GCS

Report on the standardisation of the

Grover-Counter Scale of Cognitive Development

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Report on the standardization of the Grover-Counter Scale of Cognitive Development (GCS)

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1. INTRODUCTION

The Grover-Counter Scale of Cognitive Development (GCS) is a test that approximates a culture-fair test. This test was originally developed for the testing of **mentally handicapped** children and adults in an attempt to assess their level of cognitive functioning, thereby assisting in their placement and the diagnosis of their training needs. The GCS can also be used to supplement other intelligence tests in the case of hearing-impaired children, those with impaired verbal skills, aphasia or elective mutism, or those for whom a verbal test is inappropriate. It was also hoped that the test would be useful for children who do not speak the language of the tester. This is common in our multicultural society, especially since the schools are now integrated. The test is non-verbal in the sense that the testee does not have to respond verbally to the instructions.

Professor Grover of Cape Town developed the GCS and the Human Sciences Research Council (HSRC) entered into a contract with her to market and standardise it on a more representative sample because of the interest shown by professionals who had already used the test. The scale is at present still in an experimental stage and only provisional norms are used.

2. RATIONALE

Psychological assessment tools are often used to obtain information about a learner's cognitive ability, interest, aptitude and personal characteristics. Unfortunately some of these assessment tools are sometimes biased and continued research is therefore needed to keep them up to date. The GCS is one such tool. For such a scale to be more responsibly used to measure the cognitive abilities of children, it needs to be standardised on a more representative sample. By undertaking this project, the HSRC was not only meeting an actual need, but was contributing to the advancement of fair psychological assessment.

3. BACKGROUND INFORMATION ABOUT THE GCS

3.1. Theoretical background

The Grover-Counter Scale is based on Piagetian theory and was developed according to **Piaget's stages of cognitive development.** It covers the period from the early pre-operational to the middle of the concrete operational stage. Each of the sections in the test is associated with a certain developmental stage. The testee's stage of development is revealed by his/her performance on each section (not just the score obtained, but the procedure adopted in completing the item) as well. This is one of the strengths of the Piagetian theory with its emphasis on process rather than product. The sections as well as the items in each section become progressively more challenging so as to reflect the changing procedures as the child uses new cognitive schemes when moving from one mode to the next. The level that the testee reaches is an indication of his/her ability. Because there is a greater focus on qualitative interpretation in the GCS than in some other intelligence tests it is better to take the whole process into account rather than focus on a single score. The tester needs to be well acquainted with Piagetian theory to enable him/her to make appropriate suggestions about the testee's results. Merely ascertaining from the testee's observed performance whether he/she is in the pre-operational or the concrete operational phase gives an indication of his/her training needs (Grover, 1994).

The GCS was developed with a view to addressing problems in the field of mental disability. It was originally developed for the testing of mentally handicapped children and adults in an attempt to assess their levels of cognitive functioning, thereby assisting in the placement of the testees and the diagnosis of their training needs. The GCS can be used to supplement other intelligence tests in the case of hearing-impaired children, those with impaired verbal skills, aphasia or elective mutism, or in any situation where a verbal test is inappropriate. It can also be used to examine certain aspects of non-verbal reasoning in the age range from three to nine and half years. This stage in Piagetian theory, as mentioned earlier, embraces the stage immediately following the sensori-motor stage through to the stage approaching the midpoint of the concrete operational stage.

3.2. Material

The test material comprises a plastic base with six recesses, 36 counters or shapes (half of them red and half black) with equal numbers of circles, squares and triangles, two rectangular cards with six spaces on each and eight cards bearing designs.

3.3. Aim

The aim of constructing the GCS was to provide an instrument that could measure cognitive functioning in children with extremely impaired verbal skills, whether receptive or expressive or both (Grover, 1994).

3.4. Rationale for the development of the GCS

The **rationale** for using this test for the above-mentioned children is that where testees may not be able to solve a problem in the form of a verbal response they may be able to do so behaviourally. There is a great need for a test of this nature for young children in South Africa, especially for African language speakers.

This test is suitable for both normal children between the ages of 3 and 10 years and mentally handicapped children from the chronological age of 5 years. This test differs dramatically from the **conventional intelligence tests** (such as the Weschler-type tests) in that it makes use of qualitative analysis to a large extent and is based on a different approach and theory. Conventional tests consist of sub-tests, each measuring different intellectual abilities and in combination the testee's general intelligence. The GCS on the other hand, is divided into sections and the scores obtained, together with a qualitative analysis give an indication of the testee's level of cognitive development and the cognitive processes that he/she is capable of using.

3.5. Description of the GCS

The test consists of five sections, each measuring a different stage in the testee's cognitive development.

Section A: A simple discrimination and grouping task.

Success in this section is an indication that the testee is capable of the semiotic functioning characteristic of Piaget's pre-operational stage. Gross (1985) refers to semiotic functioning in Piagetian theory as "*the ability to use symbols or signifiers*"

Section B: Completion; memorisation and minor transformation of simple patterns.

Success in this section indicates that the testee is further advanced into the pre-operational stage since representations are more symbolic. Item B2 shows some measure of imitation, symbolic play and mental imagery. Item B3 adds a measure of reverse action which indicates the beginning of the concrete operational phase.

Section C: Copying of models involving perceptual-motor matching.

This section involves perceptual-motor matching. It is now clear to the child that a certain process leads to a particular stage.

Section D: Reproduction of models from memory, which demands more, advanced perceptual activities and spatial relations.

Here the testee has to have some sense of spatial relations and be more advanced perceptually. The testee relies on a system of rules (characteristic of the concrete operational stage) to understand the relationships between the elements and properties of the objects.

Section E: A series of problems increasingly demanding careful analysis, inferential thinking, and abstractions from the given data.

Here the testee is expected to infer, analyse and abstract from the designs on the cards. The testee also has to have the ability to decenter (co-ordinate two dimensions at once), which is characteristic of the concrete operational phase.

4. METHOD

4.1. Population

The experimental version of the GCS released by the HSRC in 1994, caters for ages from 3 years to 9 years 6 months. For the purpose of the present study, children of 9 years 7 months to 10 years 11 months were included, which meant that pre-primary and primary school children formed the population from which the sample was drawn. A list of all primary schools in the country was requested from the Education and Training Information Services Unit of the HSRC and it was asked to provide the list according to the school size. For practical reasons, schools for mentally handicapped and physically disabled children were excluded.

4.2. Sample

The population from which the sample was drawn was defined as all 3 to 10 year old children in South Africa. For practical and economic reasons, children from 200 schools in the country were to be tested. This was done taking into consideration the number of school psychologists available and the time that each could probably devote to the administration of the scale.

The Education and Training Information Services Unit of the HSRC drew the list of schools from all nine provinces. Two hundred primary schools were selected from the list of all schools in the country. The statistical technique of stratified selection was used to draw the sample. The 200 schools needed were drawn by the Statistical Services Unit of the HSRC. To get the number of schools per province the total number of schools in the province was divided by the total number of schools in the country and multiplied by the total number of schools needed (the list of schools used for the sample appears in the Appendix). The number of learners needed from each school was then determined, i.e. 2 learners (a boy and a girl) per age group per school. For example, in Gauteng 25 schools were sampled, therefore, 2 learners per age group per school = 2 x 8 x 25 = 400 learners to be tested.

The age range was from 3 to 10 years as mentioned previously. It was hypothesised that 6-year-olds would be found in Grade 1 in the first half of the year and therefore only

Grade 1 to Grade 5 learners were considered for the sample. For the 3 to 5/6 year-old learners, the younger siblings of the Grade 2 learners in each sampled school were to be tested. To some extent convenience sampling was applied.

Table 1 indicates the number of learners per province, classified according to age, who were to be tested for the establishment of norms.

TABLE 1:THEORETICAL SAMPLE OF SCHOOLS AND TESTEES PER PROVINCE

Province	Number of learners	% of population	Number of schools	Number of testees per age in years								
				3 y	4 y	5 y	6 y	7 y	8 y	9 y	10 y	TOTAL
Gauteng	599 850	12,0	25	50	50	50	50	50	50	50	50	400
Free State	330 790	6,6	13	26	26	26	26	26	26	26	26	208
Western Cape	379 646	7,5	15	30	30	30	30	30	30	30	30	240
Mpumalanga	426 360	8,5	16	32	32	32	32	32	32	32	32	256
North West	453 447	9,0	18	36	36	36	36	36	36	36	36	288
KwaZulu-Natal	1 279 909	26	41	82	82	82	82	82	82	82	82	656
Eastern Cape	566 769	11	33	66	66	66	66	66	66	66	66	528
Northern Cape	70 285	1,4	4	8	8	8	8	8	8	8	8	64
Northern Province	903 799	18,0	35	70	70	70	70	70	70	70	70	560
TOTAL	**5 010 855**	**100**	**200**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**3200**

* 16 testees per school = 4 days each for 200 testers.

4.3 Training of testers and administration

Lists of selected schools were sent out with a covering letter explaining the aim of the project and requesting the provincial departments to supply the researcher with the names of the educational aid centres taking responsibility for the sampled schools. KwaZulu - Natal, Free State, Northern Cape and Eastern Cape (Uitenhage Support Services) showed interest and were willing to help with the standardisation process. Arrangements for training were made with these provinces and test materials were delivered for the standardisation to start. The first province where training was done was the Northern Cape. Five psychologists were trained to administer the GCS. The five were expected to do testing in four schools. Training was then also done in the Free State where a total of twelve psychologists were trained from Sasolburg, Welkom and Bethlehem child guidance clinics. The Bloemfontein clinic indicated that it was willing to help and that its personnel had already been trained in the administration of the GCS. Two researchers went to train and help with the administration of the scale in KwaZulu - Natal. Psychologists and psychometrists from five clinics (Durban South, Durban North, Pietermaritzburg, Ladysmith and Port Shepstone) were trained. The Western Cape also agreed to give permission for testing, and training was done there. Personnel from ten clinics were trained.

Formal permission could not be obtained to do testing in Mpumalanga, Northern Province, NorthWest, Gauteng and Eastern Cape.

5. REALISED SAMPLE

It was planned to administer the test to 3 200 learners, i.e. 16 learners from each of the 200 schools selected from the nine provinces. This could not be achieved because of the problems mentioned earlier. In the end only 469 learners were tested in four provinces. One hundred and fifty were tested in the Western Cape, 88 in the Free State, 180 in KwaZulu -Natal and 51 in the Northern Cape. Of these, 50 were excluded from the norm sample because they were either 5 years old and already in Grade 1 or they were older than 7 years and in Grade 1 and therefore did not meet the sample requirements. Information about the realised sample appears in Table 2. Four hundred and nineteen learners formed the norm sample. This sample can be seen as different from that of the

experimental version in the sense that it includes learners from diverse socio-economic backgrounds and also learners of diverse intellectual ability. The only variable that was considered when drawing the sample was age at the time of testing. Grover on the other hand, chose learners deemed by their teachers to be of average intelligence, from middle - class and mainly white background.

The following method was used to select the learners at the schools:

Using the school registers, lists of all Grade 1 to Grade 5 learners were prepared taking their age at that present moment into consideration. They were allocated numbers and the learners were then chosen randomly per age and gender i.e. there was an equal number of boys and girls. Where the child chosen could not be tested for one reason or another, the number was dropped and the tester drew another. Language in this case was not to be an issue; no matter what language the child spoke, he/she was tested in his/her mother tongue. Where the tester could not speak the language of the testee, another tester was used and if there was no tester available, the teacher was used as an interpreter.

TABLE 2:REALISED SAMPLE

PROVINCE	NUMBER OF TESTEES PER AGE (IN YEARS)								
	3 y.	4 y.	5 y.	6 y.	7 y.	8 y.	9 y.	10 y.	TOTAL
WESTERN CAPE	9	8	23	18	22	21	27	22	150
FREE STATE	7	8	13	12	12	14	10	12	88
KWAZULU - NATAL	12	14	21	24	26	27	27	29	180
NORTHERN CAPE	4	3	7	5	9	7	8	8	51
TOTAL	32	33	64	59	69	69	72	71	469

6. STATISTICAL ANALYSIS

6.1. Validity

6.1.1. Face validity

The face validity for the GCS was judged by (a) the favourable impression the test made on a number of psychologists working in the field of mental handicap, and (b)

the encouraging responsiveness of mentally handicapped subjects who had previously been deemed untestable or very difficult to test through lack of co-operation or refusal to attempt items on other tests (Grover, 1994).

6.1.2. Content validity

The content of the test may, at first sight, be considered limited in its coverage of the theoretical construct. It may be argued that, for instance, attainment of the concrete operational mode in some of the items in section E of the test is no guarantee that this mode would also be revealed in some other test involving quite different kinds of material.

Piaget himself, in many of his writings, presented his notion of horizontal dècalage or the occurrence of some degree of unevenness in the development and stability of a particular level of cognitive functioning in relation to various kinds of material.

However, taking into account one of the major objectives of the test, namely the assessment of learners with limited verbal skills, and the fact that the test allows the method and processes used by the subject to be clearly observed, and so interpreted in terms of characteristic features of a particular cognitive mode, it is considered that the contents of the test do serve to reveal the cognitive mode at which the subject is currently functioning (Grover, 1994).

6.1.3. Construct validity

Construct validity refers to the degree to which a test measures the theoretical construct or trait, it is supposed to measure. With regard to the construction of the GCS, Grover, (1994) set forth in detail the theoretical basis of the test. The clear indication of age differentiation of normal learners and the progressive movement from one level of cognitive development to the next support the construct validity of the test.

Grover also administered the test on a sample of adults independently identified as mentally handicapped and their performance also indicated that the test was

measuring a well defined theoretical construct. It is interesting to note that these performances support the similar sequence hypothesis or the view that mentally handicapped persons follow the same path of cognitive development as normal persons but at a much slower rate and with a ceiling imposed on the ultimate level reached (Grover, 1994).

In 1994, Dickman from the University of Cape Town conducted a study to evaluate the GCS for use in the assessment of black South African Township children with a mental handicap. In this study the target population was children with mental handicaps functioning within a mental age range of 3 to approximately 10 years, without serious visuo-motor problems N = 54. In this study construct and criterion validity studies were done:

Dickman's method of investigating construct validity was to set up hypotheses about the expected relationships between the GCS and the validating instrument which in that particular study was the Griffiths Scales of Mental Development (Griffiths). According to Dickman, the Griffiths was chosen because it has a number of subscales that could be expected to show varying correlations with the GCS. It was expected that the biggest correlation would be between the GCS and subscales D and E on the Griffiths. Subscale D is the Eye - Hand co-ordination subscale, which includes items on drawing, writing and shape recognition, which require reasoning ability as well as co-ordination. Subscale E is the Performance subscale, which examines non-verbal reasoning through the use of form boards, models to be reproduced and patterns to be constructed with blocks. High correlations were expected between scores on the GCS and the two subscales.

Significant correlations were found between the test age on the GCS and the Locomotor subscale, Hearing and Speech subscale, Eye-hand co-ordination and Performance. As predicted the correlations between the GCS and both the Eye-hand co-ordination subscale and the Performance were the strongest. The Performance subscale, with the emphasis on the reconstruction of patterns and models, is clearly connected to the cognitive skills that the GCS aims to evaluate. These results were expected and were seen as supportive of the construct validity of the GCS.

The significant moderate correlation with the Hearing and Speech subscale is not unexpected. While the GCS is largely non-verbal, in terms of expressive skills and therefore would not be expected to correlate with a scale that taps verbal expressive skills, the Hearing and speech subscale is regarded as " the most intellectual of all the scales"(Dickman p. 160) and one would therefore expect some degree of correlation with a nonverbal test of reasoning ability. This result was also in line with expectations.

The moderate and significant correlation with the Locomotor subscale was the most unexpected finding. This might be explained by the fact that the Locomotor subscale, which is intended to elicit gross motor skills was found to correlate significantly with Hearing and Speech, Eye-Hand coordination and Performance subscales, which tap fine-motor co-ordination, and it is this that might explain the significant correlation with the GCS.

Part of the construct validity study was an examination of whether there were differences in performance between those with and those without language problems, on the GCS and the Griffiths subscales. Language ratings were obtained on learners attending the school. For each child, two teachers were asked to state whether there was a language deficit that was marked enough to interfere with classroom communication. One of the teachers was the child's current class teacher, while the other was a prior class teacher. Two language ratings were obtained for increased reliability.

As expected the GCS was found not to discriminate between testees with and without speech difficulties. This is an important result, as one of the primary aims in the development of the GCS was to provide a means of assessment that did not disadvantage people with language difficulties.

In the present study the GCS was administered together with the Blocks subtest of the Junior South African Individual Scale (JSAIS) for the 3 to 8 - years old learners and the Senior South African Individual Scale - Revised (SSAIS-R) for the learners of 9 years 0 months to 10 years 11 months. There was a strong correlation between the

performance on the GCS and the blocks. The correlation coefficients appear in Table 3. The Socio-Economic Development questionnaire was also administered with the GCS. The teachers were asked to rate the learners. Aspects covered by the questionnaire included parental education, parental involvement in the child's education, etc. Teachers were also asked to rate the child's intellectual ability (cognitive functioning).

Table 3: Correlation of test total (total of Section A to Section E) with the blocks of the JSAIS (3 to 8 years) and the SSAIS-R (9 to 10 years)

Age in years	N	r_{xy}
3	32 (24)	0,52
4	33 (23)	0,64
5	52 (47)	0,68
6	58 (44)	0,75
7	64 (49)	0,66
8	60 (39)	0,76
9	61 (41)	0,73
10	59 (36)	0,68

The numbers in brackets indicate the number of learners who did the blocks test as compared to the number who did the Grover test.

6.1.4. Criterion validity

As one of the aims of the study was to evaluate the usefulness of the GCS in terms of assessment for placement (a prediction), some sort of criterion validity was required. According to Dickman, 1994, this was difficult as examinations at the sampled school were not written and the use of end of year marks as a criterion was therefore ruled

out. It was then decided to use school stream as one criterion. The learners at this school are, after the first couple of years, placed into regular classes or more challenging special classes. Teachers' ratings of the learners in the regular classes (the majority were in the study) were obtained as a further criterion.

The test age scores obtained on the GCS were found to correlate significantly with school stream (special class or regular class). Pupils in regular classes were rated on a 3-point scale by their teachers and this was also found to correlate significantly with the GCS. While these are relatively crude measures (Examination evaluations, school streams and teacher ratings), the results provide support for the criterion validity of the GCS.

6.1.5 Concurrent validity

During the development of the GCS, the Goodenough Draw – a - Man test was administered concurrently with the GCS to most of the subjects.

Correlation coefficients between Test Ages on the two tests were as follows:

a) Normal children within different age groups: r = 0,63 – 0,78.

b) Mentally handicapped adults resident in a hospital: r = 0,65
Test Age on the GCS ranged between 5 years 0 months and 8 years 0 months and the mean Test age was 6 years 9 months.
Test Age on the Draw - a - Man ranged between 5 years 3 months and 9 years 6 months and the mean Test Age was 7 years 0 months.

c) Mentally handicapped adults living in the community: r = 0,66
Test Age on the GCS ranged between 5 years 0 months and 9 years 3 months and the mean Test Age was 6 years 8 months.
Test age on the Draw – a - Man Test ranged between 5 years 0 months and 10 years 3 months and the mean Test Age was 7 years 0 months.

Two senior members of the protective workshop attended by mentally handicapped adults living in the community were also asked to work together to rate the subjects in terms of ability to grasp demonstrations and practical instructions regarding work - related tasks and to learn new skills. It was stressed that the level of expressive verbal ability and social behaviour should not be important criteria in rating the subject.

The rank difference correlation between ratings on the total score on the GCS and ratings by the staff of the protective workshop was 0,80. It is probable that this higher than expected figure resulted in part from the detailed guidelines provided for the workshop raters.

6.2 Reliability

The reliability of a test refers to the consistency with which a test measures that which it purposes to measure and is considered one of the test's most important features.

Reliability in this study was calculated by using the Kuder Richardson Formula-20. The reliability coefficients for 3 and 4 year olds are set out in Table 4 and those for 5 to 10 years olds in Table 5. The reliability coefficients for 3 and 4 year olds were calculated for Section A to section D and for 5 to 10 years olds for the total of all the sections, i.e. Section A to Section E, hence the different tables.

Table 4: The reliability coefficients for 3 to 4 year olds for Sections A to D

AGE	N	$\overline{X}$	s	KR-20
3	32	22,16	12,85	0,83
4	33	30,30	13,36	0,85

Table 5: The reliability coefficients for 5 to 10 year olds for Sections A to E

AGE	N	$\overline{X}$	s	KR-20
5	52	45,17	15,33	0,84
6	58	58,86	16,21	0,84
7	64	63,34	16,43	0,84
8	60	69,05	14,70	0,80
9	61	72,85	16,59	0,84
10	59	77,27	16,62	0,84

Guilford (1968) accepts a reliability coefficient of 0,70 as adequate whereas Anastasi (1976) states that a reliability coefficient of 0,80 should be accepted as the lower limit of a test before it can be released for general use. The reliability coefficient for all the sections is approximately 0.84 and this can be therefore regarded as acceptable.

6.3 Means and standard deviations

The means and standard deviations of the different sections appear in Table 6.

Table 6: Means and standard deviations of the different sections by age group

Age in years		Sect. A	Sect. B1	Sect. B2	Sect. B3	TotB	Sect. C1	Sect. C2	Sect. C3	Tot C	Sect. D1	Sect. D2	Sect. D3	Tot D	Tot AD	Edemo	Sect. E1	Sect. E2	Sect E3	Tot E	Tot AE
3	$\overline{X}$	9,53	3,84	2,13	1,56	8,71	0,94	0,63	0,53	3,28	2,03	0,22	0,59	6,50	22,15						
	s	2,55	1,97	2,34	2,06	4,48	1,32	1,62	1,54	3,91	2,88	0,87	1,43	4,14	12,85						
	N	32	32	32	32	32	32	32	32	32	32	32	32	32	32						
4	$\overline{X}$	10,55	4,18	3,52	2,52	11,23	1,82	1,64	1,33	6,32	3,06	0,67	1,03	8,26	30,30						
	s	1,77	1,72	2,08	2,00	3,58	1,38	2,40	2,04	4,51	3,12	1,49	2,11	3,79	13,35						
	N	33	33	33	33	33	33	33	33	33	33	33	33	33	33						
5	$\overline{X}$	10,96	4,52	4,21	3,75	12,98	2,50	3,54	3,81	10,44	4,83	1,85	2,29	9,91	42,01	1,21	1,31	0,27	0,21	6,07	45,17
	s	1,52	1,28	0,66	1,82	2,87	1,06	2,45	2,57	6,64	2,56	2,55	2,82	5,21	12,38	1,65	1,84	1,03	0,57	5,72	15,32
	N	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
6	$\overline{X}$	11,57	4,91	4,81	4,31	14,03	2,84	4,88	4,59	12,31	5,69	3,05	4,19	13,15	50,84	2,21	1,84	1,34	1,05	9,68	58,86
	s	0,98	0,66	0,85	1,42	2,30	0,59	1,68	2,25	3,70	1,62	2,89	2,81	5,42	9,39	2,19	2,21	2,05	1,70	8,49	16,21
	N	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
7	$\overline{X}$	11,58	4,72	4,83	4,83	14,37	2,63	4,91	5,38	13,15	5,86	3,61	4,50	16,32	52,78	2,58	2,69	1,58	1,36	12,51	63,34
	s	1,05	0,70	0,77	0,55	1,14	0,95	1,55	1,43	2,45	1,58	2,87	3,05	5,36	8,32	2,10	2,22	2,46	2,03	9,48	16,63
	N	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
8	$\overline{X}$	11,98	4,72	4,88	4,65	14,31	2,97	5,43	5,68	14,08	6,43	4,53	5,22	16,16	56,55	3,18	2,95	2,17	1,20	14,42	69,05
	s	0,13	0,94	0,69	0,97	1,74	0,18	1,08	0,87	1,49	0,95	2,97	2,72	4,85	6,04	1,86	2,18	2,74	2,04	9,60	14,70
	N	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
9	$\overline{X}$	1,92	4,82	4,95	4,82	14,59	2,80	5,43	5,67	14,23	6,48	4,98	5,16	16,86	56,90	3,28	3,51	2,57	2,08	17,37	72,85
	s	0,33	0,78	0,38	0,76	1,20	0,65	1,18	1,15	2,02	1,35	2,89	2,86	5,19	7,53	2,00	2,15	2,77	2,42	9,97	16,58
	N	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
10	$\overline{X}$	11,97	4,75	4,95	4,83	14,52	2,95	5,51	5,70	14,22	6,29	5,47	5,95	18,29	58,38	3,56	4,12	3,12	2,81	20,25	77,27
	s	0,26	1,11	0,39	0,77	1,50	0,39	1,06	1,12	1,89	1,52	2,74	2,82	4,31	7,22	1,96	2,23	2,76	2,51	10,25	16,61
	N	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59

Table 7: Discrimination values for the different Sections by Age

Section	3 years N = 32	4 years N = 33	5 years N = 52	6 years N = 58	7 years N = 64	8 years N = 60	9 years N = 61	10 years N = 59
Sect. A	0,64	0,42	0,29					
Sect. B1	0,53	0,52	0,30	0,06	-0,05	0,20	0,05	0,07
Sect. B2	0,66	0,55	0,46	0,17	0,07	0,20	0,09	0,15
Sect. B3	0,72	0,60	0,45	0,40	0,12	0,14	0,32	0,28
Sect. C1	0,69	0,54	0,36	0,34	0,41	0,19	0,49	-0,01
Sect. C2	0,58	0,69	0,68	0,50	0,50	0,32	0,52	0,33
Sect. C3	0,53	0,65	0,68	0,51	0,28	0,10	0,41	0,48
Sect. D1	0,69	0,69	0,62	0,52	0,61	0,33	0,42	0,58
Sect. D2	0,37	0,36	0,40	0,42	0,62	0,54	0,63	0,57
Sect. D3	0,57	0,47	0,51	0,66	0,51	0,42	0,58	0,56
Edemo			0,52	0,67	0,66	0,58	0,61	0,56
Sect. E1			0,47	0,62	0,69	0,69	0,65	0,54
Sect. E2			0,39	0,49	0,68	0,60	0,60	0,65
Sect. E3			0,36	0,58	0,64	0,61	0,69	0,73
Sect. E4			0,44	0,51	0,51	0,59	0,49	0,71
Sect. E5			0,51	0,46	0,40	0,53	0,59	0,62

6.4 Calculation of norms

The norms were calculated from data derived from 419 respondents. Originally it was assumed that there would be only one table of norms but after further analysis of data has been done and rural and urban (definition of these terms follows later in the chapter) scores had been computed separately, it was found that there was a difference between the characteristic performance of urban and rural learners which led to the norms being reported separately for urban and rural children.

In considering these differences, we should be reminded that Piaget never considered chronological age as the major criterion of developmental level, but what he repeatedly emphasised and the whole key to his theoretical framework was the

sequence of cognitive transformations. He clearly conceded that the previous experience and the social milieu of the individual child could speed up or slow down the process. This is also emphasised in the recent literature on the nature of cognitive development. The following are cited as examples:

During the course of cognitive development an individual conceivably constructs a large number of potentially meaningful or meaningless dimensions, classifications, programs and principles. The ones which survive are those which receive reinforcement through experiences, educational instruction and social influences" (Stanton, 1993).

"Not all mechanisms of cognitive development are situated wholly within the child, although not usually classified as 'mechanism of development' activities and environmental settings involving other people clearly play a critical role in the children's cognitive development" (Flavell, 1992)

Norm Tables 1 and 2 present the mean performance of urban and rural children respectively from the age of 3 years to the age of 10 years 6 months. These Tables provide not only total scores expected at six monthly intervals but also characteristic patterning of scores at these intervals on the different sections of the test. This allows a closer analysis of a subject's performance and can highlight individual strengths and weaknesses.

7. FINDINGS

The findings of the present sample showed a significant difference from that of the experimental version of the Grover. However, there was clear evidence of progress with age in both samples. This could be attributed to many factors. Firstly, Grover's norm sample in the experimental version consisted of learners deemed by their teachers to be of average intelligence, from a middle class and mainly white background. The present sample, on the other hand, included learners from diverse socio-economic backgrounds intellectual ability.

Secondly, it was noted that the characteristic performance of the learners in the lower age groups 3 to 5,6 years in the present sample was higher than that of learners in the experimental version. At 7 years performance is almost the same and from 8 years, performance drops below that of the experimental version. This could be attributed to the following:

1) Testing in section B for the experimental version was terminated too soon at the early ages.
2) Variations in the conditions under which testing was carried out. It must be realised that there are several factors (other than cognitive ability) which could have contributed to any differences in the results obtained for the two samples such as, the level of experience in the use of the Grover and the level of understanding of its theoretical basis. For the experimental version only two persons were involved and they had a great deal of experience with the test, whereas a large number of different psychologists were involved in testing the present sample. This could account for minor differences in administration.

Although the learners in the present study did better than those in the experimental version in the younger age groups, i.e. 3 years to 5 years, it was noted that they only reached a total of 12 in Section A at age 6 for urban learners and age 7 for rural, while in the experimental version the total score is reached at the age of 5 years. The reason for this difference could not be established as according to Piaget's theory, the skills to do Section A are already fully attained at the early pre-operational stage.

To make the test suitable for various environmental situations it was necessary to divide the learners according to variable area, (**Urban** and **Rural**). Statistical analysis to check if there would be any significant difference in their performances was done. New guidelines had to be set for starting and terminating testing, especially on Section E to prevent loss of concentration and fatigue, especially for the younger learners.

The term **urban** was used to designate schools situated within the boundaries of municipalities/local authorities, and embraces the following:

* Ordinary town or city areas, as well as vacant areas within municipal boundaries within which various structures, e.g. houses, flats, hotels, boarding houses, old age homes, caravan parks and school and university hostels may be found.
* Areas with mainly hostels, e.g. mine, factory and municipal hostels.
* Areas with mainly hospital and prison institutions within municipal/local authority boundaries.

The term **rural** was used to designate schools situated in rural areas and embraces the following:

* Town (village) without a local authority which is not situated within a tribal area and which has formal and semi-formal dwellings such as houses, huts and rondavels.
* Villages/settlements within a tribal area.
* Areas with population concentrations in informal dwellings (the so-called squatter areas).
* Areas with farms, agricultural holdings, holiday resorts, agricultural schools and colleges and other rural areas.

7.1 Guidelines for terminating testing in Section E.

1) Terminate testing if the combined score on Edemo and E1 does not reach 5. If this combined score reaches 5 proceed to E2.
2) Terminate if E2 does not reach 3 and enter a score of zero for item E2. If E2 reaches 3 proceed to E3 and E4 (E4 appears from the norms to be easier than E3 and should be attempted regardless of the score on E3).
3) Terminate if E4 does not reach a score of 4.

It is realised that exact scores cannot always be determined while testing is in process, although the experienced tester is usually able to estimate reasonably accurately. Any necessary adjustments should be made when the final reckoning of an individual's score is calculated.

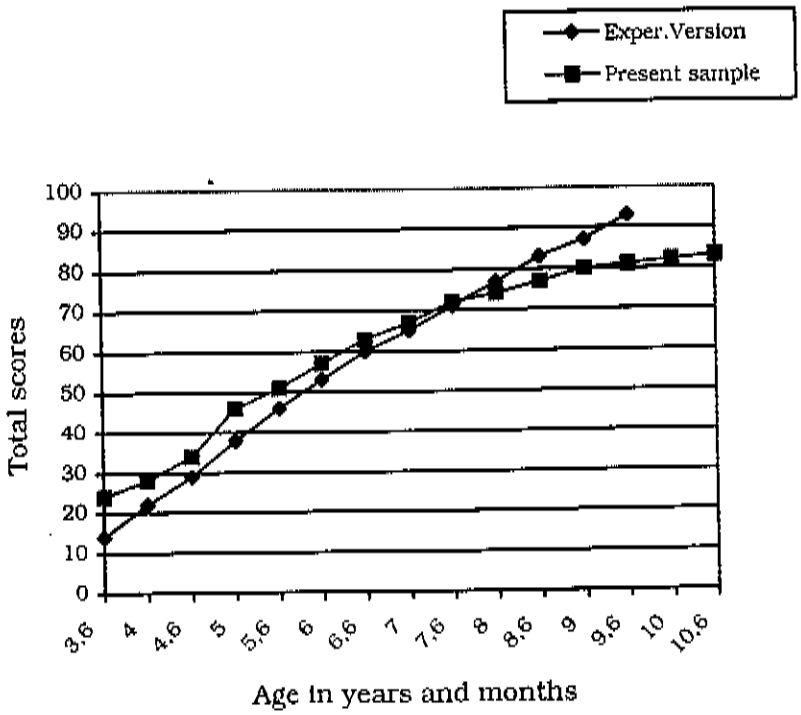

Figure 1: Comparison of the experimental version of the Grover with the present sample-urban

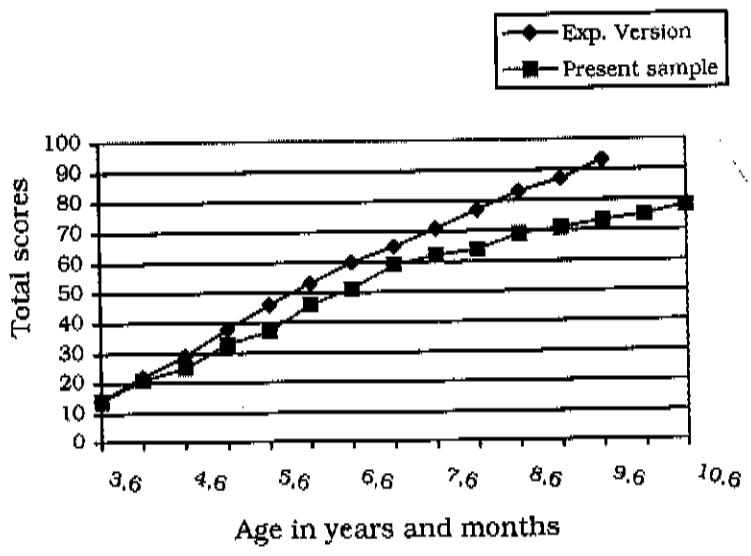

Figure 2: Comparison of the experimental version of the Grover with the present sample-rural

7.2 How to use the tables 8 and 9

Once the test has been scored the testee is placed in a particular cognitive functioning level according to his/her total score and other requirements. The scores defining the various cognitive levels from level 1 through to level 4b were originally postulated on the theoretical constructs as these are described on page 33 to 36 of the revised manual. Table 8 presents the requirements for allocation to a particular CFL. These requirements depend upon Total score obtained together with the score obtained on Section D and on Section E. The minimum score required for Section D and for Section E is deliberately set at a lenient figure as the purpose is simply to draw attention to any significant falling off in either of these sections.

If required, a finer distinction can be made by indicating whether the subject is at a lower, mid or upper point of a CFL. It has already been emphasized that revealing the cognitive mode at which the subject is currently functioning is one of the main objectives of the GCS.

For urban children the use of Table 8 is pretty straight forward but for rural children a little more care must be taken in order to use it correctly. The first step is to locate in the line, Total Score in Table 8, the total score obtained by the rural child. The corresponding Test age and CFL can then be found in that column in Table 8. Table 9 shows the chronological ages at which rural children are most likely to reach the various CFLs.

Example 1: Normal female, chronological age 6 years and 1 month -Rural
Scores: A = 12; B = 12; C = 14; D = 14; E = 3: Total = 55
CFL: Upper end of 3a
Meets requirements for Sections D and E at this CFL
Test Age (approximately) 6 years and 8 months

Example 2: Normal male, chronological age 10 years - Rural
Scores: A = 12; B = 15; C = 15; D = 15; E = 10: Total = 67
CFL Lower end of 4a
Does not meet the requirements for Section D but meets the requirements for Section E at this CFL Test Age (approximately) 8 years and 5 months

Example 3: Normal female, chronological age 9 years and 6 months - Urban

Scores: A = 12; B = 15; C = 15; D = 20; E = 20: Total = 82

CFL: Higher end of 4b

Meets requirements for Sections D and E at this CFL

Test Age (approximately) 10 years.

Table 8: REQUIREMENTS FOR ALLOCATION TO PROGRESSIVE COGNITIVE FUNCTIONING LEVELS (C.F.L)

C.F.L. level	1	2a	2b	3a	3b	4a	4b
Total score	12-27	28-45	46-56	57-66	67-73	74-79	80-81
Test Age*	3,0 - 3,11	4,0 - 4,11	5,0 - 5,11	6,0 - 6,11	7,0 - 7,11	8,0 - 8,11	9,0 - 9,11
Mean							
Total score	24	34	51	63	72	77	81
Test Age	3,6	4,6	5,6	6,6	7,6	8,6	9, 6
D minimum	-		7	10	12	16	18
E minimum		-		3	7	15	20

* Chronological age inyears in months

Table 9: CHRONOLOGICAL AGE AT WHICH EACH CFL IS LIKELY TO BE REACHED BY RURAL CHILDREN

C.F.L. level	1	2a	2b	3a	3b	4a	4b
Approximate CA when reached	4,6	5,2	6,6	7,4	8,0	Not reached even at 9 years 6 months	

* Chronological age in years in months

8. CONCLUSION

In conclusion, the author wishes to inform those interested in the GCS that training for the administration and scoring of the test is compulsory and you are requested to register for training when you purchase the test. During the training, interpretation and report writing is also discussed.

NORM TABLE 1:CHARACTERISTIC PERFORMANCES OF PROGRESSIVE AGES OF NORMAL CHILDREN OF 3 YEARS TO 10 YEARS 6 MONTHS - URBAN: N= 239

	A	B1	B2	B3	B	C1	C2	C3	C	D1	D2	D3	D	A-D	DEM	E1	E2	E3	E4	E5	E	TOTAL
3,6	10	4	2	2	8	1	1	0	2	4	0	0	4	24								24
4	10	4	3	2	9	2	1	1	4	4	0	1	5	28								28
4,6	10	5	3	3	11	2	2	2	6	5	1	1	7	34								34
5	11	5	4	3	12	2	3	3	8	5	1	2	8	39	2	1	1	1	1	1	7	46
5,6	11	5	4	4	13	2	3	4	9	5	2	3	10	43	2	2	1	1	1	1	8	51
6	12	5	5	4	14	2	4	4	10	6	3	3	12	48	2	2	1	1	2	1	9	57
6,6		5	5	4	14	3	4	5	12	6	3	4	13	51	3	3	2	1	2	1	12	63
7		5	5	5	15	3	5	5	13	6	4	4	14	54	3	3	2	2	2	1	13	67
7,6						3	5	6	14	6	4	5	15	56	3	3	3	2	3	2	16	72
8						3	5	6	14	7	5	5	17	58	3	3	3	2	3	2	16	74
8,6						3	6	6	15	7	5	5	17	59	4	4	3	2	3	2	18	77
9										7	5	6	18	60	4	4	3	3	4	2	20	80
9,6							6	6	15	7	5	6	18	60	4	4	4	3	4	2	21	81
10										7	6	6	19	61	4	4	4	3	4	2	21	82
10,6										7	6	6	19	61	4	5	4	3	4	2	22	83

NORM TABLE 2:CHARACTERISTIC PERFORMANCES OF PROGRESSIVE AGES OF NORMAL CHILDREN OF 3 YEARS TO 10 YEARS 6 MONTHS - RURAL: N=210

CA	A	B1	B2	B3	B	C1	C2	C3	C	D1	D2	D3	D	A-D	DEM	E1	E2	E3	E4	E5	E	TOTAL
3,6	8	4	1	1	6									14								14
4	9	4	2	1	7	1	1	0	2	3	0	0	3	21								21
4,6	9	4	3	2	9	1	1	1	3	4	0	0	4	25								25
5	10	4	3	3	10	1	2	2	5	5	0	1	6	31	1	1					2	33
5,6	10	4	4	3	11	2	2	3	7	5	1	1	7	35	1	1					2	37
6	11	4	4	4	12	2	3	3	8	5	1	2	8	39	2	2	0	1	1	1	7	46
6,6	11	5	4	4	13	2	4	4	10	5	1	3	9	43	2	2	1	1	1	1	8	51
7	12	5	5	4	14	3	4	5	12	6	2	4	12	50	2	2	1	1	2	1	9	59
7,6	12		5	4	14	3	5	5	13	6	3	4	13	52	2	3	1	1	2	1	10	62
8				5	15	3	5	5	13	6	3	4	13	53	3	3	1	1	2	1	11	64
8,6				5	15	3	5	6	14	6	3	5	14	55	3	3	2	1	3	2	14	69
9						3	5	6	14	6	4	5	15	56	3	3	2	2	3	2	15	71
9,6						3	5	6	14	6	4	5	15	56	4	4	2	2	3	2	17	73
10						3	5	6	14	6	5	5	16	57	4	4	2	2	4	2	18	75
10,6						3	6	6	15	6	5	5	16	58	4	4	3	2	4	3	20	78

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APPENDIX: LIST OF TESTED SCHOOLS

School number	School name	Town/City	Province	Rural Urban	Medium of Instruction
1. 309340	Laerskool Simon Van Der Stel	Wynberg	Western Cape	Urban	Afr.
2. 311812	New Fields Primary School	Athlone	Western Cape	Urban	Eng.Afr.
3. 480681	Rio Grande	Manenberg	Western Cape	Urban	Eng./Afr.
4. 109279	Knysna Laerskool	Knysna	Western Cape	Urban	Eng./Afr.
5. 310735	Laerskool Floreat	Steenberg	Western Cape	Urban	Afr.
6. 477389	St. Mary's Primer	Malmesbury	Western Cape	Urban	Afr.
7. 350117	Diaz Primer	George Industria	Western Cape	Urban	Afr.
8. 330531	Saron Primary	Saron	Western Cape	Urban	Afr.
9. NK00069	J.S.Klopper Primary	Matroosfontein	Western Cape	Urban	Eng./Afr.
10. 32203	Laerskool Plooysburg	Kimberley	Northern Cape	Rural	Afr.
11. 44218	Breipal farm School	Kimberley	Northern Cape	Rural	Afr.
12.15201	Beacon Primary School	Kimberley	Northern Cape	Urban	Eng./Afr.
13. 13201	Barkly-Wes Primere Skool	Barkley-wes	Northern Cape	Urban	Afr.
14. 21903	Esimanyama Lower Primary	GreyUrban	KwaZulu-Natal	Rural	Zulu
15. D000370	Thandenani Primary	Mfofo Area	KwaZulu-Natal	Rural	Eng. /Zulu
16. 561	Simla Primary	Shall Cross	KwaZulu-Natal	Urban	Eng.
17. 02122	Springvale Primary	Springvale	KwaZulu-Natal	Rural	Eng. / Zulu

18. 515	Highstone Primary	Phoenix	KwaZulu-Natal	Urban	Eng.
19. 1381	Minya Primary	Nongoma	KwaZulu-Natal	Rural	Eng./Zulu
20. 403	Crossmead Primary	Chatsworth	KwaZulu-Natal	Urban	Eng.
21. 02198	Tshelabantu C. Primary	Kearsney	KwaZulu-Natal	Rural	Eng. / Zulu
22.0967127	Zuza Junior Primary	Madadeni	KwaZulu-Natal	Urban	Zulu
23. 1240	Mashayilanga Primary	Underberg	KwaZulu-Natal	Rural	Eng. /Zulu
24. 0951877	InsuzenEng.cwensa Primary	Tongaat	KwaZulu-Natal	Rural	Eng./ Zulu
25.D000121	Ebomvini Primary	Izingolweni	KwaZulu-Natal	Rural	Eng. /Zulu
26. 0958576	Mjwayeli Primary	Loskop	KwaZulu-Natal	Urban	Eng./ Zulu
27. 0954923	Mbasela Primary	Inanda	KwaZulu-Natal	Rural	Eng./Zulu
28. 00963037	Hayibana Lower Primary	KwaMakhuta	KwaZulu-Natal	Urban	Eng.
29. 0980670	Muzikayise Primary	Madadeni	KwaZulu-Natal	Urban	Eng./Zulu
30. 105578	Rondevlei Primary	Viljoenskroon	Free State	Rural	Eng./SSotho
31. 110136	Genade Primere	Bultfontein	Free State	Rural	Eng./SSotho
32. 31095	Byelkanderkoms Primary	Bainsvlei	Free State	Rural	Eng./SSotho
33. 60300	Fauna Primary	Fauna Sig	Free State	Urban	Eng. /Afr
34. 60730	President Brand Primary	Pellissier	Free State	Urban	Afr.
35. 30821	Metsimaholo Primary	Oranjeville	Free State	Urban	Eng./SSotho
36. 256430	Bokantsho Primary	Viljoensdrif	Free State	Rural	Eng.
37. 2300151	Heide Primary	Heidedal	Free State	Urban	Afr.
38. 106603	Vulindlela Primary	Harrismith	Free State	Urban	Eng. /Zulu

39. 258072	Malebaleba Primary	Odendaalsrus	Free State	Urban	Eng.
40. 0032816	Repeng.khotso Primary	Deneysville	Free State	Urban	Eng. /SSotho
41. 936077	Phamong Junior. Primary	Phuthas	Free State	Rural	Eng./SSotho