# Revised Manual for the Grover-Counter Scale of Cognitive Development (GCS)

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# ACKNOWLEDGEMENTS

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# 1. BACKGROUND AND DESCRIPTION

## 1.1 BACKGROUND

The Grover Scale has its origin in an attempt to address practical problems arising predominantly in the field of mental handicap. The assessment of the level and nature of current intellectual or cognitive functioning in a mentally handicapped child or adult is one basic requirement for all further management. Decisions regarding such important matters as the correct placement in an educational or work setting; the precise kind of teaching or training programme that will be most effective at any particular time; the choice of exact remedial measures matched to clearly observed cognitive weaknesses - all these should rest on an assessment of cognitive functioning which is well focused and accurate and the results of which can be translated into meaningful recommendations.

The test is not intended to replace a recognised and well-standardised predominantly verbal type test for use with subjects who have well developed verbal skills. Neither is it intended as an all-round development scale, though in both such cases it can serve as a valuable supplement.

## 1.2 TARGET POPULATION

The Grover Scale was designed for use with the following South African populations: in general, normal children in the chronological age range from 3 years to approximately 10 years, particularly where a predominantly verbal test is unsuitable for some reason; specifically, mentally handicapped children and adults from chronological age approximately 5 years onwards, particularly where a predominantly verbal test is unsuitable.

## 1.3 AIM

A major aim in devising the Grover Scale was to provide an instrument which could reveal such cognitive functioning (within a defined range) in persons with extremely impaired verbal skills, whether receptive or expressive or both.

Impaired or limited verbal ability, especially of the expressive kind, is characteristic of many mentally handicapped persons but may stem also from other causes such as defective hearing, aphasia, elective mutism, or the fact that the language medium of the test used is not the mother tongue of the subject, a situation which can, unfortunately, occur in a multi-linguistic society. One of the settings in which the need for an alternative test has become increasingly clear is that facing the psychologist who must assess and make meaningful decisions about mentally handicapped African children, for instance, the child's suitability for admission to special education.

In all such cases the subject may be able, if given the chance, to solve a problem behaviourally although unable to do so in the form of a verbal response.

## 1.4 OTHER CONSIDERATIONS IN DESIGNING THE GROVER SCALE

(a)   The test should enable the procedures adopted by the subject on each item to be clearly observable and the scoring system should take this and not merely the final product (Pass/Fail) into account.

(b) The test, being one of cognitive functioning, should not be adulterated by items, which no longer have any significant cognitive component. This occurs particularly when tests of the mosaic type designed for young children are administered to adults. Certain items of development significance in childhood may be achieved by mentally handicapped adults simply through years of practice and repetition, for example, tying a bowknot, and naming the days of the week.

(c) The material should be inherently appealing to children and mentally handicapped adults.

(d) A minimum of simple equipment should be required both for convenience, easy replacement, and to avoid prohibitive costs.

(e) Testing time should be relatively short.

## 1.5 THEORETICAL BASIS

The theoretical basis of the test is derived from the Genetic Epistemology of Piaget with its conception of orderly sequential stages or modes in intellectual development. These modes are characterised by the progressive appearance of new cognitive structures brought about by the interplay of assimilation and accommodation as the child interacts with widening aspects of the environment and increasingly uses reflections upon and abstractions from the immediately given data to solve problems.

The test covers the period extending from approximately 3 years of age to approximately 10 years and 6 months in normal development. This period, in Piagetian terms, embraces that stage immediately following the Sensori-motor Mode through to the mid-point of the Concrete Operational Mode.

The test aims at revealing the cognitive mode at which the subject is currently functioning within this period. It is a full understanding of this, rather than a single quantitative result, which makes possible meaningful recommendations regarding the kind of teaching or training programmes that will be most effective, the choice of precise remedial measures matched to clearly observed weaknesses, and correct placement in an educational or work setting.

## 1.6 DESCRIPTION OF EACH SECTION

The aim and rationale for each section of the test are given with the interpretation of results (refer to Paragraph 5). Only a brief description of the sections is consequently given at this stage.

(a) Section A: A simple discrimination and grouping task.

(b) Section B: Completion of, memory for, and minor transformation of simple patterns.

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

(d) Section D: Reproduction of models from memory demanding more advanced perceptual activities and a grasp of spatial relations.

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

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## 2. ADMINISTRATION

### 2.1 TEST MATERIAL

The test material consists of:

➢ Revised Manual for the Grover-Counter Scale of Cognitive Development (Order Number 3445)
➢ Answer booklet (Order Number 3446)
➢ Recessed base (Order Number 3447/1)
➢ 36 counters (Order Number 3447/2)
➢ 8 cards bearing designs (Order Number 3448/1)
➢ 2 small space boards (Order Number 3448/2)
➢ Folder for test material (Order Number 3449)
➢ Complete set (Order Number 3450)
➢ Report on the standardisation of the Grover-Counter Scale of Cognitive Development (Order Number 3600)

While the 8 cards are printed in black and red, these designs are printed in this manual in black and grey, where the grey represents the red.

The tester also needs the following:
➢ A stopwatch;
➢ A suitable cloth for the table to prevent counters sliding about.

### 2.2 THE TESTER

The tester should be a psychologist and should receive training in the administration of the test and the interpretation of results.

The tester should learn and be completely familiar with the procedure and the method of scoring for each item without the necessity for reference to the Manual while testing.

### 2.3 THE TEST SITUATION

Testing is done on an individual basis.

**The subject should sit next to the tester (not opposite).**

The tester should use both demonstrations (gestures) and short verbal instructions (in the mother tongue of the subject) to ensure that the subject has the best possible opportunity to grasp what is required. If the subject is totally incapable of understanding verbal instructions, the tester should strongly emphasise and, if necessary, repeat pointing and other gestures.

The tester should encourage the subject at all times by suitable verbal comment or gesture e.g. good/hand clapping, but should not give any further help other than that indicated for each item.

The tester should closely observe and record the method used by the subject on each item. Where the subject's attempt is imperfect, the tester should rapidly sketch such an attempt in the space provided on the scoring sheet. This will ensure more accurate scoring of items after the actual testing is completed.

The tester should make qualitative observations about the subject with regard to such factors as co-operation, attention, persistence, ability to see his/her own errors and, where the subject is verbal, the nature and quality of language used, the ability to name colours, forms, some of the objects depicted in the designs, as well as spontaneous comments or explanations.

## 2.4 TIMING

Testing time should not exceed 30 minutes and for less able subjects a shorter period since the more difficult sections will not be presented.

In Section E accurate timing must be recorded.

## 2.5 SCORING

The instructions for scoring are given with each section. The main test consists of five sections, A, B, C, D and E, which should be given in this order, as should the items in each section. A minimum score on certain sections is required in order to proceed to the next section. When this minimum score is not achieved, testing is terminated at this point.

Section X is not part of the main test and is presented only when the subject fails to achieve the minimum required score (8 points) on the first presentation of Section A. The procedure to be adopted and the method of scoring are given after Section E.

## 2.6 ADMINISTRATION AND SCORING PROCEDURE FOR EACH SECTION

### SECTION A

Section A may be omitted if it is estimated that the subject functions at or above the 6 year (urban) and 7 year level (rural).

**Material**

For this section, only 24 counters, 4 of each kind, are used. Set the other 12 aside.

**Definitions**

A true set consists of four counters of the same form and colour, e.g. four black circles.
A mixed set consists of four counters of the same form but different colours, e.g. three black squares and one red square.
A container is one of the six recesses in the base. Each true set has its own particular container, thus:
Top row (from left to right): black circles; black squares; black triangles
Bottom row (from left to right): red circles; red squares; red triangles.
A correct container is one that matches the arrangement above.

## Procedure

Before testing starts, ensure that all true sets, <u>four of each kind</u>, are in their correct containers in the base. Place the covered base in front of the subject on the table. Introduce the task with a brief statement according to age and ability of the subject. Say for example: *Here are some games/puzzles for you to do. I will show you what to do.*

Uncover the prepared base and place it in front of the subject. Point to the counters and say: *Look at these.* Allow the subject to examine them for 5 seconds but try to avoid the removal of the counters. If any are removed, replace them in the correct container. Record any verbalization referring to form or colour. If the subject has incorrectly named the colours, the tester runs a finger over the three sets in the top row and says: *What colour are these?* If a correct response is given, confirm and say: *Yes, black.* If an incorrect or no response is given, say: *Black.* In either case say: **Look** (pointing). *All these here at the top are black.*

Repeat the procedure for the bottom row.

Pick up and replace a counter from each container in turn, starting at the top left and completing the top row, then the bottom row from left. While doing so, say: **See, *each one has its own place/little house. These*** (e.g. black circles) *go in here; these in here, etc.* Remove all 24 counters, place them on the table in front of the subject and mix them. Say: *Put them* (pointing to the counters) *all back in the right place* (pointing to recesses in the base). If a counter is misplaced, shake your head and say: *No, not there.* Remove the misplaced counter and place it on the table. Do this three times only, then ignore errors and let the subject complete the task. Record the score achieved.

## Scoring

*2 points* for each true set in a correct container
*1 point* for each true set in an incorrect container
*0.5 points* for each mixed set in a container

## Deductions

*2 points* for an all red upper and an all black lower arrangement that is otherwise correct
*1 point* (up to 3 points) for each counter removed by tester

Round off the total score for Section A, e.g. 6,5 = 7. Maximum score for Section A = 12.

If the minimum score (8 points) is achieved, proceed to Section B. If the minimum score is not achieved, proceed to Section X.

## SECTION B

### Material

For this section the tester needs 18 black counters and two 6-space boards.

For Items B1 and B2, 18 black counters and a 6-space board are needed. After completing these two items three black circles and three black squares remain on the table. These are mixed and used together with the 6-space board with the correct B2 pattern made on it as well as the second space board for Item B3.

### Procedure

**Item B1 (complete the pattern):**
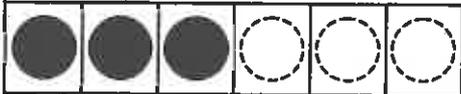


Mix all 18 black counters on the table in front of the subject. Place a 6-space board in front of the subject. The tester places a black circle on each of the first 3 spaces of the board.

Say: **You finish this** (pointing to the three empty spaces on the board). If the subject begins with a wrong counter, e.g. a triangle, the tester says **no**, and removes the counter and points to the circles on the board. Intervene thus <u>once</u> only. Record the score and replace the counters with the others.

**Item B2 (reproduce from memory):**



The tester makes the whole pattern B2 from left to right on a 6-space board in view of the subject.

Say: **Look at this** (pointing to the pattern on the board). **You must <u>remember</u> how to make it. I'm going to take it away** (use a sweeping hand gesture to indicate it will be removed). Allow 5 seconds for the subject to look at the pattern. Remove the counters and mix them with the others. Say: **You make it here** (pointing to the space board). Record the score, noting whether the subject works from left to right or right to left. If quite correct leave the pattern on the table. If it is incorrect, correct it and leave the pattern on the table.

**Item B3 (transfer of sequence):**
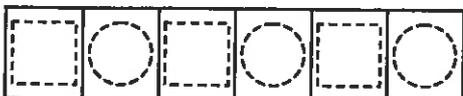


Say: **Now you make it** ( pointing to Item B2 on the table), **but begin with a square/block** (pointing to a black square). **Begin here** (the tester places his/her finger on the first left hand space on the empty board). If the subject begins with a circle or from the right hand end, say **no**, remove the counter and place it with the others. Intervene thus <u>once</u> only. Record the score, break up the pattern and remove the boards.

### Scoring

<u>Item B1:</u>

*5 points* if three black circles were added

*3 points* if there was one initial intervention before pattern was completed correctly

*2 points* if two black circles were added

<u>Item B2:</u>

*5 points* if pattern was completed correctly (working from left to right)

*4 points* if the testee worked from left to right, started with a square but alternated

*4 points* if the testee worked from right to left, started with a circle but alternated

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*2 points* for two correct pairs (left to right or right to left)

**Deductions**

*1 point* for working from right to left

<u>Item B3:</u>

*5 points* if pattern was completed correctly (working from left to right) with no intervention by tester

*3 points* if pattern was completed correctly (working from left to right), but with one intervention by tester

*2 points* for two correct pairs (working from left to right)

*1 point* for one correct pair (working from left to right)


Maximum score for Section B = 15.

## SECTION C (COPY FROM MODELS)

### Material

For this section the tester needs all 18 red and all 18 black counters.

### Procedure

**Example (tree):** Place all 18 red counters mixed together in front of the subject.

Say: **These are yours** (pointing to the subject). Place all 18 black counters mixed together in front of the tester.

Say: **These are mine** (pointing to self).

Say: **Look nicely.** The tester constructs the example (tree) with the black counters ensuring that the subject is watching. The exact order indicated at the items of Section C is followed. Ensure that the completed model is directly in front of the subject. Say: **Look at this tree. Now I will make one with your red counters.** The tester constructs an identical tree with the red counters to the side of the black tree. Say: **They look the same** (pointing to the two trees). The tester leaves the black tree; breaks up the red tree and mixes the counters with the other red ones. Say: **You make the tree here** (pointing to the place at the side of the model) **with your red ones** (pointing to the red counters). Do not score but record S (success) or F (failure). Break up both models and replace the counters. If the subject is quite unable to make the tree, terminate the testing.

**Item C1 (flower):** Say: **Look nicely.** The tester constructs the flower with the black counters ensuring that the subject is watching. The exact order indicated at the items of Section C is followed. Ensure that the completed model is directly in front of the subject.

Say: **This is a flower. You make a flower like this with yours** (pointing to the red counters). The subject must make the flower at the <u>side</u> of the model. Record the **score**. Break up the model and the product and replace the counters.

**Item C2 (aeroplane):** The tester <u>screens</u> the model (aeroplane) while constructing it rapidly with the black counters and then exposes the completed model to the subject. Make certain that the completed model is pointing in a North West direction as seen by the subject and that it is directly in front of the subject. Say: **This is an aeroplane, look it is flying <u>this</u> way.** The tester demonstrates a North West direction with his/her hand. Say: **You make one flying <u>like this</u>, here with yours** (pointing to the red counters). Record the **score**. Break up the model and the product and replace the counters.

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**Item C3 (road sign):**
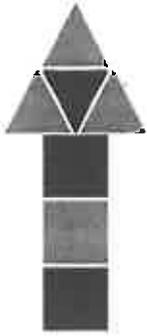


The tester mixes all 36 counters together on the table. The tester <u>screens</u> the model (road sign) while constructing it rapidly with the black and red counters and then exposes the completed model to the subject. Ensure that the completed model is directly in front of the subject.

Say: ***This is a road sign. Perhaps it says "Danger". You make one just like this, here, with these black and red ones*** (pointing to the counters on the table). If the subject starts with the wrong colour, e.g. a black triangle for the apex, say: ***No, look*** (pointing to the colours) ***at this colour.*** Let the subject correct his/her mistake. Do not intervene again. Record the score. Break up the model and the product and replace the counters.

## Scoring

Examples for scoring are given for each item.

**Item C1:**
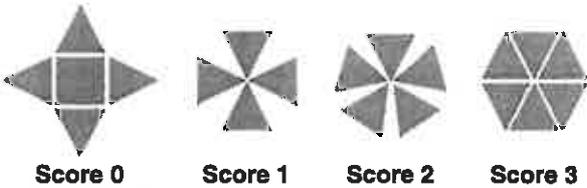


*3 points* for a perfect copy

*2 points* if only five triangles were used, all apexed to the centre

*1 point* if only four triangles were used, all apexed to the centre

*0 points* if the apex does not point to the centre or for any other additions

**Item C2:**
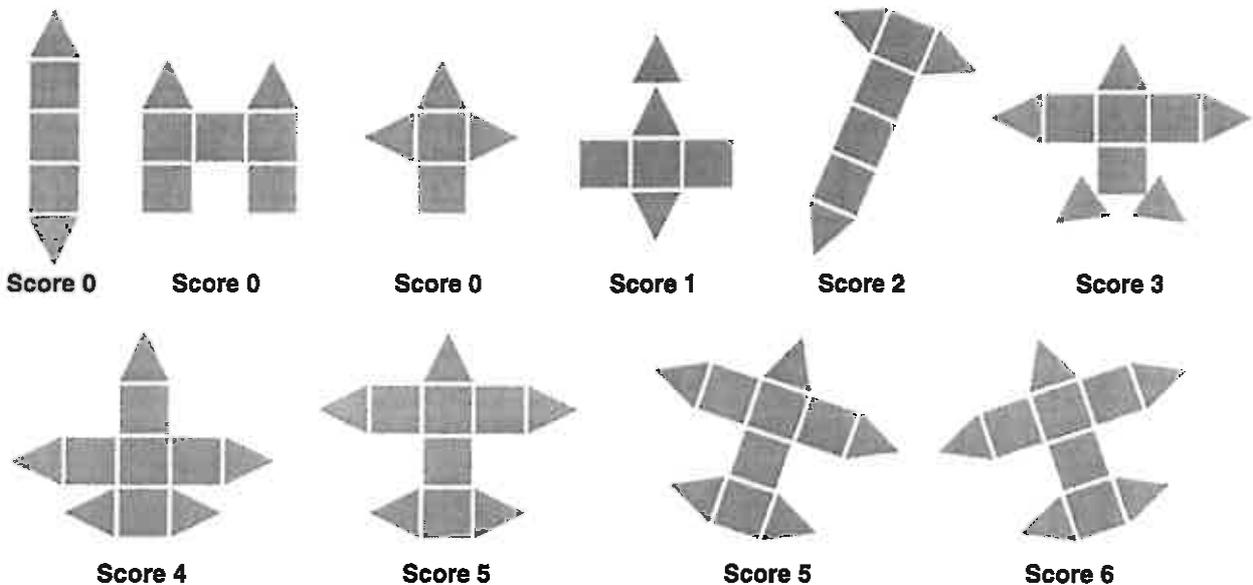


*6 points* for a perfect copy and angle

**Deductions:**

       *1 point* for each error (see the examples for scoring).

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**Item C3:**
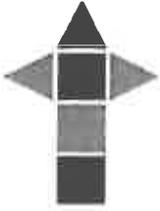


| Score 0 | Score 0 | Score 0 | Score 1 | Score 2 |
|---------|---------|---------|---------|---------|

| Score 3 | Score 4 | Score 5 | Score 6 |
|---------|---------|---------|---------|
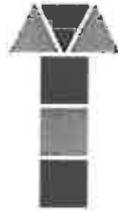
*6 points* for a perfect copy

**Deductions:**

*1 point* for each error (see above examples)

*1 point* for errors in colour

Maximum score for Section C = 15.

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## SECTION D (REPRODUCTION OF MODELS FROM MEMORY)

### Material

For this section the tester needs all 18 red and all 18 black counters.

### Procedure

If the subject is able to speak, the tester can ask him/her to name the object, but the tester should in all cases give the names of the objects (man, star and car). Item D1 should always be administered even to the younger children but items D2 and D3 should only be administered to children from 4 years 6 months. For children under 5 years 6 months, testing should be terminated at the end of section D.
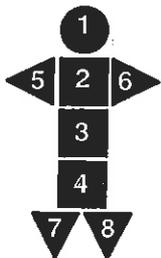
**Item D1: (man)**   Mix all 36 counters together on the table.

Say: *Look nicely.* The tester constructs the man with the black counters ensuring that the subject is watching. The exact order shown in the diagram of Section D is followed. Ensure that the completed model is directly in front of the subject.

Say: *This is a man. You must remember how to make it. I'm going to take it away* (use sweeping hand gesture to indicate it will be removed). *Look nicely at the man.* Allow 5 seconds. Break up the model. Mix the counters with the others.

Say: *You make the man. Make it the same colour as mine.* If the subject starts with a red counter, say *no/shake head*, remove the counter and point to the black counters. Intervene thus <u>once</u> only. Record the score. Break up the product and replace the counters.
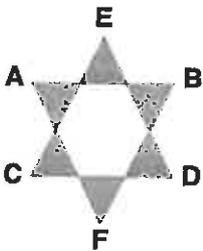
**Item D2: (star)**   The tester <u>screens</u> the model (star) while constructing it rapidly with six red counters and then exposes the completed model to the subject. Ensure that the completed model is directly in front of the subject.

Say: *This is a star. You must remember how to make it. I'm going to take it away* (use sweeping hand gesture to indicate it will be removed). *Look nicely at the star.* Allow 5 seconds. Break up the model. Mix the counters with the others.

Say: *You make the star. Make it the same colour as mine.* If the subject starts with a black counter, say *no/*shake head, remove the counter and point to the red counters. Intervene thus <u>once</u> only. Record the score. Break up the product and replace the counters.

If the subject has used six red counters, leaving a very wide space (see examples for scoring, score 0).
Say: *Is that right? Are you sure?* If the subject changes the product, record the score again. Score the better of the two products.

**Item D3: (car)**

The tester <u>screens</u> the model (car) while constructing it rapidly with eight black counters and then exposes the completed model to the subject. Ensure that the completed model is directly in front of the subject.

Say: *This is a car. You must remember how to make it. I'm going to take it away* (use sweeping hand gesture to indicate it will be removed). *Look nicely at the car.* Allow 5 seconds. Break up the model. Mix the counters with the others.

Say: **You make the car. Make it the same colour as mine.** If the subject starts with a red counter, say *no*/shake head, remove the counter and point to the black counters. Intervene thus <u>once</u> only. Record the score. Break up the product and replace the counters.

## Scoring

Examples for scoring are given for each item.

**Item D1:**



| Score 0 | Score 0 | Score 2 | Score 3 | Score 4 |

| Score 4 | Score 5 | Score 6 | Score 6 | Score 7 |
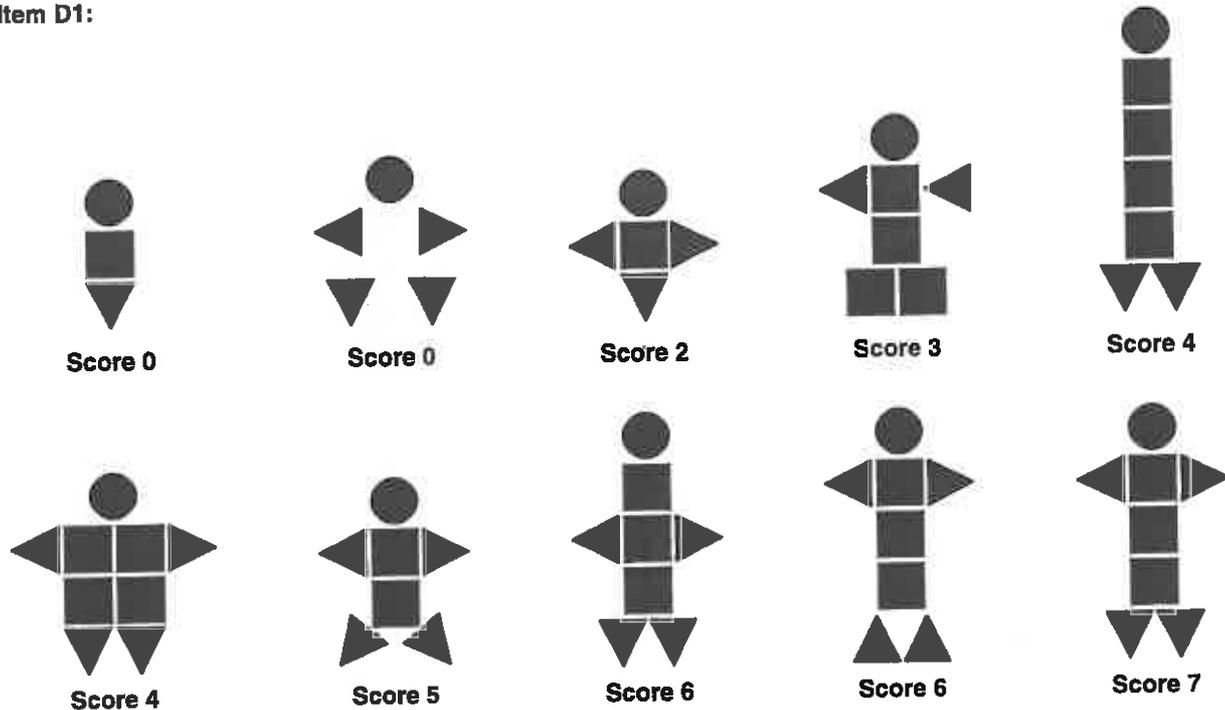
*7 points* for a perfect reproduction

**Deductions:**

    *1 point* if two or four squares were used for the body

    *2 points* if one or more than four squares were used for the body

    *2 points* if one or both arms were omitted

    *2 points* if one or both feet were omitted

    *2 points* if a square/squares were used for one or both arms and/or for one or both feet

    *1 point* if the arm/s are misplaced, e.g. immediately below the head or attached to the second or lower square of the body

    *1 point* if one or both arms and/or one or both feet were inverted

    *1 point* if foot/feet is/are incorrectly attached

    *1 point* if the wrong colour was used or if colours were mixed

**Item D2 (score strictly):**



| Score 0 | Score 0 | Score 3 | Score 3 | Score 4 | Score 6 | Score 8 |
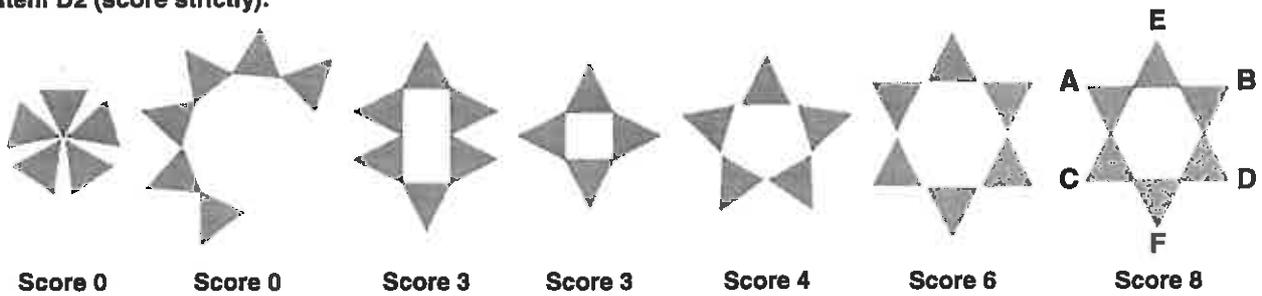
*8 points* for a perfect reproduction with minimum trial and error

**Deductions:**

*1 point* if much trial and error occurs

*1 point* if only five triangles were used

*1 point* for loss of horizontal line A to B

*1 point* for loss of horizontal line C to D

*1 point* for loss of vertical line E to F (F must be opposite E)

*1 point* for loss of correct inner space (hexagon)

*1 point* for lack of closure (triangles <u>slightly</u> apart)

*2 points* if only four triangles were used

*2 points* for loss of star form, e.g. by elongation

➤ Some young children approach Item D2 in a characteristic way (see examples for scoring). If 6 red triangles are used to construct about 3/4 of a circle with a wide space left, deduct

➤ *2 points initially*. Then score as follows:

➤ Subject self corrects, e.g. by pushing the triangles together score the final product in the usual way

➤ Subject corrects the pattern after enquiry by the tester (Is that right?), deduct *1 point*, then score the final product in the usual way

➤ Subject closes with black triangles, with or without enquiry, **score** *1 point* in total

➤ Subject leaves the circle wide open even with enquiry, score *0*

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**Item D3:**
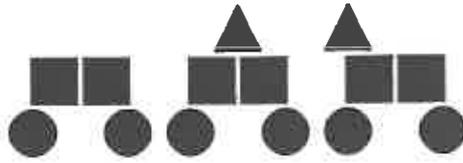


Score 0

Score 1
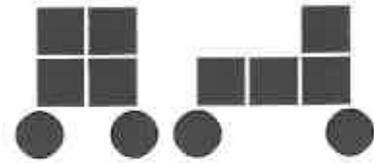
Score 2
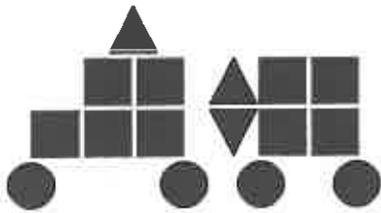
Score 2
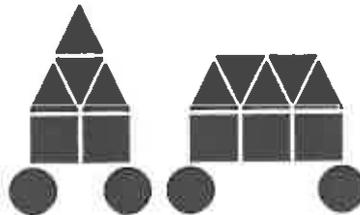
Score 3
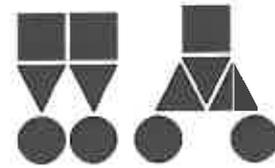
Score 4
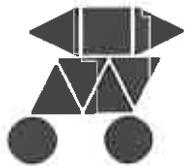
Score 5

Score 7
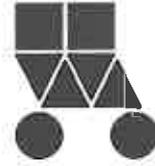
Score 7
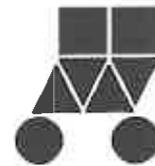
Score 8

*8 points* for a perfect reproduction

*0 points* if only one counter is used for the body and top or if the parts are unconnected

*1 point* if the body and the top are not differentiated, with or without inaccurate additions

*2 points* if squares only are used for both the body and the top, with or without inaccurate additions

*Deduct 3 points* if squares are used for the body and triangles for the top, *deduct* for other errors

*4 to 8 points* if triangles are used for the body and squares for the top - *deduct points* for other errors but

*deduct 1 point* only for a wrong slope to the front triangle. Refer to the **exa**mples for scoring

*Deduct 1 point* if the wheels are absent or incorrect

Terminate testing for subjects under 5 years 6 months of age.

Maximum score for Section D = **23.**

## SECTION E (COMPLEX DESIGNS AND PATTERNS: ANALYSIS AND COMPLETION)

**Material**

For this section the tester needs all 18 red and all 18 black counters, as well as the cards with the designs of the butterfly, the church and the cards with the patterns. A stopwatch is also required.

**Time**

The maximum time for each item in Section E is 130 seconds. Timing always starts when the subject picks up the first counter. Even when the subject has not completed the item, the tester stops him/her when 130 seconds have elapsed, saying: **That's a bit hard.** The product is then scored. However, in the case of E4 and E5, after scoring the product achieved in 130 seconds (or less) and where the product is incorrect, the tester introduces the enquiry procedure and allows a further 30 seconds if applicable.

The actual time taken for each item should be recorded.

**Procedure**

If the subject is able to speak, the tester can ask him/her to name the object, but the tester should in all cases give the names of the objects (butterfly, church). The subject must construct the product in all cases on the table to the side of the card and not below or on the card.

**Example (butterfly):** Mix all 36 counters together on the table. Present the card with the design of the butterfly. If suitable, ask the subject to name it, otherwise the tester says:

**It is a butterfly. I will make it with the counters.** Ensuring that the subject is watching, the tester constructs the butterfly with the black counters to the side of the card, slowly following the order indicated by the numbers shown at the items of Section E. While constructing, the tester points to each part on the card and then to the part made by the counters.

The tester says: **First this wing** (top left). **Now this one** (top right). **Now the butterfly's tummy** (the tester puts the triangles together and pushes the combined triangles up in the space under the wings). **Now these** (the tester adds the bottom left and the bottom right triangle). When the model is completed, say: **Look nicely. See how I made the butterfly.** Allow 5 seconds. Break up the model. Mix the counters with the others. Leave the card on the table.

Say: **You make the butterfly.** Start timing when the subject picks up the first counter. If the subject picks up a red counter at any time, say: **No, make it the same colour as this** (pointing to the card). Intervene thus <u>once</u> only. Stop timing when 130 seconds have elapsed (or sooner if the subject is finished). Record the score. Break up the product and replace the counters. Remove the card.

**Item E1 (church):**



Present the card with the design of the church. If suitable, **ask** the subject to name it, otherwise the tester says: *It is a church. You make the church with the counters, here* (pointing to the place to the side of the card). *Start with this part* (placing finger on the tower on the card). Start timing when the subject picks up the first counter. If the subject picks up a red counter at any time, say: *No, make it the same colour as this* (pointing to the card). Intervene thus <u>once</u> only. Stop timing when 130 seconds have elapsed (or sooner if the subject has finished). Record the time and accuracy. Break up the product and replace the counters. Remove the card. Whether the product is correct or incorrect, say:

*This is how we make (you made) the roof.* The tester demonstrates slowly with the triangles.

Say: *Look.* Tester runs finger up slope of roof on left, along top and down slope on right.

Terminate testing if the combined score on Edem and E1 does not reach 5 points. 

**Item E2 (half design):**



Present Card E2a (whole design) and E2b (half design) side by side on the table.

Say: *Look, this* (pointing to Card E2b) *is the top half of this* (pointing to Card E2a). *I want you to make the <u>whole</u> pattern, the top* (pointing to the top part of E2a) *and the bottom* (pointing to the bottom part of E2a). The tester removes Card E2a and leaves Card E2b on the table. Say: *Begin with the black part.* Say: *Look.* Tester runs a finger up slope on left of black part, along top and down slope on right. Start timing when the subject picks up the first counter. Stop timing when 130 seconds have elapsed (or sooner if the subject has finished). Record the time and accuracy. Break up the product and replace the counters. Remove the card.

**Item E3 (black and red parts):**
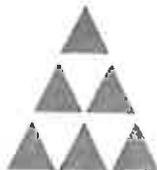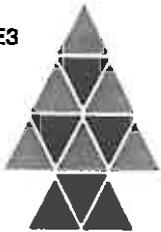


Present Card E3. Say: *Look, here is a black part* (pointing). *I want you to make the <u>black</u> part with the counters here* (pointing to the place to the side of the card) *and the red part here* (pointing to another place to the side of the card). Leave the card on the table.

Say: *Begin with the black part* (pointing to the three black triangles and the black base). Start timing when the subject picks up the first counter. If the subject starts to make the whole pattern, say: *No. Just the black part here, and the red part here.* Stop timing when 130 seconds have elapsed (or sooner if the subject has finished). Record the time and note whether the subject produced at least one part (black or red) correctly within the time limit. Break up the product and replace the counters. Remove the card.

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**Item E4 and practice card:**
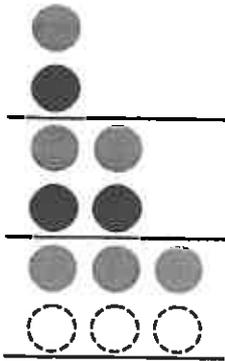


The tester presents the practice card and says: *Look at this* (pointing at the whole pattern). Then the tester covers all but the first section. Say: *One red* (point - hold up one finger), *one black* (point - hold up one finger). Repeat: *One red, one black.* The tester moves the cover down to expose the second section. Proceed as above, i.e. two red, etc. The tester exposes the whole card and proceeds as above for the first line of the third section, i.e. three red. The tester then points to the space in the third section and says: *What comes here?* If the subject says "three black", say: *Good, make it here with the counters on the table.* If no response or a wrong response is given, the tester says: *Look again* (pointing), *here is one red, one black; here are two red, two black; here are three red, what comes here* (pointing to the space)? If the subject is quite unable even with assistance to manage this practice card, terminate testing. ✋ No score is given for the practice card, but the result is recorded. Break up the product and replace the counters. Remove the card.

**Item E4 (first pattern):**
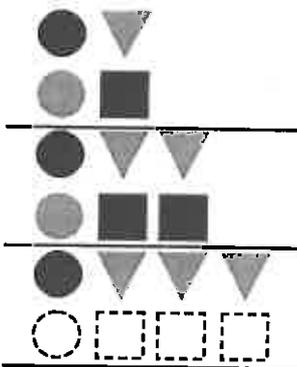


The tester presents Card E4.

Say: *This card is a little harder. Look at this pattern carefully.* The tester runs his/her finger round and over the whole pattern. The tester then covers all but the first section (expose only first and second rows).

Say: *Look nicely.* Tester places finger slowly on each counter in first row, then second row. Tester moves cover down to expose second section (rows 3 and 4) and repeats the pointing. Tester exposes last section and repeats pointing for fifth row. Tester points to empty space (for row 6). Say: *Show me with the counters what will come here.* Tester runs finger along empty space for row 6.

Say: *Look nicely at the pattern and think it out carefully.* Leave card on table. Start stopwatch when subject picks up first counter. Stop stopwatch when 130 seconds have elapsed (or sooner if the subject has finished). Record the score and time.

If the product is incorrect, say: *Is that right? Are you sure?* If necessary, point towards the product and towards the card and look at the subject. If the subject says, yes or nods head, terminate the item and record the score achieved. If the subject begins to change the product, allow a further 30 seconds, then stop the subject. Score the changed product. The final score for the item is that obtained on the better of the two products.

Break up the product and replace the counters. Remove the card. Terminate testing if score on E4 does not reach 4 points. ✋

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**Item E5 (second pattern):** The tester presents Card E5.
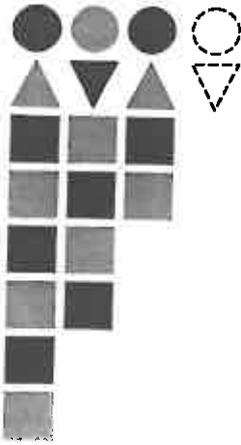
Say: *Look at this pattern carefully.* The tester places his/her finger just at the top of each column in turn, saying: *Here is the first column, here is the second and here is the third. Now you make the fourth column* (pointing to the top of the space on the card where the fourth column would be). *Think it out carefully.* Start timing when the subject picks up the first counter. Stop timing when 130 seconds have elapsed (or sooner if the subject has finished). Record the time and accuracy.

If the product is incorrect, say: *Is that right? Are you sure?* If necessary, point towards the product and towards the card and look at the subject. If the subject says, yes or nods head, terminate the item and record the score achieved. If the subject begins to change the product, allow a further 30 seconds, then stop the subject. Score the changed product. The final score for the item is that obtained on the better of the two products.

Break up the product and replace the counters. Remove the card. Terminate testing.

## Scoring

It should be noted that the E section especially the later items (i.e. from E2 to E5) was devised to test the extent to which the child has moved into a new stage of cognitive development namely the concrete operational mode. Therefore, the score of 1 and possibly also 2 are not really any indication of this transition but simply result from the application of skills required at the earlier developmental stage namely preoperational symbolic perceptual mode. In view of this, a few slight changes are made in the scoring to avoid the picking up of meaningless 1 or 2 points on items E 2 onwards.

### Example:

    *5 points* for a perfect construction

    *2 points* (each wing 1 point) if upper wings (1+2) and (3+4) are correct

    *2 points* if the two triangles for the body (5+6) are correctly placed

    *1 point* if both lower wings (7 and 8) are correctly angled

### Item E1:

*6 points* for a perfect construction

### Deductions:

    *1 point* if there is no centre triangle for the roof, but the product is otherwise correct

    *1 point* if there is one square more/less in the tower, but the product is otherwise correct

    *1 point* if there is extra unit added to the body, but the product is otherwise correct

    *4 points* if only the tower is correct and the body is missing/quite wrong

### Item E2:

*6 points* for a perfect construction with minimal trial and error

*4 points* for a perfect construction but after much trial and error

*3 points* if only the given half of the design is correct

*3 points* if only the whole black section is correct

A score below 3 should be given 0


### Item E3:

*6 points* if both parts are quite correct

*3 points* if only one part is quite correct


### Deductions:

*1 point* for each minor error, e.g. base of black part


### Item E4:

*6 points* if the product is correct without trial and error or any enquiry

*5 points* if the product is correct after trial and error and/or enquiry


➤ Apart from the initial circle, the other three items in the 6th row involve three variables, namely, number (3 counters); colour (black); form (squares). Each of these three variables carries *2 points*.

➤ Example: Red circle and three squares of any colour except all black.

➤ Score *2 points* for correct number (3); *2 points* for correct form (squares); *0 points* for colour. Score is 2 + 2 = 4.


### Deductions:

If the initial circle is a wrong colour or form, deduct 1 point

Some subjects simply copy (repeat) the 5th row. This is not scored as above, but scores *0 points*, as it shows complete lack of grasp.


### Item E5:

*6 points* if the product is correct without trial and error or enquiry

*4 points* if the product is correct after trial and error and/or enquiry

*2 points* if the first two counters are quite correct and one red square was added

*Deduct 1 point* if the product is otherwise correct except for the red triangle inverted


Maximum score for Section E = 35.

## SECTION X

This section is presented only if the subject fails to achieve 8 points on the first presentation of Section A. It is divided into Sections X1 and X2.

### Material

For Section X1, only 12 (4 of each) black counters and the base are required. For Section X2, only 12 (4 of each) red counters and the base are required.

### Procedure X1

Leave a single black counter of correct form in each of the three top containers. Place the base thus prepared in front of the subject. Place the remaining nine black counters mixed together in front of the subject. Pick up the black circle from the first container. Say: ***These go in here.*** Replace and repeat with the square and the triangle. Pointing to the counters on the table, say: ***Put them all back in here*** (pointing to the three top recesses in the base). If the subject misplaces a counter, shake your head and say *no*, remove the counter and replace it on the table. Repeat this <u>three times</u> only, then ignore errors and let the subject complete the task. Record the score. Remove and set aside all black counters.

### Procedure X2

Leave a single red counter of correct form in each of the three bottom containers. Place the base thus prepared in front of the subject. Place the remaining nine red counters mixed together in front of the subject. Pick up the red circle from the first container. Say: ***These go in here.*** Replace and repeat with the square and the triangle. Pointing to the counters on the table, say: ***Put them all back in here*** (pointing to the three bottom recesses in the base). If the subject misplaces a counter, shake your head and say *no*, remove the counter and replace it on the table. Repeat this <u>three times</u> only, then ignore errors and let the subject complete the task. Record the score. Remove and set aside all red counters.

### Scoring

<u>Procedure X1:</u>

*1,5 points* for each recess to which three black correct counters were added

*1,0 points* for each recess to which two black counters were added (no other form added with two correct counters)

### Deductions:

0,5 points (up to 1,5 points) for each wrong counter removed by the tester

<u>Procedure X2:</u>

*1,5 points* for each recess to which three red counters were added

*1,0 points* for each recess to which two red counters were added (no other form added with two correct counters)

### Deductions:

0,5 points (up to 1,5 points) for each wrong counter removed by the tester

Round off the total score for Section X, e.g. 4,5 = 5. Maximum score = 9.

If 5 points or more were achieved on Section X, proceed to Section A (second presentation). *Deduct 1 point* (penalty for second presentation) from the score for Section A second presentation. Enter this score and disregard the score for Section X and Section A first presentation. If this score is 6 points or more, proceed to Section B. If this score is less than 6 points, terminate the testing. The total score for the test would then be the score for Section A second presentation or the score for Section X, whichever is the greater.

# 3. CONSTRUCTION AND STANDARDIZATION OF THE GROVER INDIVIDUAL SCALE

## 3.1 DEVELOPMENT OF ITEMS

The development and preliminary checking of the test items were started in 1989. The items were planned and graded to illustrate the changing procedures, with increasing age, adopted by subjects in solving the presented problems. Each item, therefore, had to meet the criterion of providing opportunities for dealing with a problem in a variety of ways from the earliest sensori-motor manipulation of counters in an unplanned way through to a clear grasp of the nature of the goal, leading to a planned procedure to attain this.

Although each item, from Section A onwards, had to allow for varying methods of approaching the task, each new section had also to make greater demands involving the need for the exercise of new cognitive schemes or structures. The range of the problems presented in the test had to reflect the growing ability to move through the later sensori-motor mode into the early and later pre-operational, symbolic, perceptual mode and finally into the early and mid-point of the concrete operational mode.

A second criterion that had to be met in developing the items was that the solution of the problems required no expressive verbal communication on the part of the testee and that administration required the minimum of verbal explanation strongly supported by demonstration.

During the pilot studies, a number of items were presented to normal children in the age range 3 years to nearly 11 years of age. A few items were discarded for the following reasons: The item, e.g. an original B4, was too difficult for the age intended but did not fit into another section; and the item could not be sufficiently demonstrated. It was also found necessary to include certain new items. Pilot studies showed that the transition to Section E was too abrupt. The example for Section E and Item E1 were introduced. At the same time a practice card was introduced for Item E4. These new items were tried out on additional pilot samples of children in the age range 6 to 10 years.

Some modifications were made in the scoring system where this had proved not to provide sufficiently clear guidelines. In the early pilot studies a scoring system for the items of Section E was based on both power and speed, that is, the score obtained depended in part on the number of seconds taken to complete the item. This was later abandoned since it was clearly observed that such a procedure failed to take into account individual working style and tempo. Particularly disadvantaged was the careful, meticulous child. It was seen that, in some instances, such a child who was working systematically but rather slowly towards a correct solution, just failed, perhaps in the placing of the last counter, to achieve the time limit needed to be allotted a particular score.

It was decided to replace such a graded time system by a single time limit for each E item. A suitable time limit was arrived at by a careful analysis of the recorded times taken by children on each item. The purpose of this single time limit for each item is not to emphasise speed but to avoid a protracted struggling by the child when it is quite obvious that the item is beyond his/her ability.

It is generally accepted that emphasis on speed over power is inappropriate for young children and mentally handicapped subjects.

## 3.2 SAMPLES

The following samples provided the data or supporting data for various aspects of the standardisation procedure:

### 3.2.1 Sample 1

This sample consisted of some 200 normal children from chronological age 3 years to just over 10 years. This constituted the main sample for establishing preliminary norms. The testing was carried out during the period 1990 to 1992.

All the children were in some form of educational setting from pre-school centres through the primary school standards up to and including Grade 5. All these settings were open or integrated so that children from different ethnic groups were included. However, the great majority were white children. Verbal communication was in the language of instruction, namely, English or Afrikaans. Educators were asked to select for assessment on the Grover-Counter Test those children considered average in their academic or learning ability.

### 3.2.2 Sample 2

This sample consisted of 50 mentally handicapped adults.

Of these adults 25 were mentally handicapped adults resident in a large hospital (Care and Rehabilitation Centre). The criteria for selection from this population were:
(a)    Chronological age within the range 20 to 49 years.
(b)    Assessment on previously administered tests, other than the Grover-Counter Scale, placing the subject within the range from Moderate to Lower Mild Category of mental handicap (IQ not less than 35).
(c)    Freedom from very severe visual impairment and/or very marked incapacity in the use of the hands to manipulate small objects.

The other 25 mentally handicapped adults were living in the community (parental home, group house or similar) and attending a Protective Workshop daily. Criteria (a) and (c) were the same as for the first group. Reliable records of recent assessment of intelligence on other procedures were not available for all the subjects. It may, however, be assumed with some justification that criteria (b) was met. The subjects had attended Special Schools (Training Centres) which cater for Learners in the IQ range 30-50. The Protective Workshop itself has admission criteria one of which is a school report indicating progress made during the school years.

### 3.2.3 Sample 3

This was a small sample (31 subjects) of African, isiXhosa-speaking, normal children, chronological age 3 years to 7½ years. Samples 3 and 4 were both drawn from the subjects of a Special Research Study

(University of Cape Town) conducted by Dickman a clinical psychologist with some ability in isiXhosa, assisted by an isiXhosa-speaking clinical psychologist. Full training in the use of the Grover Scale had been given to them.

The original larger group from which this sample was selected, consisted of 56 African, Xhosa-speaking, normal children all of whom were in some form of educational setting ranging from a crèche through to the primary school grades. This setting admitted children from certain ethnic groups only, the schools being under the authority of a particular Education Department. Verbal communications were in isiXhosa. Instructions for administration of the GCS in isiXhosa had been obtained through the back translation method. Here again Educators were asked to select for assessment children considered to be average, that is achieving at the expected level for their age.

It became necessary to exclude 25 older children from the original group for the following reason. Analysis of the results obtained on the Grover Scale indicated the suitability of this test for these children up to approximately 7½ years. Scores achieved at each age up to almost 8 years were completely in line with those achieved by the subjects in Sample 1. Beyond this chronological age there was a consistent trend for scores on the test to fall significantly below the chronological age and hence well below the expected norm. The reason for this observed declining ability with increasing age on this test for these isiXhosa-speaking children only is not at present known and requires further investigation.

Where the test is used for assessing African, isiXhosa-speaking mentally handicapped children in the Lower Mild Category and below, this finding does not constitute a serious obstacle since the cognitive functioning level, even for children older than 10 years, is most unlikely to approach the 8 year level and is usually well below this.

### 3.2.4  Sample 4

This sample consisted of 50 African, isiXhosa-speaking children in the age range 9 years to 16 years, all previously identified as mentally handicapped. These children were all attending a Special School (Training Center) or were on the waiting list for admission to such a Center.

### 3.2.5  Sample 5

In 1997 the Human Sciences Research Council (HSRC) undertook to standardise the GCS on a larger and more representative sample. This entailed the training of a number of suitably qualified psychologists in the theoretical basis of the GCS and in the administration, scoring and interpretation of results. It also entailed the translation of the test instructions into several African languages, a necessity in a multi-linguistic society.

This work , which occupied the period 1997 to 1999 was carried out under the leadership of Sebate.

The sample originally consisted of 469 children from four provinces namely: Northern Cape, Free State, Western Cape and KwaZulu Natal (Sebate, 2000). 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. Four hundred and nineteen learners then

formed the norm sample. This sample 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.

## 3.3   NORMS

The final norms were established predominantly from data derived from Samples 1 and 5 but were supported by findings from Samples 2 and 3. Originally it was assumed that only one set of final norms would need to be presented based on the performance of subjects constituting Sample 1 and Sample 5 but further detailed analyses, especially of Sample 5 clearly revealed some interesting and important findings;

1.   The subjects constituting Sample 5 could be divided into two distinct sub-groups, namely Urban and Rural (The definition of these terms is given in the Appendix).
2.   The performance of subjects constituting the urban sub-section of Sample 5 (n= approx. 200) and the performance of subjects constituting Sample 1 (which could also be defined as an urban sample) were sufficiently close to allow these two samples to be considered as drawn from a common population, (namely, an urban population,) for which a single set of norms could be established. See Norm Table 6.
3.   The performance of subjects constituting the rural sub-section of Sample 5 was however, significantly different. These rural children lagged behind the urban children and progressively so as chronological age increased.

In considering these differences between the urban and the rural children, it should be noted 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 scores for learners 3 years 0 months to 9 years 6 months are provided in Table 5 (Urban) and from 3 years 6 months to 9 years 6 months Table 6 (Rural) in the Appendix. 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 could highlight individual strengths and weaknesses.

## 3.4 COGNITIVE FUNCTIONING LEVEL (CFL)

The scores defining the various cognitive levels from level 1 through to level 4b were originally postulated on the theoretical constructs as described on pages 32 to 36. The postulated scores were strongly confirmed by the actual scores achieved by the subjects constituting the final Urban sample (urban sub-section of Sample 5 together with Sample 1). Table 4 (Appendix) 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 scores required for Section D and for Section E are deliberately set at a lenient level as the purpose is simply to draw attention to any significant falling off in either of these sections.

Four main levels are given, all but Level 1 being divided into two sub-levels. 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.

The use of Table 4 for urban children is pretty straight forward but for rural children a little more care must be taken in order to use it correctly. The first step here too is to locate on Table 4, in the line Total Score, the total score obtained by the rural child. The corresponding Test age and CFL can then be found in that column. Examples will illustrate:

Example 1

a) Urban child: chronological age 5 years 0 months
   Total score: 46
   Approximate Test Age: 5 years 4 months
   CFL 2b, just below midpoint.

b) Rural child : chronological age 5 years 0 months
   Total score: 35 (Note that this score of 35 falls in the Total Score Range 28-39 (Table 4)
   Corresponding approximate Test Age: 4 years 6 months
   Corresponding CFL 2a, close to midpoint.

Example 2

a) Urban child: chronological age 8 years 0 months
   Total Score: 76
   Approximate Test Age: 8 years 1 months
   CFL 4a.

b) Rural child: chronological age 8 years 0 months
   Total Score: 62 (Note that this score of 62 falls in the Total Score Range 53-63 (Table 4)
   Corresponding approximate Test Age: 6 years 10 months
   Corresponding CFL: 3a upper.

It is evident from the examples that rural children reach the progressive CFLs only at markedly higher chronological ages than the urban children do. It is thus important that, when reporting the results of assessment of a child on the GCS, it be clearly indicated whether the child is urban or rural. It has to be accepted that the current cognitive functioning of the rural child usually does not reach the level expected at his/her chronological age. But it should not readily be assumed that this finding represents the real potential of the rural child but can be attributed largely to the adverse or limiting conditions to which the child has been exposed and hence could most probably be improved if these limiting or adverse circumstances were changed for the better.

# 4. STATISTICAL DATA

## 4.1 RELIABILITY

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

Reliability in this study was calculated using the Kuder Richardson Formula-20. The reliability coefficients for 3 and 4 year olds are set out in Table 1 and those for 5 to 10 years olds in Table 2. 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 1: 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 2: 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 average reliability coefficient for all the sections is approximately 0,84 which can be regarded as acceptable.

## 4.2 VALIDITY

### 4.2.1 Face validity

Face validity cannot be measured objectively. In the case of the GCS the face validity 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 been previously deemed untestable or very difficult to test through lack of co-operation or refusal to attempt items on other tests.

The test has been clearly shown to have inherent appeal for a wide range of subjects.

### 4.2.2 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).

### 4.2.3 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.

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 confirmed construct validity of the GCS.

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 Educators were asked to state whether there was a language deficit that was marked enough to interfere with classroom communication. One of the Educators was the child's current classroom educator, while the other was a prior classroom educator. 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 study conducted by the HSRC in 1999, 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.

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.

### 4.2.4 Criterion validity

As one of the aims of the study conducted by Dickman in 1994 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 classes. Educators' 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). Learners in regular classes were rated on a 3-point scale by their Educators and this was also found to correlate significantly with the GCS. While these are relatively crude measures (Examination evaluations, school streams and educator ratings), the results provide support for the criterion validity of the GCS.

### 4.2.5 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:

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

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.

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 order 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.

## 5. THE INTERPRETATION OF RESULTS IN TERMS OF COGNITIVE FUNCTIONING LEVELS (CFL)

### 5.1 COGNITIVE FUNCTIONING LEVELS (CFLS)

These are described not only in terms of which items are likely to be, to some extent at least, within the competence of the subject, but also in terms of the characteristic ways or procedures adopted by the subject in the attempt to solve the presented problems.

### 5.1.1 Level 1 : Early Pre-operational, Symbolic Perceptual Mode (approximately 3 years to 3 years 11 months)

During the second year of life, the child makes the transition from the Sensori-motor Stage into the stage described above. Interaction with objects is characterised by a more objective approach to the material presented, that is, the realization that there is a particular end result to be achieved through the application of explicit acts. Attention can be focused briefly on at least some relevant features of the stimulus material, the goal held in mind and behaviour actively persisted in long enough for the child to indicate that the task is completed.

The child is now capable of mentally combining schemes of action, imitation, and the use of images to evoke familiar objects and situations. In addition to language, imitation and use of images may both be considered as elements in the development of the symbolic representative process by means of which a degree of anticipation and planning for appropriate action become possible.

The term, perceptual, is used in the description not to suggest that perception is absent at higher levels but to emphasize its tendency to dominate the child's approach to problem solving at Levels 1 and 2.

Section A of the test and Items B1 and C1, which are tackled with some degree of success at the mid-point of Level 1, require in addition the following cognitive skills: Discrimination and matching of two colours (black and red) and three forms (circle, square, triangle) and grouping in terms of these variables; the reconstitution of simple spatial sequence and order provided no reversal or transformation of the material is involved which conflicts with perceptual information.

### 5.1.2 Level 2 : More advanced stages of the Pre-operational, Symbolic Perceptual Mode (approximately 4 years to 5 years 11 months)

This level sees the extension and greater stability of the processes revealed at Level 1.

Performance on Section A is marked by a less tentative, more assured approach suggesting that an internalized plan now precedes and guides the motor behaviour. Some children, for instance, gather up all the black circles and place them, then select the next category of counters and proceed in this way. A full score on Section A is attained during Level 2.

Item B2 may still cause some difficulty. This item demands an active process of reconstructive memory which is influenced by the general cognitive functioning level the child has reached. For success the child must retain and reproduce not merely what has been perceived (perhaps just a random set of counters) but what has been understood, namely, a regular alternation of two forms. Children between 4 and 5 years of age may succeed in alternating the two forms which make up the pattern but show uncertainty as to which form to start with. They are also quite liable to work from right to left, the convention of working from left to right probably not being well established until the elements of reading and writing have been introduced.

Item B3 may be considered easier than Item B2 by virtue of the fact that the model is present, but this itself can produce a conflict between what is seen and what must be reproduced.

There is gradual improvement on Section C. This section depends heavily upon perceptual-motor matching, a skill which is essential for many further kinds of learning. Even here, however, knowledge does not stem merely from a passive registration of the given sensory data leading to a sort of photocopy. Improvement in performance results largely from increased perceptual activities, that is better, though still incomplete, exploration of the configuration.

Section D again requires reconstructive memory and a kind of information processing since direct perceptual support is removed at the time of reproduction. Virtually every normal child from 4 years of age is able to recognise and give a meaningful name to the three-presented models. Thus, the child is dealing with identifiable objects. However, the previous knowledge of or familiarity with these objects varies greatly among the three items.

Item D1 (man) does not show marked stages of improvement after about 5 years. This is probably because the individual parts making up the model together with their positions relative to one another are already well known to a child of 5 years.

Item D2 (star) presents a far less familiar situation and one which involves difficult relationships of the parts to the whole. The child under 5 years of age seems at a loss as to how to tackle this item. From about 5 years the approach is rather more confident but the main difficulty is to achieve a properly co-ordinated closed figure. After placing the six red triangles to form about three quarters of a circular outline, the child searches for more red triangles to fill the gap but not finding any, either leaves the reproduction wide open or fills the gap with black triangles. Occasionally a child may spontaneously push the six red triangles together to achieve a rough closure.

Item D3 (car), though familiar and concrete in nature, is complex in structure and demands, in the brief exposure time allowed, a close analysis of the parts and the way they are integrated.

The types of performances at Level 2 on Items D2 and D3 clearly reveal some characteristic features of the pre-operational child's limitations in dealing with spatial representations. At Level 2a the child may simply omit several details of the model reducing it to those basic elements that match his/her understanding. Thus in the case of D3 (car) the reproduction may consist only of one or two squares to which two circles (wheels)

are attached. Throughout Level 2 there is the tendency towards centration or the focusing of attention on only one dimension of the configuration at the expense of other equally important ones. This is illustrated in D2 (star) where the child centres on the outline or periphery of the model with the results already described. Closely associated with these features is synthetic incapacity. While several of the component parts of a model may be reproduced, these are not in proper relationship to one another but merely juxtaposed or joined together in random fashion. Examples of this are shown for D3 (car) on the Scoring Examples Sheet.

### 5.1.3 Level 3: Transition from Pre-operational Mode to threshold of Concrete Operational Mode (approximately 6 years to 7 years 11 months)

A chief characteristic of this level is a lessening of the deforming effects of a response based on the immediate impact of perception as new cognitive structures come into operation to interact with, modify and even contribute to refinements in perceptual processes themselves. However, this growing independence of thought from perception is achieved only in those problems where the number of dimensions to be considered is limited and necessary transformations of the given data remain simple. A full score on Sections B and C is expected during this level.

There is gradual improvement on Items D2 and D3. At Level 3a performances on these items still tend to show a reliance on topological properties rather than a true and consistent understanding of Euclidean relationships involving a system of reference. According to Piaget a system of reference presumes operational co-ordination of several fields one with another. The attainment of such a system indicates the extent to which the child is moving into the Concrete Operational Mode.

Section E confronts the child with new tasks in which some of the props provided in previous sections have been removed. The demonstration item (butterfly) and Item E1 (church) may be considered as providing links between these earlier sections (C and D) and the more difficult E items; but whereas in Sections C and D both the whole model and its component parts are clearly visible, the reconstruction now has to be carried out from discrete units whose boundaries and inter-relationships are not defined in the presented model.

Even before Level 3 is reached the very attentive child may achieve some success on the demonstration item (butterfly) because of the detailed demonstration that has been offered, and may also score one or two points on Item E1 (church).

During Level 3 perfect or near perfect performance is achieved on the demonstration item but Item E1 continues to cause difficulty. The tower, being made up of squares placed one on the other and topped with a single triangle is not a problem though judgement of height may be faulty. Construction of the body of the church requires inferential processes based on a far better grasp of geometric forms. The approach at this level remains a trial and error one in which the child may attempt to produce the oblique lines of the roof by setting squares at an angle.

### 5.1.4 Level 4 : Mid Concrete Operational Mode (approximately 8 years to 9 years 6 months)

During this level the ability to analyse and re-construct with accuracy quite complex configurations and to transform these in particular ways, as for instance, in the vertical transposition of Item E2, and the figure ground problem of Item E3, becomes more evident.

According to Piaget the age 9 years, which lies midway through the period in which concrete operations first take shape, marks a decisive turning point in the development of spatial concepts, that of the completion of the framework appropriate to comprehensive Euclidean and projective systems.

Items E4 and E5 give opportunity for yet another manifestation of the application of concrete operational thinking processes. There are two very different ways in which these items can be approached: the trial and error or groping approach on the one hand; and the systematic or logical approach on the other. At Level 4a the former predominates. The child now has some understanding of the goal but attempts to reach it remain at an essentially practical level of manipulating the counters in various ways, a method which may or may not lead to ultimate success. At Level 4b a more systematic approach emerges in which the performance is governed by some sort of plan. It might be said that the child attempts to solve the problem mentally before any motor activity is initiated.

Both Items E4 and E5 require that the child perceives the pattern as a whole or integrated unit but is also able to discover how each row and/or column is logically related to preceding and succeeding ones.

In E4 there are three variables to be taken into account, namely the number of counters in a row, the colour, and the form of these. At Level 4a difficulties arise in taking all these variables into account simultaneously, in other words there is a failure of decentration. At Level 4b the child appears to have carried out a careful preliminary analysis of the pattern considering all the variables and then unhesitatingly completing the missing row.

Item E5 is more complex than E4. It requires the discovery of the additional factor of the arithmetic progression in the four columns, namely the repeated reduction by two counters. At Level 4a the first two counters are likely to be correct but then the child, over influenced by the "perceptual pull", that is the appearance of squares in all other columns, adds a single red square. At Level 4b this, or some other error in the initial attempt may be spontaneously corrected. Verbal children at this level are often able to explain how they reached the correct solution.

There is, then, during Level 4 an increasing transition from what Piaget calls the figurative aspects of knowledge to the operational aspects which are not given directly in the observable data but must be derived by reflection upon and abstractions from the observed material.

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## APPENDIX

## TABLE 4    REQUIREMENTS FOR ALLOCATION TO PROGRESSIVE COGNITIVE FUNCTIONING LEVELS (CFL

| CFL level | 1 | 2a | 2b | 3a | 3b | 4a | 4b |
|---|---|---|---|---|---|---|---|
| Total score<br>Test Age* | 12 - 27<br>3,0 - 3,11 | 28 - 39<br>4,0 - 4,11 | 40 - 52<br>5,0 - 5,11 | 53 - 63<br>6,0 - 6,11 | 64 - 74<br>7,0 - 7,11 | 75 - 80<br>8,0 - 8,9 | 81 – 90+<br>8,10 - 9,6 |
| **Mean**<br>Total score<br>Test Age | 24<br>3,6 | 34<br>4,6 | 49<br>5,6 | 59<br>6,6 | 70<br>7,6 | 77<br>8,4 | 85<br>9,2 |
| D minimum required | - | - | 7 | 10 | 12 | 16 | 18 |
| E minimum required | - | - | - | 3 | 7 | 15 | 20 |

\*      Chronological Age in years and months

Example 1:  Urban Female, chronological age 6 years and 1 month

Scores:  A = 12; B = 12; C = 14; D = 14; E = 3:  Total = 55

CFL:  Lower end of 3a

Meets requirements for Sections D and E at this CFL

Test Age (approximately) 6 years and 2 months.


Example 2: Urban male, chronological age 9 years and 6 months

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

CFL:  Lower end of 4b

Meets requirements for Sections D and E at this CFL

Test Age (approximately) 9 years.


Example 3: Rural female chronological age 9 years and 6 months

Score: A = 12; B = 15; C = 13; D = 16; E = 12. Total = 68

CFL: Mid 3b

Meets requirements for Sections D and E at this CFL

Test Age (approximately) 7 years and 4 months.


Example 4: Mentally handicapped male, chronological age 23 years

Scores:  A = 12; B = 15; C = 15; D = 15; E = 10:  Total = 67

CFL:  Lower end of 3b

Meets requirements for Sections D and E at this CFL

Test Age (approximately) 7 years and 2 months.

## NORM TABLE:5 CHARACTERISTIC PERFORMANCES AT PROGRESSIVE AGES (3 Years To 9 Years 6 Months) OF AN URBAN POPULATION (N = 400)

| MAX. SCORE AGE | A(X) 12 | B1 5 | B2 5 | B3 5 | B 15 | C1 3 | C2 6 | C3 6 | C 15 | D1 7 | D2 8 | D3 8 | D 23 | A-D 65 | DEM 5 | E1 6 | E2 6 | E3 6 | E4 6 | E5 6 | E 35 | TOTAL 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.0 | 8 | 3 | - | - | 3 | - | - | - | - | 1 | . | - | 1 | 12 | | | | | | | | 12 |
| 3.6 | 10 | 4 | 2 | 2 | 8 | 1 | 1 | 0 | 2 | 4 | 0 | . | 4 | 24 | | | | | | | | 24 |
| 4.0 | 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 |
| 5.0 | 11 | | 4 | 3 | 12 | 3 | 3 | 3 | 9 | 5 | 1 | 2 | 8 | 40 | | | | | | | | 40 |
| 5.6 | 12 | | 4 | 4 | 13 | 3 | 4 | 3 | 10 | 6 | 2 | 2 | 10 | 45 | 2 | 2 | | | | | 4 | 49 |
| 6.0 | | | 5 | 4 | 14 | | 4 | 4 | 11 | 6 | 3 | 3 | 12 | 49 | 2 | 2 | | | | | 4 | 53 |
| 6.6 | | | | 4 | 14 | | 5 | 4 | 12 | 6 | 3 | 4 | 13 | 51 | 2 | 2 | 2 | 2 | | | 8 | 59 |
| 7.0 | | | | 5 | 15 | | 5 | 5 | 13 | 6 | 4 | 4 | 14 | 54 | 2 | 2 | 2 | 2 | 2 | | 10 | 64 |
| 7.6 | | | | | | | 6 | 5 | 14 | 6 | 4 | 5 | 15 | 56 | 3 | 3 | 3 | 3 | 2 | | 14 | 70 |
| 8.0 | | | | | | | | 5 | 14 | 7 | 6 | 5 | 18 | 59 | 3 | 3 | 3 | 3 | 4 | | 16 | 75 |
| 8.6 | | | | | | | | 6 | 15 | | 6 | 5 | 18 | 60 | 4 | 4 | 3 | 3 | 2 | 2 | 18 | 78 |
| 9.0 | | | | | | | | | | | 6 | 6 | 19 | 61 | 5 | 5 | 3 | 3 | 4 | 2 | 22 | 83 |
| 9.6 | | | | | | | | | | | 7 | 6 | 20 | 62 | 5 | 5 | 4 | 4 | 4 | 2 | 24 | 86 |

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# NORM TABLE 6: CHARACTERISTIC PERFORMANCES AT PROGRESSIVE AGES (3.6 years to 9 years 6 months) OF A RURAL POPULATION (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 | 1 | 1 | 0 | 2 | 3 | 0 | 0 | 3 | 14 | | | | | | | | 14 |
| 4,0 | 9 | 4 | 2 | 1 | 7 | 1 | 1 | 1 | 3 | 4 | 0 | 0 | 4 | 21 | | | | | | | | 21 |
| 4,6 | 9 | 4 | 3 | 2 | 9 | 1 | 2 | 2 | 5 | 5 | 0 | 1 | 6 | 25 | | | | | | | | 25 |
| 5,0 | 10 | 4 | 3 | 3 | 10 | 1 | 3 | 3 | 7 | 5 | 1 | 1 | 7 | 31 | 1 | 1 | | | | | 2 | 33 |
| 5,6 | 10 | 4 | 4 | 3 | 11 | 1 | 3 | 4 | 8 | 5 | 1 | 2 | 8 | 35 | 1 | 1 | | | | | 2 | 37 |
| 6,0 | 11 | 4 | 4 | 4 | 12 | 2 | 4 | 4 | 10 | 6 | 1 | 2 | 9 | 39 | 2 | 2 | | | | | 4 | 43 |
| 6,6 | 11 | 5 | 4 | 4 | 13 | 2 | 5 | 5 | 12 | 6 | 3 | 3 | 12 | 43 | 2 | 2 | | | | | 4 | 47 |
| 7,0 | 12 | 5 | 5 | 4 | 14 | 3 | 5 | 5 | 13 | 6 | 3 | 4 | 13 | 50 | 2 | 2 | | | | | 4 | 54 |
| 7,6 | | 5 | 5 | 4 | 14 | 3 | 5 | 5 | 13 | 6 | 3 | 4 | 13 | 52 | 2 | 3 | 0 | 1 | 2 | – | 8 | 60 |
| 8,0 | | 5 | 5 | 5 | 15 | 3 | 5 | 6 | 14 | 6 | 4 | 4 | 14 | 53 | 2 | 3 | 0 | 1 | 3 | – | 9 | 62 |
| 8,6 | | | | | | 3 | 5 | 6 | 14 | 6 | 4 | 5 | 15 | 55 | 2 | 3 | 0 | 2 | 3 | – | 10 | 65 |
| 9,0 | | | | | | 3 | 5 | 6 | 14 | 6 | 4 | 5 | 15 | 56 | 3 | 3 | 0 | 2 | 3 | – | 11 | 67 |
| 9,6 | | | | | | 3 | 5 | 6 | 14 | 6 | 4 | 5 | 15 | 56 | 4 | 4 | 0 | 2 | 3 | – | 13 | 69 |

## DEFINITION OF TERMS "URBAN" AND "RURAL":

The terms urban and rural are used as defined by the school register of needs study which was conducted by the HSRC in 1996.

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.

The difference in the cognitive functioning level of the urban and rural children necessitated the two sets of norms. The researchers believe that apart from physiological reasons, the most basic reason lies in the different styles of interaction between child and adult (at home, at school and in the community as a whole) and the child rearing practices adopted.

Do these lead on the one hand (Urban) to a self-directed, exploratory and problem solving child who feels free to express own ideas, or on the other hand (Rural) to an "other-directed" child characterised by rote learning, strict obedience and conforming behaviour and an unwillingness to explore new interests or to express own ideas which will most likely lead to adult disapproval.

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