays acculturation factors, to elucidate how education and culture effect the reserve capacity of clinical samples. For example, black patients stratified for quality of education, who suffer from dementia of the Alzheimer's type, depression, etc.

(2) various cultural settings, including individuals with notably lower levels of education or little English proficiency, or who dwell in the more impoverished rural areas.

(3) the interaction of level and especially quality of education *together with ageing*.

(4) the inclusion of an even more sensitive delayed recall component of Incidental Learning, which further increases the test's cross-cultural utility, as it is evaluated internally against the individual's immediate recall score, rather than requiring appropriate norms, which may be lacking (Shuttleworth-Edwards *et al.*, 2001a).

4.7 Conclusions

An analysis of the effects of level and quality of education on English and African language participants for the Digit Symbol—Incidental Learning Pairing and Free Recall procedures was found to be of non-significant influence. A high degree of culture-fair status is posited for this sensitive incidental measure of short-term visual memory.

The implications of this unexpected finding reach into areas of under-researched importance for the practising clinician, who must bring valid tests to the accurate assessment of individuals from a variety of cultural backgrounds. Where increasing amounts of acculturation continue to change the neuropsychological test profile of individuals in developing countries, the effects of a variable quality of education have been shown, which combine with varying levels of schooling and postgraduate study to effect test performance. The ensuing need for current appropriately stratified normative data for widely used tests, such as Digit Symbol—Incidental Learning has been reiterated by researchers. Just as vital, as Ardila (1995) asserts, is the search for commonality in test performance among existing groups, which has been demonstrated in this study.

Chapter 5: REFERENCES

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Appendix A: Initial Contact Sheet

WAIS-III Master's Research

Initial Contact Sheet

Surname: ______________________ First Name: ______________________

Contact Address: ____

Contact Telephone Number(s): ______________________________________

Gender: [Male] [Female]

Age: [21] [22] [23] [24] [25] [26] [27] [28] [29] [30]

Home Language: [English] [Xhosa] [Other African Language:]

Language at place of study or work: [English]

Schooling: [Private School] [DET]

Check that the 5 high school years were completed in the same category of school. [ ]

Name of School and Town: ______________________________________

Educational Level: [Matric Only] [Graduate]

If Matric only, check that they do not intend to, nor have tried to study further. [ ]

Ever been diagnosed with or had one of the following:

Learning Difficulty	Yes	No
Neurological Disorder	Yes	No
Psychiatric Disorder	Yes	No
Head Injury	Yes	No

If Yes to any of the above - give details: ______________________________

____

____

Arranged Date of Testing: ____________________ Time: ____________________

Tester: ____________________________ Venue: ____________________

Further Contacts? ____

Protocol Number: [ ]

Appendix B: **Informed Consent Form**

WAIS-III Master's Research

Response Booklet

Protocol Number: [ ]

INFORMED CONSENT

In South Africa we have had various tests to measure IQ - you may have completed one at school or when applying for a job. These tests have been found to be outdated and problematic in various ways, especially in terms of their applicability to previously disadvantaged groups. In America and Britain they have now developed a new test: the Wechsler Adult Intelligence Scale-III (WAIS-III), which is hoped to be more fair and less culturally biased towards certain groups. We are conducting this research on the WAIS-III to see how specific variables in the South African context affect performance on this test. This will allow us to see if the use of this test in South Africa and for various population groups will be fair and acceptable in terms of the new labour legislation.

We are doing this research as part of our Masters in Clinical Psychology at Rhodes University, Grahamstown and would thus appreciate your co-operation in completing the tests and supplying us with certain demographic information. The information provided will be treated as confidential. The results will not be linked to specific participants and specific test performance will not be available to anyone besides the researchers. Results of this research may be used for presentation at conferences and for publication in professional journals.

I________________________ have read the above and give my consent for the information given and test performance results to be used for the above mentioned research.

______________________ Signed

______________________ Date

Appendix C: Demographic Data Sheet

WAIS-III Master's Research

Answer Booklet

Protocol Number: [ ]

Gender: [Male] [Female]

Age: [21] [22] [23] [24] [25] [26] [27] [28] [29] [30]

Home Language: [English] [Xhosa] [Other African Language:]

Language at place of study or work: [English]

Schooling: [Private School] [DET]

Check that the 5 high school years were completed in the same category of school. [ ]

Where all 12 years of schooling completed in the same type of school: [Yes] [No]

If NO, give brief history of changes: ______________________________

____

____

Educational Level: [Matric Only] [Graduate]

If Matric only, check that they do not intend to, nor have tried to study further. [ ]

Matric Symbol: [A] [B] [C] [D] [E] [F]

Matric Exemption: [Yes] [No]

Ever failed a year at school [Yes] [No]

If "Yes" when and why: ______________________________

What have you done since leaving school (year by year): ____________________

____

____

____

____

____

____

Appendix D: Answer Booklet (extract)

Digit Symbol—Coding

1	2	3	4	5	6	7	8	9
—	⊥	⊐	└	⊔	○	Λ	✕	=

Sample Items

2	1	3	7	2	4	8	2	1	3	2	1	4	2	3	5	2	3	1	4

5	6	3	1	4	1	5	4	2	7	6	3	5	7	2	8	5	4	6	3

7	2	8	1	9	5	8	4	7	3	6	2	5	1	9	2	8	3	7	4

6	5	9	4	8	3	7	2	6	1	5	4	6	3	7	9	2	8	1	7

9	4	6	8	5	9	7	1	8	5	2	9	4	8	6	3	7	9	8	6

2	7	3	6	5	1	9	8	4	5	7	3	1	4	8	7	9	1	4	5

7	1	8	2	9	3	6	7	2	8	5	2	3	1	4	8	4	2	7	6

Appendix E: Response Booklet (extract)

Digit symbol – I.L.
Code – Apprentisage incident
Κωδικοποίηση: Ευκαιριακή μάθηση
Associazione di simboli a numeri: Apprenimento incidentale
Clave de números, Aprendizaje Incidental

Símbolo Numérico de Aprendizagem Incidental
Kodning – inlärning
Tall symbol Indirekte kombinasjonslæring
Tal-symbol – vilkårlig indlæring
Symbool Substitutie Incidenteel Leren

P.

5	1	8	2	9	4	6	3	7

8	5	6	3	1	9	4	7	2

F.R.