

Acknowledgements

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INTRODUCTION

TROG stands for Test for Reception of Grammar and is an individually administered, multiple choice test designed to assess understanding of grammatical contrasts in English. TROG has proved of value in the assessment of children suffering from specific language disorders, deafness, mental retardation and cerebral palsy. It can also be used by psychologists and speech therapists to investigate language comprehension in adults with acquired dysphasia.

The test consists of 80 four-choice items. In each item the subject is required to select from an array the picture which corresponds to a phrase or sentence spoken by the tester.

TROG enables the tester to discover not only how a person's comprehension compares to that of other people of the same age, but also to pinpoint specific areas of difficulty.

Items are divided into blocks of four items, each block testing understanding of a specific type of contrast. The test is usually scored in terms of the number of blocks passed, rather than the number of items correct. A block is passed if all four items in that block are responded to correctly.

Contrasts are arranged in order of increasing difficulty. Testing is started at a baseline of five consecutive blocks correct, and is discontinued when five consecutive blocks have been failed. Vocabulary cards are provided for use in situations where the tester is uncertain whether the subject knows the meaning of the individual words used in TROG.

Norms are available for children aged from four to twelve years of age.

The test takes 10 to 20 minutes to administer.

RATIONALE AND DEVELOPMENT OF THE TEST

TROG was originally designed as a research tool to be used in assessing aspects of language comprehension in children suffering from specific developmental language disorders. The author was investigating the incidence of comprehension problems in such children, and was interested in the question of whether children whose expressive speech was grammatically abnormal had problems in understanding grammatical contrasts (Bishop, 1979).

In the course of the research it became apparent that the test materials which had been developed to look at understanding in children were of considerable interest to a wide range of professionals. Published tests specifically designed to evaluate comprehension of grammatical structure seemed few and far between, and those which did exist were not without flaws. It was therefore decided in 1981 to devise and standardize a final version of TROG suitable for clinical use. The particular advantages of this test are as follows:

1. The test is appropriate for a wide age range (4 to 13 years of age), and can be used with dysphasic adults.
2. No expressive speech is required from the subject.
3. Test pictures are clearly drawn and brightly coloured. A deliberate effort was made to exclude pictures which are hard to discriminate on a visual basis.
4. Care has been taken to use a restricted simple vocabulary in test sentences, to minimize the likelihood of failure due to the subject not knowing the meaning of individual words. Vocabulary cards allow the tester to check comprehension of the nouns, verbs and adjectives used in TROG in cases of doubt.
5. Every attempt has been made to minimize the influence of nonlinguistic factors, such as plausibility of pictured events, on performance in TROG.
6. Test sentences may be repeated. This minimizes the likelihood of errors arising from inattention rather than poor comprehension of grammar.
7. Four 4-choice items are used to test each grammatical contrast. The probability of a person getting all four items correct by chance is .004. This means that TROG can provide a meaningful assessment of a subject's understanding of individual structures and can be used, not only to assess overall level of functioning, but also in a diagnostic way, to pinpoint particular areas which are giving the subject difficulty. It also enables the tester to identify particular patterns of error which may indicate why the subject is failing to comprehend.

TEST CONSTRUCTION

Criteria used in designing test items were as follows:

1) Enough items should be included for each grammatical contrast to enable one to assess whether the child understood that contrast.

2) The test should not usually take more than 15 minutes to administer.

3) Items should cover a wide range of difficulty, making the test appropriate for as wide an age range as possible.

4) The contrasts tested should be selected to include those known to reveal particular problems in language disordered populations.

5) Contrasts which cannot be unambiguously represented in pictorial form should be excluded from the test.

The first two criteria constrained the number of structures which could be included. To reduce testing time, it was decided to construct the test so that a baseline and ceiling could be established for each subject, and testing be limited to blocks within that range. Consideration of criteria 3 and 4 led to the final adoption of the following blocks of items:

- A noun
- B verb
- C adjective
- D two element combination
- E negative
- F three element combination
- G singular/plural personal pronoun
- H reversible active
- I masculine/feminine personal pronoun
- J singular/plural noun inflection
- K comparative/absolute
- L reversible passive
- M in and on
- N postmodified subject
- O X but not Y
- P above and below
- Q not only X but also Y
- R relative clause
- S neither X nor Y
- T embedded sentence

Blocks A, B, C, D and F assess whether the subject has the prerequisite skills to cope with grammatical structure, namely whether he or she can identify individual words, and simple word combinations in situations where understanding of function words, word order or inflectional endings is not critical.

The first version of TROG included items testing comprehension of tense distinctions, but it proved very difficult to represent pictorially events occurring at different points in time, and one could not be certain whether failure on these items reflected true lack of comprehension of tense, or inability of the child to recognise what the pictures were supposed to convey. It was decided to exclude such items in the final version of TROG. Distinctions between question forms were excluded because departure from the simple statement form subtly alters the task requirement; the subject is required to respond directly to the sentence in a question form (cf. items such as "When do you sleep?" in Carrow's (1973) Test for Auditory Comprehension of Language), which is a different requirement from the rest of the test, where the subject must match the sentence to a picture. It was felt that children might fail such items because they were confused by the alteration in task requirement, rather than through inability to understand the sentence.

A further consideration in test design was how to select the types of distractor to be used for each sort of item. Performance in a multiple choice task is not simply a function of the complexity of the test sentence: it will also depend on the particular distractors used in the picture array. A child who appears to understand the sentence "the circle is in the star", when the correct picture is contrasted with circles above, below and beside stars, may fail the same sentence if the distractors include a picture depicting a star inside a circle, when understanding of word order becomes critical.

For children performing at a fairly low level of ability, the author has found it helpful to include lexical as well as grammatical distractors. A lexical distractor is a picture which fails to correspond to the test sentence by one content word, whereas a grammatical distractor is a picture which differs from the test sentence by a grammatical contrast only, i.e. by an inflection, function word, or by word order. E.g. in TROG item 35 ("he is sitting in the tree"), picture 4 ("she is sitting in the tree") is a grammatical distractor, whereas pictures 2 ("he is sitting on the wall") and 1 ("he is swinging in the tree") are lexical distractors. The inclusion of lexical distractors enables one to tell from the subject's error pattern whether there is a specific difficulty with grammatical structure (in which case errors should be restricted to selection of grammatical distractors), or whether the subject has a more general problem. For example, a child who is highly inattentive, doesn't listen to or doesn't remember the test sentence, or doesn't scan the array properly, would be expected to make a high proportion of lexical errors.

Persons who have not yet reached ceiling by block M are unlikely to make many lexical errors, and lexical distractors are not included beyond this point. All distractors are now grammatical, representing a situation in which the same content words as in the test sentence could be used in different order or with different function words to describe the picture.

STANDARDIZATION

Testing was carried out by volunteer students who were studying for a degree or diploma to qualify as speech therapists, and who were paid on a pro rata basis for each child tested. Testers proposed nurseries and schools known to them where they had permission to test children. Private schools were excluded. Most students returned to their home town to test children in the vacation, although some testers worked in schools near their college or university. Within each school, all potential subjects were divided by sex and age-band, and subjects then selected at random, using a table of random numbers. After a list of subjects had been prepared, children were excluded on the following grounds:

- : child currently receiving speech therapy
- : child suffering from hearing loss, visual handicap, or physical handicap severe enough to warrant special treatment in the classroom
- : child diagnosed as educationally subnormal or maladjusted by an educational psychologist
- : neither parent is a native speaker of English
- : child living in a household where a language other than English was habitually used
- : child had lived in a non-English-speaking country for more than 6 months in the past three years

Substitutes were selected for children excluded on these grounds, and for children who were absent on the day of testing. Each tester was allocated a quota of children to test in several age ranges. Age bands covered one year, except for four-year-olds, where three-monthly intervals were used, and five-year-olds, where six-monthly intervals were used. Ages were computed in terms of years and completed months. The aim was to test from 150 to 200 children in each age band, and this was achieved except for the three youngest groups, where testing took longer than anticipated, so some testers did not fulfil their quota. Numbers tested are shown in table 1.

Table 1

Numbers tested in each age band

age	boys	girls	total
4.0-4.2	70	56	129
4.3-4.5	57	63	120
4.6-4.8	67	80	147
4.9-4.11	80	77	157
5.0-5.5	88	77	165
5.6-5.11	76	90	166
6.0-6.11	108	109	217
7.0-7.11	96	98	194
8.0-8.11	85	84	169
9.0-9.11	80	78	158
10.0-10.11	73	84	157
11.0-11.11	81	91	172
12.0-12.11	79	73	152

All children were given TROG (including the vocabulary cards) and the English Picture Vocabulary Test. Children were given all TROG items, except in cases where 9 consecutive blocks were failed, in which case testing was discontinued. Baseline and ceiling points were subsequently derived from the data, and all results were corrected to take these into account. Order of TROG and EPVT was alternated from child to child. Testers were told to use their discretion in deciding whether or not both tests should be given in a single session, or whether two sessions were needed. In practice, four-year-olds often needed two separate sessions, whereas older children did not.

By arranging for each tester to test several age bands, it was ensured that any bias in sample characteristics or in testing procedure was spread across all age groups. The geographical distribution of the sample was determined by where testers were able to work, and no attempt was made to ensure it was representative of the population of Great Britain, although as many different areas as possible were included.

Table 2

area	% in general population ¹	% in TROG sample
Scotland	9.2	3.9
Northern Ireland	2.8	6.6
Wales	5.0	7.1
North	5.6	0
Yorks + Humberside	8.7	5.9
East Midlands	6.8	5.8
East Anglia	3.3	2.2
South East	30.0	34.2
South West	7.8	12.7
West Midlands	9.2	11.8
North West	11.5	9.9

¹Census 1981: Preliminary Report

Originally, it had been hoped that by using the English Picture Vocabulary Test alongside TROG, one would have some way of checking on the normality of the sample (i.e. one would anticipate that the sample should have a mean EPVT standard score of 100, with s.d. of 15). However, enquiries revealed that the Full Range EPVT had never been properly standardized (norms being estimated from limited standardization data from earlier versions of the test), so clearly one could not rely on data from this test (Brimer, personal communication). In fact, the EPVT means for some age groups departed substantially from 100, but it seemed likely that this reflected the inadequate standardization of the EPVT, rather than any abnormality of the TROG standardization sample.

In order to have further evidence that the standardization sample was reasonably representative of British children, fathers working in the summer of 1982 recorded the paternal occupation of their subjects wherever possible. Such data were available for 506 of the 2112 children in the standardization sample. This subset of children did not differ significantly from the remainder in mean EPVT score or mean TROG blocks passed, and appeared to be reasonably representative of the British population, both in terms of numbers of children living with a lone mother: 10.7% in the TROG sample, and 10.4% in the General Household Surveys of 1979-1981 (Office of Population Censuses and Surveys, 1982), and in terms of numbers with unemployed fathers: 7.7% in the TROG sample, cf. 7% of married men in the General Household Survey of 1981 (Central Statistical Office, 1983). For children living with both parents, social class was classified according to the Registrar-General's Classification of Occupations, 1980. Ideally, one would have liked to compare the distribution obtained here with the data from the 1981 Census, but at the time of going to press, data were not available, so comparisons had to be made with the 1971 Census. It should be noted that unemployment in Great Britain has increased substantially over the past 10 years, and its effect has been felt particularly strongly among skilled "craft" workers (Central Statistical Office, 1983), so one can expect the proportions of individuals in the different social classes to have altered. Table 3 shows the social class distribution for children in the TROG standardization sample, compared to that of married men aged from 25 to 54 in the 1971 Census.

Table 3

social class	1971 general populatn	TROG sample (n=506)
I: professional	6.0%	10.2%
II: managerial	19.9%	27.4%
IIIN: skilled nonmanual	10.6%	11.9%
IIIM: skilled manual	39.9%	26.3%
IV: semiskilled manual	15.6%	11.1%
V: unskilled	5.7%	2.7%
other/unemployed	2.3%	10.4%

It can be seen that, compared to the 1971 figures, the TROG sample is overrepresentative of nonmanual workers. It is possible that this is indicative of a change in patterns of employment over the past 10 years, but it may be a real bias, in which case we need to assess how serious its effects would be. Analyses on children of known social class indicated that although a statistically significant effect of social class on TROG performance was detectable, its absolute magnitude was small, and one could be confident that if the social class distribution of the TROG sample is biased, this would not have any serious effect on the normative data (see appendix 8).

TESTING CONSIDERATIONS

The way in which TROG is used will depend on the tester's aims in giving the test. We may distinguish two sorts of use:

quantitative assessment of comprehension

The tester may wish to use TROG to discover whether or not a person's comprehension is normal for their age. In such cases, TROG will be treated like any other clinical test, and will probably be given as part of a battery of tests. The main interest will be in the centile equivalent of the score obtained.

qualitative assessment of comprehension

In many cases a tester may know that a person has a comprehension problem, but wish to explore further the nature of that problem. There are several questions that may be asked in such cases, e.g.

- a) Does the subject have a specific difficulty with grammar, or a more generalized comprehension problem?
- b) Which grammatical structures are giving the subject particular difficulty, and, conversely, which does he or she understand adequately?
- c) Is the subject's comprehension like that of a younger child (delayed comprehension), or is it deviant?
- d) How does comprehension compare across different modalities?

TROG was designed to enable one to answer questions such as these, as well as to give a quantitative estimate of level of understanding.

These two forms of assessment are not mutually exclusive, and usually information about both qualitative and quantitative aspects of comprehension will be obtained. However, when a qualitative assessment is required, it will usually be necessary to use the vocabulary cards as well as the main TROG book, and both testing and interpretation of results will be more time-consuming than when a quick, quantitative assessment is all that is required.

DIRECTIONS FOR ADMINISTRATION

General considerations

Testing should be carried out in a quiet room, away from others. In the course of the test, the tester should encourage the subject and tell them that they are doing well, but should not give feedback about specific items (except when using Vocabulary Cards, see below). Appendix 6 gives an example of a completed record form with notes.

Is it necessary to use the vocabulary cards?

If you are uncertain whether or not to use the vocabulary cards, go to the previous section ('Testing Considerations'), and decide whether you wish to do a quantitative or qualitative assessment of comprehension. If you decide a quantitative assessment is all that is required, go straight to page 11 and continue with the section entitled 'Administering TROG'.

Use of Vocabulary Cards (optional)

The first three blocks of TROG test understanding of a few of the nouns, verbs and adjectives used later on in the test. The vocabulary cards are used to check understanding of the remainder of the vocabulary used in TROG. These cards allow one to discover whether errors on TROG might reflect vocabulary failure, rather than grammatical problems. The front page of the record form has a section for recording results obtained with the vocabulary cards. A subject is credited with knowing a vocabulary item if he or she can either i) name the picture correctly, or ii) point to the correct picture from the card when the examiner provides the name. Since, for most subjects, naming is quicker than pointing, the usual procedure is to start by asking the subject to name the items on the card, and then to ask him or her to point to any that were misnamed. However, if the subject is very shy, is unintelligible, or has word-finding difficulties, it is better to use the pointing response from the start. Pointing should also be used for all subjects with card VI, as it is difficult to elicit adjectives as naming responses. The usual procedure for each card is as follows:

- i) The subject is asked to name the pictures (stage 1).
- ii) For any items not named correctly, the subject is asked to point to the picture as the tester names it (stage 2).
- iii) If the subject makes an error on any picture at stage 2, then he or she is corrected.
- iv) Continue with next card.
- v) TROG is administered.
- vi) Any words failed at iii) are retested to see if the subject had retained knowledge of their meaning (stage 3).

Stage 1: Ask the subject to name the items on the card in the order in which they occur, going from left to right down the page. For cards 1 to 4 say "what are these things?", and for card 5 say "can you tell me what they are doing?". It is quite permissible for the tester to point to each item in turn if the subject finds this helpful. If the subject gives the same word as recorded on the form, record a tick in the appropriate box under the "naming" column, and do not test this word further. (N.B. be sure to record the tick in the correct place: the order on the form is different from the order on the cards). It does not matter if the subject inflects the word, or embeds it in a sentence, so long as the stem of the word is produced. If the subject gives any other name, record the response in the "naming" box. This word will need to be tested further, even if the name that was provided is a correct description of the picture. (E.g. if a child says "round" for circle). If the subject has produced all names correctly, proceed to the next card.

Stage 2: For the items that have not been named, the tester should ask the subject to point to the picture on the card. The order of presentation is the order on the record form, omitting items that have already been named in stage 1. For cards 1 to 4 the instruction is "show me the....."; for cards 5 and 6 the instruction is "which one is.....". On card 1, picture 2, use the term most likely to be familiar to the child. Note that for the verbs on card 5, the verb should be presented with the -ing ending, and for "dropping", "looking at" and "carrying" the word "something" should be added. If the subject does point correctly to a word named by the tester, enter a tick in the box under the column "pointing pre", and do not test this item further. If the subject makes an error, record a cross in the box, and tell the subject the correct response, saying "this one is (a)" Items failed at this stage will be retested at stage 3.

Stage 3: Words that were not responded to correctly in Stage 2 should be retested after TROG has been administered. The procedure is as for stage 2, except that there is no need to correct the subject if errors are made. A tick should be entered in the "pointing post" box for correct responses, and the number of the picture selected should be entered if an error is made.

N.B. cards 5 and 6 contain some items for which more than one response could be counted as correct in the pointing condition. If the subject points to "drinking" or "carrying" for "standing", say "can you show me another one that's standing?". "Looking" cannot be unambiguously tested using this procedure, since all the figures could be said to be "looking". Both the "big" figure and the "tall" figure are valid responses to both the words "big" and "tall".

Administering TROG

1. Establishing the baseline

children aged 7 years or below, and subjects thought to have comprehension difficulties: start at block A.

children aged 8 to 9 years: start at block D.

subjects aged 10 years and above: start at block H.

If a subject aged 8 or over makes an error in the first five blocks tested, go backwards through the test from the starting point administering earlier blocks until a baseline of five consecutive blocks correct has been established or until block A is reached. Then continue forwards through the test from the point you had reached, until a ceiling is established (see below).

2. Establishing the ceiling

Stop testing when the subject has failed five consecutive blocks. (See below for definition of 'failing a block').

3. Introducing the test

Open the book at the starting page and give the subject a few seconds to scan the pictures. Then say "I want you to point to the picture that goes with what I say. Listen carefully". Say the test word or sentence, and record the subject's response. See below for what to do in cases whether there is no response or an ambiguous response. Then say "Good! Now I am going to show you some more pictures. Each time I say something, you point to the picture that goes with what I say." Continue turning each page, saying the test sentence when the subject has had time to scan the pictures.

4. Presentation of test items

The full test sentence as written on the record form should be spoken clearly and naturally. Critical morphemes (see below) should be given moderate stress, but not to the point of artificiality.

critical morphemes

block E	"not"
block G	pronoun
block I	pronoun
block J	plural inflection of noun
block M	preposition
block O	"but not"
block P	preposition
block Q	"not only...but also"
block S	"neither...nor"

N.B. For items where the tester has the option of using "woman" or "lady", use the term most likely to be familiar to the child. Bishop (1983) found that many deaf children understood "lady" but not "woman".

5. Repeating items

The section on "What to do if..." lists several situations when test sentences should be repeated. If necessary, sentences can be repeated several times. It is important that all repetitions are of the entire test sentence. Repetition of only part of a sentence is not permitted. E.g. the tester should behave as follows:

Tester: "The girl drops the cups".
Subject: "Did you say 'cup' or 'cups'?"
Tester: "The girl drops the cups".

The author has found it helpful to record when items are repeated, by marking R against the item for each repetition. Normative data on repetitions have not yet been analysed, but it can be said with confidence that it is unusual for normal subjects to request more than one repetition of any one item.

6. Scoring

For each item, the tester records the number of the picture selected on the record form. At the end of each block of four items, check the four responses made against the key next to the block on the record form. If all four items are correct, write P (for "pass") in the box; otherwise write F (for "fail"). It is important to score in this way as you go along so that you will recognise when the ceiling has been reached.

WHAT TO DO IF.....

i) the subject does not respond

Wait for about 8 seconds, and then repeat the test sentence. If the subject still does not respond repeat again after a further 8 seconds. If a further 8 seconds elapses without a response, write N (for "no response") by the item on the record form, and proceed to the next item. If there is no response to all items for two consecutive blocks, abandon the test. N.B. do not time items with a stopwatch: this can make subjects feel pressurized and cause them to respond too quickly for accuracy.

ii) the subject names the pictures but does not point

This may occur on the first item. Repeat the instruction "I want you to point to the picture that goes with what I say", and repeat the item. If this is not effective, the subject's finger should be guided to the correct picture, N ("no response")

recorded, and the next item attempted. If the subject persists in naming the pictures rather than listening to the tester, then the tester should use the vocabulary cards to give further demonstration of what is required. Present a card, name a word, and then guide the subject's finger to the correct picture. Do this three or four times, and try to induce the subject to point spontaneously. If you are successful, return to TROG and start again at item 1.

iii) the subject points to more than one picture

If a subject points to more than one test picture say "Only one is right. Listen carefully", and repeat the test sentence. If the subject persists in pointing to more than one picture, record the numbers of the pictures which he or she has selected and proceed to the next item. Such responses are counted as errors, and the block will be failed.

iv) the subject points before you have finished speaking

Say "Wait until I have finished speaking. Listen carefully", and repeat the test sentence. Do this regardless of whether the premature response was correct. If the subject persists in responding prematurely, the tester should gently hold his or her hand until each test sentence has been presented. Premature responding can be an indication that the subject feels under the pressure: make sure that you are giving the subject ample time to scan the pictures before you speak so that the pace of testing feels fairly relaxed.

v) the subject changes his or her response

Record both the original and the final response, and circle the final response to avoid later confusion. The final response is the one the subject is credited with.

vi) the subject persistently points to one corner

If you notice that the subject continues to point to one corner of the page, say "Remember to look at all four pictures", and be careful to give the subject ample time to scan the page before you speak the test sentence.

vii) the subject asks you to repeat the test sentence

Repeat the sentence if the subject directly requests it, or if he or she repeats the sentence, correctly or incorrectly, in a questioning tone of voice.

viii) the subject repeats the sentence wrongly

This situation poses a problem, for while a misrepetition can reflect a temporary lapse of attention by the subject, it can also occur when the subject is having difficulty in processing the sentence, and so simplifies it. In the latter situation, the

subject would persist in misrepeating the sentence, even if presented with the correct version repeatedly. It was decided therefore to adopt the rule of thumb that the tester should only repeat a misrepeated test item if the subject gives an indication of awareness that something is wrong, by misrepeating the sentence in a questioning tone of voice (see vii). Otherwise, it may be of interest to record what the subject says, and see whether their choice of picture matches what they said, but the tester should not repeat the item unless asked to do so.

ix) the subject makes a response but seems doubtful

Sometimes a subject will express doubt about a response that has just been made. Occasionally this happens after moving on to the next item, in which case the tester should return to the previous item. The subject may express doubt directly, by saying something like, "oh dear, that's wrong", or else by making a statement indicating awareness that the picture does not correspond to the sentence. E.g.

tester: "the knife is longer than the pencil"

subject: (pointing to picture 1) "No, the pencil is longer"

If this occurs, the tester should say "listen carefully" and should repeat the item.

x) the subject is distracted

Repeat the item if the subject is distracted by some external event.

xi) the subject does not scan the pictures properly

When testing patients with visual field defects, testers should be alert to the possibility that the patient might not see all four picture choices. It is permissible for the tester to help the subject by pointing to each picture in turn and waiting for the subject to look at it. It is best to do this immediately after turning the page, before speaking the test sentence. If the tester suspects that, despite such a procedure, the patient is neglecting pictures in one quadrant or hemifield, then a retrospective check of errors will reveal whether there is indeed a tendency for errors to occur when the correct picture is in one position rather than another.

INTERPRETATION OF TEST RESULTS

(see appendix 6 for a worked example)

1. Quantitative

Calculate the total number of blocks passed and enter this number in the appropriate box on the form, crediting the subject with passing all blocks below the baseline.

Appendix 1 is used to convert this result into a centile score. Compute the subject's age in years and completed months (i.e. do not round up to the next month). Enter the row corresponding to the subject's age, and move along this row until you come to the number of blocks passed. The centile score is given at the head of the column. Intermediate values should be interpolated between those given.

A centile score allows a direct statistical comparison of a child's performance with normal children of the same age, and is an index of the percentage of normal children expected to obtain a score equivalent to or below that obtained by the subject. E.g. if a subject scored at the 10th centile, this would tell us that 10% of normal children would be expected to obtain a score equivalent to or below the one obtained by the subject, and conversely, 90% of children would do better.

If desired, an age-equivalent score can be obtained from Appendix 2.

2. Qualitative

If the subject is performing below age level, then a consideration of the pattern of errors can provide information about the underlying nature of the comprehension problem. We shall consider here how one can tackle the questions raised on page 8.

a) Does the subject have a specific problem with grammar, or a more generalized comprehension disorder?

There are three pieces of information one can consider relative to this question:

i) If the vocabulary cards were used, one can consider how far the subject's comprehension problems can be accounted for in terms of weak receptive vocabulary. The tester should make a list of vocabulary items which were not understood on the final testing. Words which were failed on blocks A to C should also be included in this list. For each vocabulary item, appendix 3 lists errors which could have arisen from not knowing that word. The tester should check through this list for all vocabulary items failed by the subject, and mark V* (for "vocabulary error") on the record form against any errors on TROG which can be accounted for in this way.

In the author's experience, it is unusual to find a child whose poor TROG performance can be accounted for totally in terms of poor receptive vocabulary. The majority of children know most of the vocabulary used in TROG. Children with severe receptive problems who make many errors on the vocabulary cards typically also make many errors on TROG, even

if one restricts consideration to **items** using vocabulary familiar to them. In such cases it might be helpful to assess comprehension in a different modality, such as written or signed language.

Dysphasic adults sometimes **demonstrate** relatively good comprehension of grammar despite **having** difficulty understanding all the **vocabulary** terms. The **author** has not carried out a systematic study of such patients, **but has** observed cases who have difficulty understanding some **very common** words (such as "cow"), **but who** are able to **understand complex** constructions, such as the passive, provided one **restricts** consideration to items **where** the nouns and verbs were **fully** understood.

(SEE APPENDIX 6, NOTE 7)

ii) For blocks D to L, one can **examine the errors** made by the subject to see if they are predominantly **grammatical** or **lexical**. The tester may use Appendix 4 to **categorize errors** on these blocks, and to see whether the **relative proportions** of **grammatical** and **lexical errors** are in the **expected range**. Bishop (1983) found that deaf children usually make a lower proportion of **lexical errors** than normal children performing at the same **overall level**. In many cases they seem able to identify the **basic vocabulary** terms used in a sentence, and select a picture **corresponding** to a combination of these, but have little understanding of **grammatical structure**. The opposite pattern is sometimes found in mentally retarded children, and in children with **attentional problems**, who may make a great many lexical errors, even though they have demonstrated good understanding of the TROG **vocabulary** with the vocabulary cards. In these cases the **comprehension problem** is not one of grammar, but results from poor listening skills and/or limited ability to process several **critical pieces of information** in a sentence.

(SEE APPENDIX 6, NOTE 8)

iii) If the English Picture Vocabulary Test has also been given, Appendix 5 may be used to discover whether the subject's **comprehension problems** are comparable on the two tests. In normal subjects, **there is a strong correlation** between the two comprehension tests. Bishop (1979), using the Peabody Picture Vocabulary Test, found that language disordered children with **expressive grammatical problems** did poorly on both TROG (an earlier version of the test), and on the PPVT, but their performance on TROG was **disproportionately poor**. Appendix 5 shows what score can be expected on TROG given a particular raw score on the EPVT. If the obtained TROG score is lower than expected, this is an indication that the subject has a **disproportionate difficulty in understanding grammar**, relative to **vocabulary**. (A TROG score above expectation would indicate the converse, i.e. that the subject had greater difficulty with understanding vocabulary than with grammar).

(SEE APPENDIX 6, NOTE 9)

b) Which grammatical structures are not understood?

The simplest way of answering this question is by making a list of blocks which are passed and failed by the subject. The probability that the subject would get four out of four items correct simply by guessing is $.25^4$, i.e. .004. Even if the subject was ignoring the lexical distractors and guessing between the grammatical distractor and the correct item, the probability of all four items correct is still low, i.e. $.5^4 = .063$. So if we find a subject has passed a block we can be confident that that structure is understood. On the other hand, it may happen that a subject fails a block when we suspect that they really understand the structure. A lapse of attention on one item can lead to the whole block being failed. When doing a quantitative analysis of performance, it is important that testers do not depart from the definitions of "passing" and "failing" blocks used here. However, if a tester feels that a subject really does have good understanding of a structure which was "failed", it is quite permissible to return to that structure at the end of the test, and readminister the block, provided one does not use the results from this retesting in a quantitative analysis. If it were the case that a subject who made several careless errors on TROG subsequently demonstrated good understanding of several blocks which had been failed, it would be appropriate to report the centile score obtained from the original testing, but to note that the poor performance on the test appeared to arise from carelessness or inattention, rather than genuine difficulty with grammatical structure, since adequate understanding was subsequently demonstrated.

(SEE APPENDIX 6, NOTE 10)

c) Is comprehension delayed or deviant?

A child who performs poorly on TROG, but whose pattern of performance looks very similar to that of a younger, normal child may be described as having "delayed" comprehension. Such a pattern is common among educationally subnormal children and is also found in some language disordered children. Deaf children, children with receptive language disorders, and dysphasic adults frequently produce patterns of performance on TROG which do not resemble those of normal children at any age. The following patterns may be regarded as deviant.

i) LIMITED SPAN OF PROCESSING AND/OR MEMORY

Some subjects have no problems in understanding single words, but seem unable to remember and combine the meanings of several words in a sentence, and may, for example, respond only to the first or last word in an instruction. Such subjects will run into difficulties on block D and will fail later blocks, not because of any specific grammatical disability, but rather because of their inability to cope with two or three elements in a sentence. These subjects will make lexical as well as grammatical

errors on blocks G onwards. In such cases it may be interesting to see whether performance improves when written presentation is used.

ii) UNDERSTANDING OF SENTENCE ELEMENTS, BUT LITTLE UNDERSTANDING OF GRAMMATICAL STRUCTURE

This pattern is typical of profoundly deaf children and is readily identified. The child interprets sentences by picking out main content words with which he or she is familiar and selecting a picture corresponding to a combination of these. The result is that the child passes blocks A to D, and block F, but makes many grammatical errors (and very few lexical errors) on later sections. In the most severe cases, there may be no understanding of even the most elementary grammatical devices, such as the word "not", and such children will treat all negative sentences as positive, a pattern which is not found in the course of normal development. The author has observed cases of deaf children who, in a written version of TROG, read "not" out aloud, yet still treat negative sentences as positive, indicating that, although they have learned to pronounce the word, they do not understand it.

iii) USE OF 'ORDER OF MENTION' STRATEGY TO DECODE WORD ORDER

This interesting pattern of performance is quite common in profoundly deaf children, and in language disordered children with receptive problems. Children conforming to this pattern are far from random in their responses. On the contrary, their behaviour is clearly rule-bound, but their rules are not always correct. The typical finding is of a child who treats all sentences as if they followed Subject-Verb-Object (SVO) word order. This results in systematic misinterpretation of all passive sentences as active (i.e. the subject will make four grammatical errors on block L), and misinterpretation of sentences with post-modified subject (block N) as if they consisted of two SVO clauses (e.g. "The pencil on the shoe. The shoe is blue"). A child following this strategy would respond 3,2,4,1 to the four items on block N. Such children may appear to be doing very well on blocks A to K, but will find many of the subsequent blocks (especially L, N, P, R, S, and U) extremely difficult.

(SEE APPENDIX 6, NOTE 11)

d) How does comprehension compare across different modalities?

This question is often of considerable practical importance in deciding how best to help a person with comprehension problems. The author hopes to be able to produce at least one parallel form of TROG in the near future, and this will facilitate comparisons of this kind. Until parallel forms are available, testers will have to compare modalities using the available version of TROG. In the author's experience, practice effects

can occur if the test is readministered, and a person can be expected to improve their performance by one block from one administration to another, even when there is one week's separation between tests. This practice effect must be borne in mind when comparing results from different administrations of one form of TROG.

Bishop (1982, 1983) describes studies of language disordered and deaf children in which comprehension of an earlier version of TROG is compared under conditions when instructions were spoken, written, or signed.

A further note on interpretation

It is important to recognize that TROG is not designed to measure effective understanding of language in everyday life. Language comprehension is not a unitary ability. People make use of many linguistic and nonlinguistic cues to arrive at an understanding of what is being said to them. TROG is specifically designed to look at one component of language comprehension, comprehension of grammatical structure, in isolation, to determine whether this aspect of language is giving a person particular difficulty.

Some people who do poorly on TROG may not have obvious difficulties in following conversation. It is not uncommon to encounter language disordered children whose parents report in good faith that they understand everything that is said to them. In such instances the child may be getting by with a small receptive vocabulary and a good ability to deduce likely utterances from context. For example, a child sitting up late to watch television who understands only a few common nouns may well appear to understand his parents' saying "Don't you think it's about time John went to bed?"

The converse situation may also occur, where a person who appears to have serious comprehension problems does surprisingly well on TROG. The author has sometimes encountered this in adults with neurological disease. In such instances it appears to be nongrammatical factors (e.g. poor auditory memory, weak receptive vocabulary, inability to follow a fast rate of speaking) that are responsible for the comprehension failure, rather than grammatical disability.

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Appendix 1

CENTILE EQUIVALENTS FOR BLOCKS PASSED

age:	centile								
	1	5	10	25	50	75	90	95	99
4.0-4.2	1	2	3	4	6	8	10	13	16
4.3-4.5	1	2	3	5	7	10	12	14	17
4.6-4.8	1	2	4	5	8	11	13	14	17
4.9-4.11	2	3	4	6	9	12	13	15	17
5.0-5.5	3	4	6	8	11	13	15	16	17
5.6-5.11	5	6	7	9	12	14	15	16	17
6.0-6.11	5	7	9	11	14	16	17	18	19
7.0-7.11	6	9	10	13	15	17	18	19	20
8.0-8.11	9	11	12	14	16	18	-	19	20
9.0-9.11	10	13	14	15	17	18	-	19	20
10.0-10.11	11	13	15	16	18	-	-	19	20
11.0-11.11	12	14	15	16	18	-	-	19	20
12.0-12.11	13	15	16	17	18	-	-	19	20

Entries in body of table are numbers of blocks passed

Adults: TROG has not been standardized on adults, although the test has been given to a small sample of Canadian and American neurological patients and their relatives. The patients all had full scale IQs of 90 or over and were aged 16 to 42. Results for 18 epileptic patients with right-sided focal lesions and 9 relatives suggest that centiles for 12-year-olds can be used for people passing up to 18 blocks. A score of 19 blocks passed corresponds roughly to the 60th centile, and a score of 20 blocks passed to the 80th centile.

Appendix 2

AGE EQUIVALENT SCORES

blocks passed	age equivalent (years)
5	4
6	4½
7	4½
8	4½
9	5
10	5½
11	5½
12	5½
13	6
14	7
15	8
16	9
17	10
18	11+

Appendix 3

IDENTIFICATION OF VOCABULARY ERRORS

<u>vocabulary</u>	<u>errors</u>
apple	23(1), 39(1)
bag	24(4)
ball	16(3), 37(3), 73(all)
big	14(1), 42(2), 43(1), 58(3), 66(4), 70(4), 80(2)
bird	43(2), 65(all)
black	58(1), 78(3)
blue	54(2), 65(all), 66(1), 71(3)
book	69(all), 77(all)
box	21(3), 42(4), 49(all), 50(all), 57(all)
boy	13(4), 17(2, 4), 21(4), 30(1), 38(4), 53(all), 59(all), 75(all), 80(all)
brown	55(4), 72(1), 73(all)
carry	24(1), 28(3), 34(3)
cat	37(1), 55(all), 67(all), 78(all)
chair	33(2), 57(all)
chase	30(2), 31(3, 4), 45(3, 4), 47(1, 2), 53(all), 70(all), 78(all), 80(all)
circle	51(all), 56(all), 63(all), 79(all)
comb	62(all)
cow	26(3), 32(1), 48(4), 55(all), 78(all)
cup	14(2), 40(4), 42(3), 49(all)
dog	15(3), 18(1, 2), 20(3, 4), 31(1), 70(all), 72(all), 73(all), 80(all)
drink	68(all)
drop	40(1)
eating	23(4), 60(1)
elephant	28(4), 46(3)
fat	53(3)
flower	61(all), 65(all)
food	68(all)
girl	19(1, 4), 22(2), 45(2), 67(all), 70(all)
hat	76(all)
horse	29(1), 36(2), 44(4), 53(all), 59(all), 72(all)
jumping	21(2), 27(3)
knife	41(2), 52(all)
long	41(1), 74(2)
looking	26(4), 36(1)
man	23(2), 47(4), 48(3)
pencil	41(3), 50(all), 54(all), 61(all), 69(all), 77(all)
picking	39(2)
pushing	29(2, 3), 32(2, 3), 46(1, 4), 48(1)
red	10(4), 57(all), 74(1), 77(2), 79(2)
running	13(2), 75(all)
sheep	30(4)
shoe	43(4), 52(all), 54(all), 76(all)
sitting	15(4), 22(3), 25(1), 33(3), 35(1), 60(3), 67(all)
spoon	62(all)
square	64(all), 71(all)
standing	38(2), 59(all)
star	51(all), 56(all), 63(all), 64(all), 71(all), 79(all)
table	22(1), 25(2)
tall	44(2)
tree	35(2)
wall	27(1), 44(3)
woman/lady	24(2), 34(4)
yellow	56(1), 69(2)

Appendix 4

LEXICAL AND GRAMMATICAL ERRORS: blocks D to L

block	item	picture			
		1	2	3	4
D	13	L	L		L
	14	L	L	L	
	15	L		L	L
	16		L	L	L
E	17	G	L		L
	18	L	L	G	
	19	L		G	L
	20		G	L	L
F	21		L	L	L
	22	L	L	L	
	23	L	L		L
	24	L	L		L
G	25	L	L	G	
	26	G		L	L
	27	L		L	G
	28		G	L	L
H	29	L	L	G	
	30	L	G		L
	31	L		G	L
	32	L	L	G	
I	33	G	L	L	
	34		G	L	L
	35	L	L		G
	36	L	L	G	
J	37	L		L	G
	38		L	G	L
	39	L	L		G
	40	L	G		L
K	41	G	L	L	
	42		G	L	L
	43	G	L		L
	44		G	L	L
L	45		L	G	L
	46	L		L	G
	47	G	L		L
	48	G		L	L

BLOCKS D TO L	
total errors	expected L errors*
1-3	0-1
4-5	0-2
6-7	0-3
8-9	0-4
10	0-5
11-12	1-5
13	2-7
14-15	3-7
16	4-8
17	5-9
18	6-9
19	6-10
20+	7-16

*95% confidence limits

L = lexical error
G = grammatical error

Appendix 5

TROG SCORES RELATIVE TO EPVT RAW SCORES

raw EPVT score	TROG BLOCKS PASSED	
	95% confidence limits	mode
5-9	1 - 11	3
10-14	2 - 12	5
15-19	2 - 13	5
20-24	2 - 13	5
25-29	3 - 14	5
30-34	4 - 15	8
35-39	4 - 15	9
40-44	5 - 18	13
45-49	6 - 18	14
50-54	9 - 19	16
55-59	10 - 19	17
60-64	10 - 19	17
65-69	11 - 19	18
70-74	11 - 19	18
75-79	13 - 19	18
80-84	14 - 20	19
85-89	14 - 20	19
90-94	15 - 20	19
95-99	15 - 20	19
100-104	15 - 20	19
105-109	15 - 20	19
110-114	17 - 20	19

To use this table: Locate the subject's EPVT raw score in the left hand column. The middle column gives the range of values in which the subject's TROG score is expected to fall. The right hand column gives the modal TROG score for this EPVT score in the standardization sample.

In the standardization sample the correlation between EPVT raw scores and TROG blocks passed was .774. The partial correlation between the two tests after adjusting for age was .442.

TROG FORM A

Name:.....
 surname first name John
 Date:..... 8th December 1982
 Date of birth:..... 12th December 1974
 Age:..... 7-11 Sex:..... M
 Tester:..... DB

VOCABULARY CHECK

		naming	pointing	
			pre	post
I	7	elephant	✓	
	4	hat	✓	
	3	bag	✓	
	6	book	✓	
	1	spoon	✓	
	5	sheep	✓	
	2	woman/lady	✓	
	8	table	✓	

II	1	flower	✓	
	4	cat	✓	
	2	drink	glass	✓
	3	shoe	✓	
	8	girl	✓	
	7	chair	✓	
	6	horse	✓	
	5	ball	✓	

III	7	dog	✓	
	8	circle	round	6 ✓
	4	square	box	8 8
	2	boy	✓	
	5	cup	✓	
	6	star	✓	
	1	wall	✓	
	3	apple	✓	

		naming	pointing	
			pre	post
IV	7	food	Lakes	✓
	1	man	✓	
	4	bird	✓	
	6	knife	✓	
	5	box	✓	
	2	cow	✓	
	8	pencil	pen	✓
	3	tree	✓	

V	1	dropping	✓	
	6	drinking	✓	
	8	jumping	✓	
	2	pushing	✓	
	5	carrying	—	2 2
	4	chasing	running	✓
	3	standing	✓	
	7	looking	✓	

VI	8	big	XXXXXXXXXXXX	✓
	4	red	XXXXXXXXXXXX	6 6
	3	tall	XXXXXXXXXXXX	✓
	6	yellow	XXXXXXXXXXXX	✓
	2	fat	XXXXXXXXXXXX	✓
	7	brown	XXXXXXXXXXXX	5 ✓
	5	blue	XXXXXXXXXXXX	✓
	1	black	XXXXXXXXXXXX	✓

TOTAL BLOCKS PASSED

8

AGE EQUIVALENT

4 ³/₄

CENTILE

below 5

A	1	shoe	2
	2	bird	1
	3	comb	3
	4	apple	4

P

2134

B	5	eating	2
	6	picking	3
	7	sitting	1
	8	running	4

P

2314

C	9	long	1
	10	tall	2
	11	red	2
	12	black	3

P

1223

D	13	the boy is running	3
8-9 yrs	14	the big cup	4
start	15	the dog is sitting	2
here	16	the red ball	1

P

3421

E	17	the boy is not running	1	G
	18	the dog is not drinking	3	G
	19	the girl is not jumping	3	G
	20	the dog is not sitting	2	G

F

3421

F	21	the boy is jumping over the box	1
	22	the girl is sitting on the table	4
	23	the man is eating the apple	3
	24	the woman/lady is carrying the bag	3

P

1433

G	25	they are sitting on the table	4
	26	the cow is looking at them	2
	27	they are jumping over the wall	4
	28	the elephant is carrying them	1

F

4221

H	29	the girl is pushing the horse	4
10+ yrs	30	the boy is chasing the sheep	3
start	31	the man is chasing the dog	2
here	32	the cow is pushing the woman/lady	4

P

4324

I	33	she is sitting on the chair	1	G
	34	the woman/lady is carrying him	1	
	35	he is sitting in the tree	4	G
	36	the horse is looking at her	4	

F

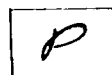
4134

J	37	the cats look at the ball	2	
	38	the boy stands on the chairs	3+1	R 3+1 (4)
	39	the boys pick the apples	3	
	40	the girl drops the cups	2	G

F

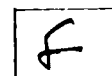
2133

K	41	the knife is longer than the pencil	1	④
	42	the box is bigger than the cup	1	
	43	the shoe is bigger than the bird	3	
	44	the horse is taller than the wall	1	



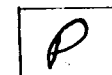
4131

L	45	the girl is chased by the horse	②	3	4
	46	the elephant is pushed by the boy		4	4
	47	the horse is chased by the man		1	4
	48	the cow is pushed by the man		1	5



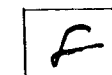
1232

M	49	the cup is in the box		3
	50	the pencil is on the box		1
	51	the circle is in the star		2
	52	the knife is on the shoe		4



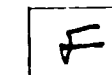
3124

N	53	the boy chasing the horse is fat		3
	54	the pencil on the shoe is blue		2
	55	the cow chasing the cat is brown		4
	56	the circle in the star is yellow		4①



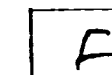
4123

O	57	the box but not the chair is red		4
	58	the cat is big but not black		4
	59	the horse but not the boy is standing	②	3
	60	the boy is sitting but not eating		2



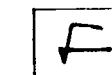
1422

P	61	the pencil is above the flower		1
	62	the comb is below the spoon		1
	63	the star is above the circle		2
	64	the square is below the star		1



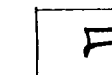
4343

Q	65	not only the bird but also the flower is blue		4
	66	the box is not only big but also blue		3
	67	not only the girl but also the cat is sitting		4
	68	the girl has not only food but also a drink		3



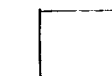
1223

R	69	the pencil is on the book that is yellow		4
	70	the girl chases the dog that is big		2
	71	the square is in the star that is blue		1
	72	the dog chases the horse that is brown		1+2



1243

S	73	neither the dog nor the ball is brown		
	74	the pencil is neither long nor red		
	75	neither the boy nor the horse is running		
	76	the boy has neither hat nor shoes		



1422

T	77	the book the pencil is on is red		
	78	the cat the cow chases is black		
	79	the circle the star is in is red		
	80	the boy the dog chases is big		



3144

Appendix 6

WORKED EXAMPLE: John X

1. The **date of birth** is 12th December 1974, and **date of testing** was 8th **December** 1982, so age is calculated as 7 **years** 11 months. **N.B.** Age is not "rounded up".
2. John **was given** the vocabulary cards and named all items **correctly except** for "drink", "circle", "square", "food", "**pencil**", "**carrying**" and "chasing". He was asked to point to these **items** as the **tester** named them and did so correctly for "drink", "food", "**pencil**" and "chasing". He made errors on the **other words**, and also on "red" and "brown". He was told the **correct response** for these items, and retested on them after TROG had **been administered**. He then pointed correctly to "circle" and "**brown**", but not to "square", "carrying" and "red".
3. On TROG, John passed 8 blocks of items.
4. R is recorded against items where the sentence was **repeated**. Note that on items 38 and 72, John pointed to two pictures, and persisted in doing so when the item was repeated. These responses are treated as errors. On items 41 and 56, John changed his response and the final response was circled and accepted.
5. Testing was started at block A and discontinued after block R when five consecutive blocks had been failed.
6. Appendix 1 indicates that a score of 8 blocks passed falls just below the 5th centile for a 7-year-old. Appendix 2 places John's score at the 4½-year-old level.
7. John failed "square", "carrying" and "red" on final vocabulary testing. Appendix 3 indicates that the following errors could arise from not knowing these words:

item	picture selected
64	all errors
71	all errors
24	1
28	3
34	3
16	4
57	all errors
74	1
77	2
79	2

John's errors on items 57, 64 and 71 could thus have arisen from his **not** knowing the vocabulary, and these errors are marked V* on the record form. Scrutiny of the record sheet indicates that the majority of John's errors cannot be accounted for in terms of inadequate knowledge of vocabulary, since most errors occur on items where he knew the nouns, verbs and adjectives used in the test sentence.

8. Appendix 4 allows us to classify John's errors on blocks D to L as grammatical (G) or lexical (L). We find that John has made a total of 13 errors on these blocks, and all of these are grammatical. Appendix 4 indicates that if a subject makes 13 errors on these blocks, we would expect between 2 and 7 of these errors to be lexical, so we can conclude that John is making an unusually low proportion of lexical errors.

9. John obtained a raw score of 52 on the EPVT. Appendix 5 indicates that we would expect a person with this score to pass between 9 and 19 TROG blocks. John has more difficulty with TROG than would have been predicted from his receptive vocabulary.

10. John's performance on TROG blocks can be summarized as follows:

understood

2 word combinations
3 word combinations
reversible active
comparative
in and on

not understood

negatives
pronoun: singular/plural
pronoun: masculine/feminine
noun singular/plural
reversible passive
postmodification of subject
X but not Y
above and below
not only X but also Y
relative clause

11. John's pattern of performance on negatives is unusual. He appears to have no understanding of "not", and ignores it when it occurs. He is able to use word order information, and passes blocks H and M, but he seems to impose SVO word order on all sentences, so systematically misinterprets blocks L and N. We can conclude that although his overall score is at the 4½-year-old level, John's pattern of performance is not simply delayed, but is deviant.

Appendix 7

SPLIT-HALF RELIABILITY COEFFICIENTS

These coefficients are based on total scores on odd and even blocks (out of 10). The standardization sample was given the whole test, without using baseline and ceiling, and these coefficients are based on raw scores without including any corrections for baseline and ceiling (since such correction would artificially inflate reliability). Reliability coefficients are not given for the older age bands, as the skewed distribution of scores obtained by these groups means that correlation coefficients would be artificially reduced because of restriction of range.

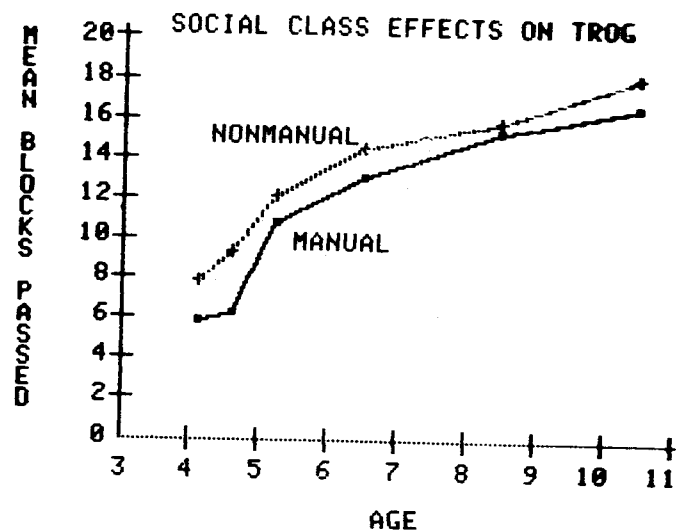
age group	reliability coefficient
4.0-4.2	.776
4.3-4.5	.848
4.6-4.8	.806
4.9-4.11	.804
5.0-5.5	.738
5.6-5.11	.740
6.0-6.11	.759
7.0-7.11	.766
8.0-8.11	.648

Appendix 8

Social Class effects on TROG

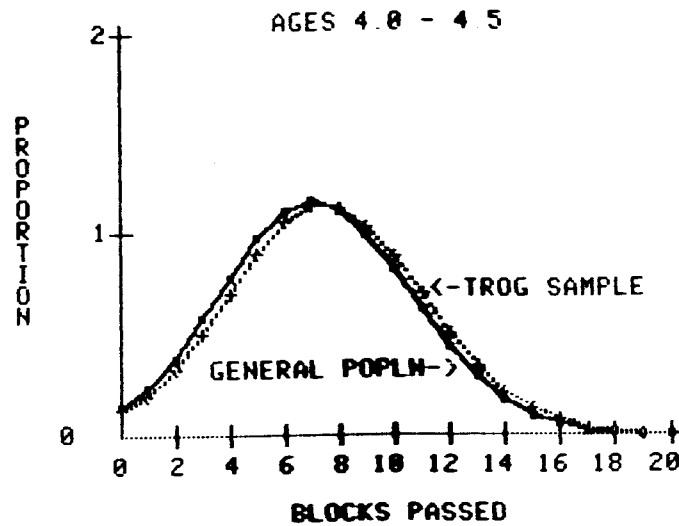
Figure 1 shows the mean TROG blocks passed for children with fathers in Nonmanual and Manual occupations. Adjacent age bands were summed to give reasonable sample sizes. Analysis of covariance showed that after the effects of age had been accounted for, social class (i.e. Manual vs Nonmanual) had a significant effect on performance ($F = 9.87$; d.f. = 1, 473; $p < .01$), with Nonmanual children obtaining a score which was on average 1.1 blocks higher than that of Manual children.

Figure 1

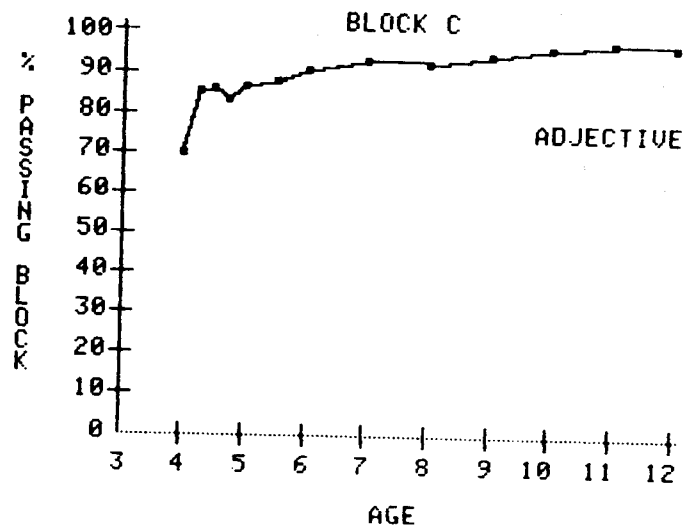
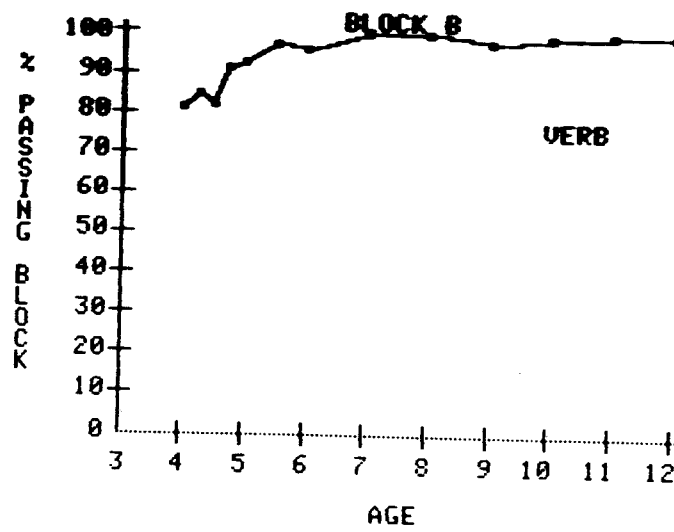
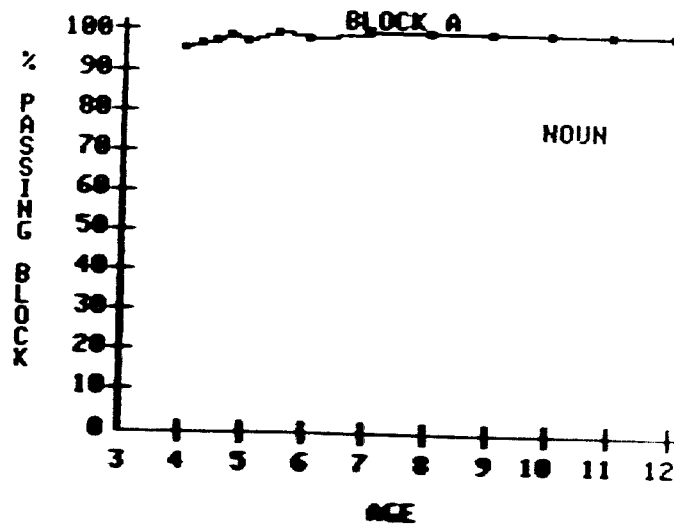


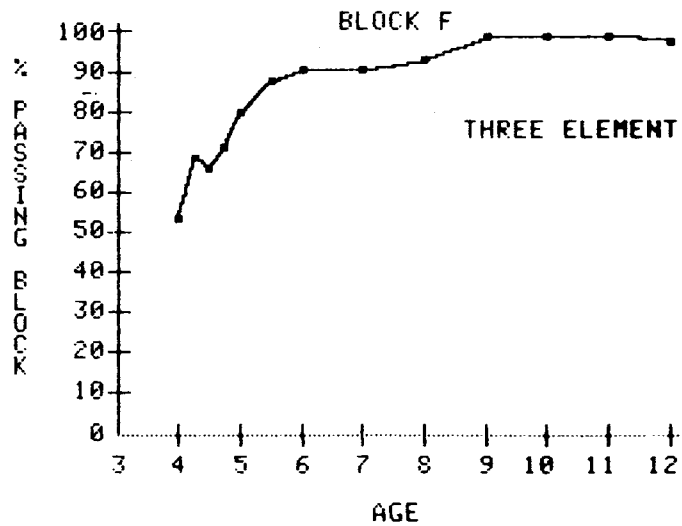
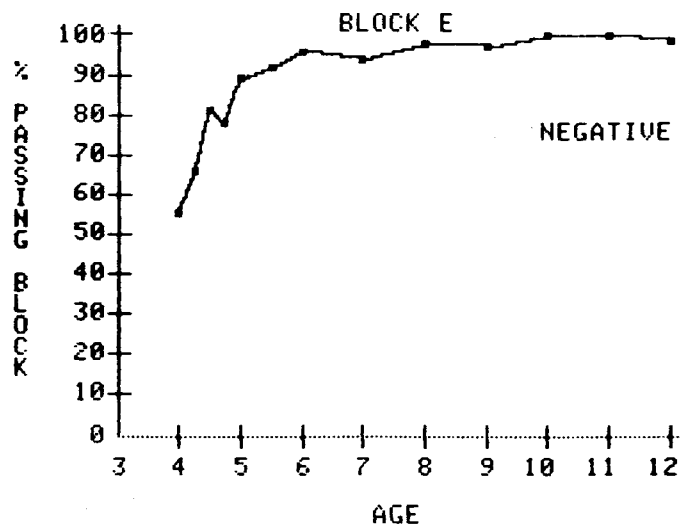
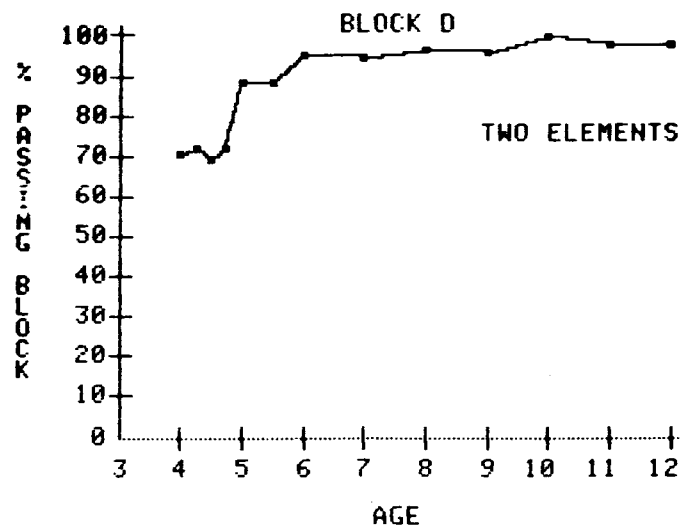
To see how any bias in the proportions of Manual and Nonmanual children would affect the norms, for each pair of age bands, two theoretical distributions were computed, using normal probabilities. The first was that which would arise if one had a sample where 37.4% were Nonmanual and 62.6% Manual (as in the general population, 1971), and the second was that which would arise if the sample consisted of 55.2% Nonmanual and 44.8% Manual children (as in the TROG sample). The means and s.d.s obtained by Manual and Nonmanual children in the standardization were used in estimating these distributions. Figure 2 shows the theoretical distributions obtained for children aged 4.0 to 4.5 (where the mean differences in blocks passed for Manual and Nonmanual children was relatively large, i.e. 2 blocks). It can be seen that the distributions are very close to one another. Indeed, similar distributions computed for children aged 5 and over were effectively superimposed.

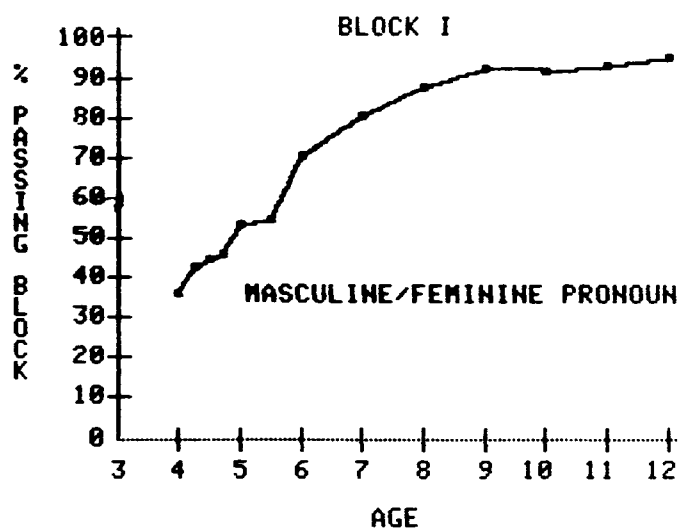
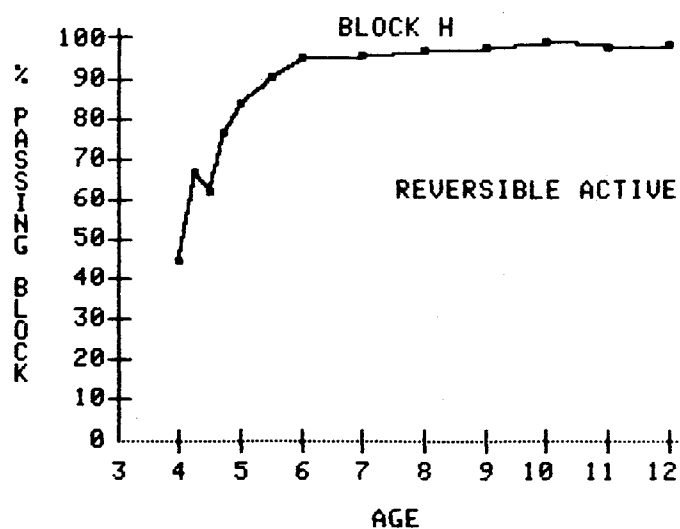
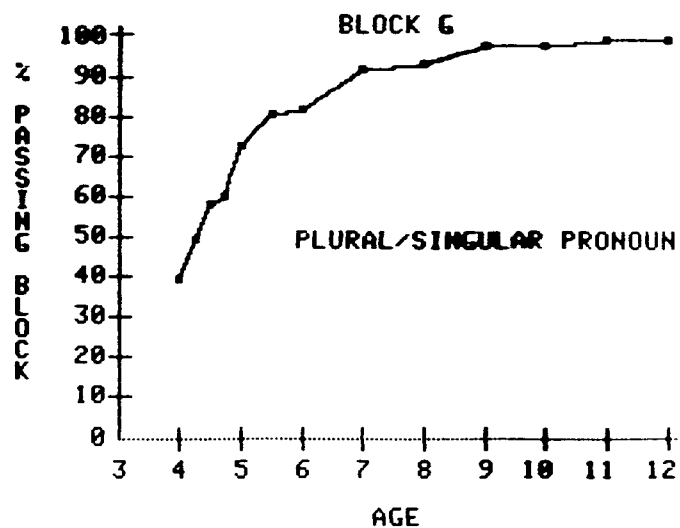
Figure 2



Thus, while social class does exert a statistically significant effect on TROG performance, we can be confident that any excess in the proportion of Nonmanual children in the standardization sample would not have an appreciable effect on the norms. As final confirmation of this conclusion, all centiles were recomputed after excluding all children known to be Nonmanual social classes. Differences in the centiles obtained with and without these children included were so slight as to be negligible.

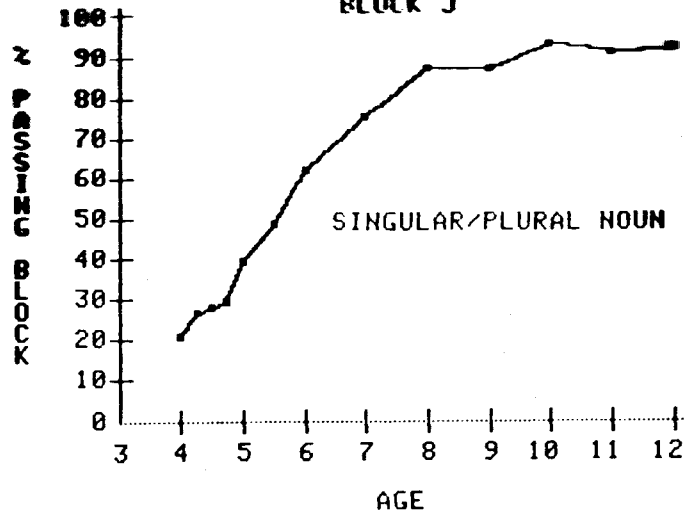




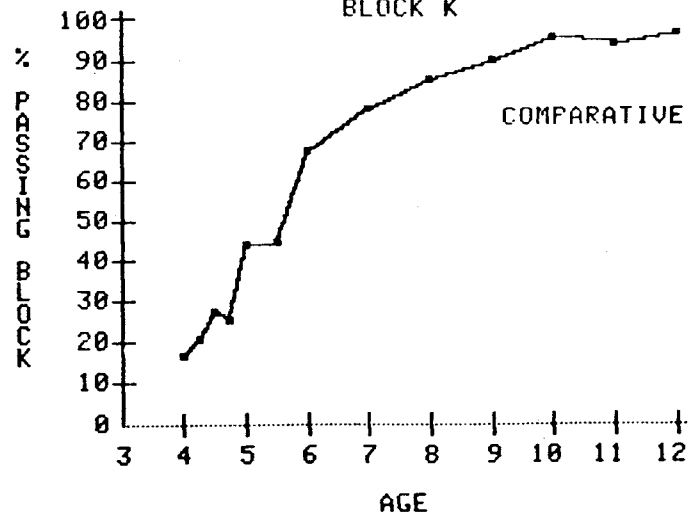


-37

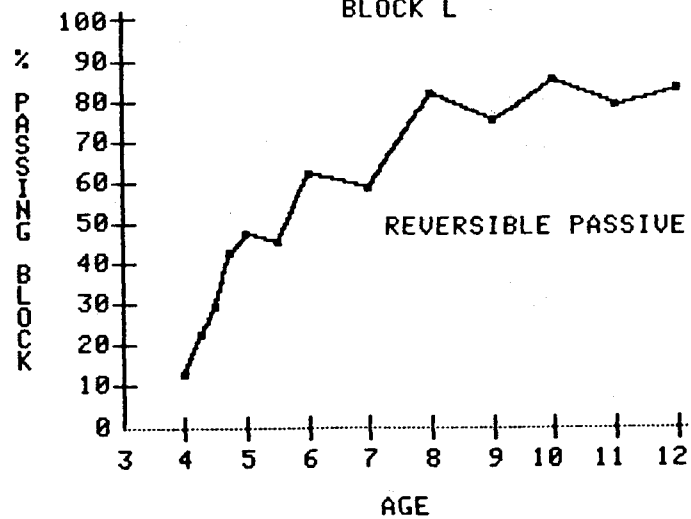
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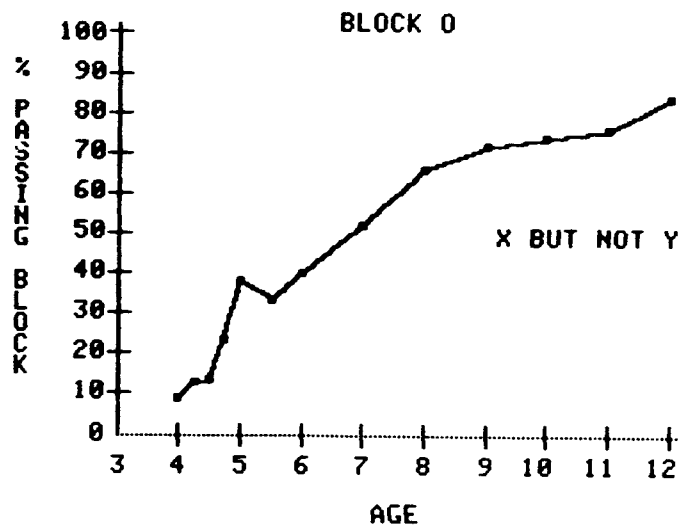
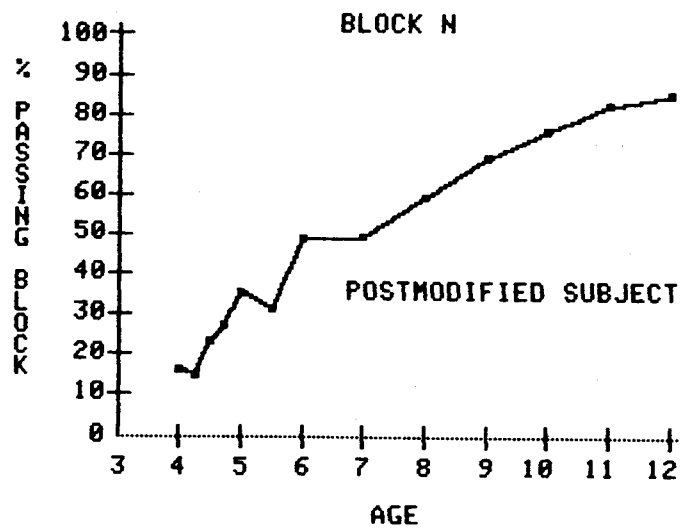
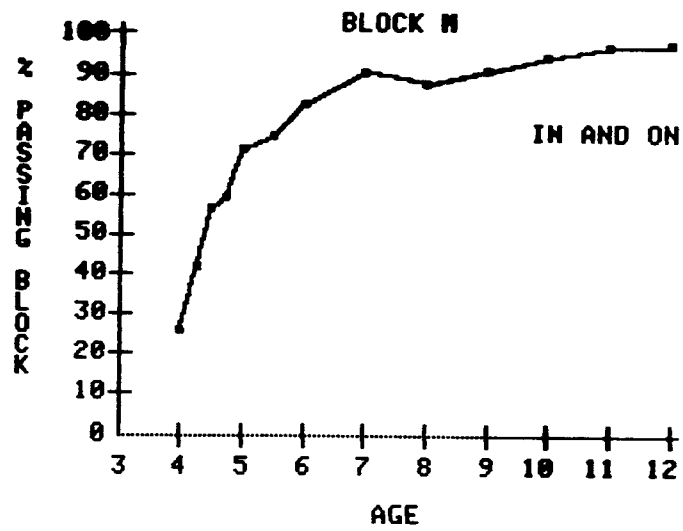


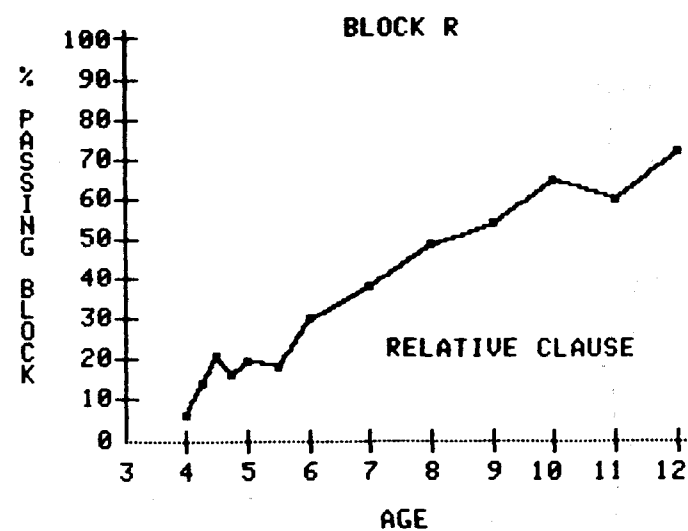
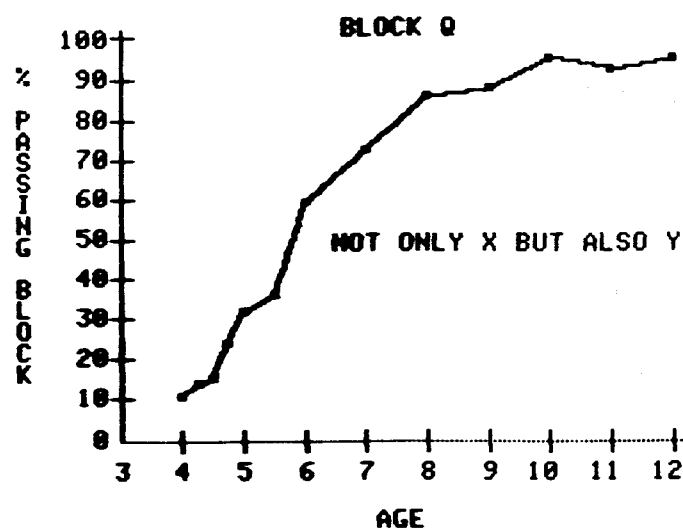
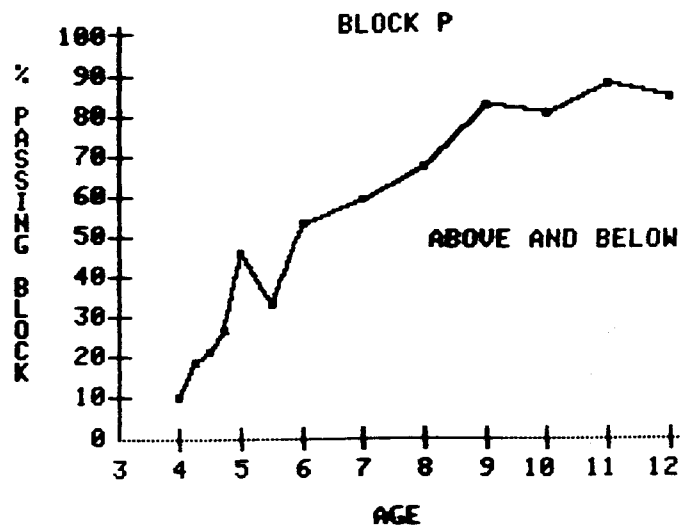
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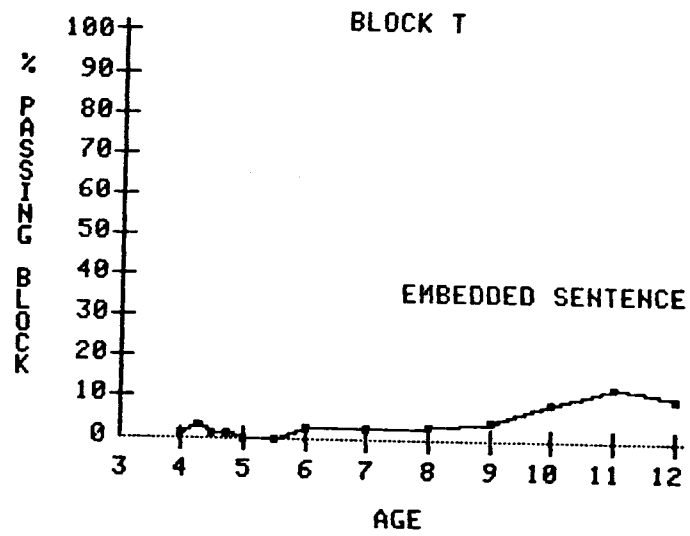
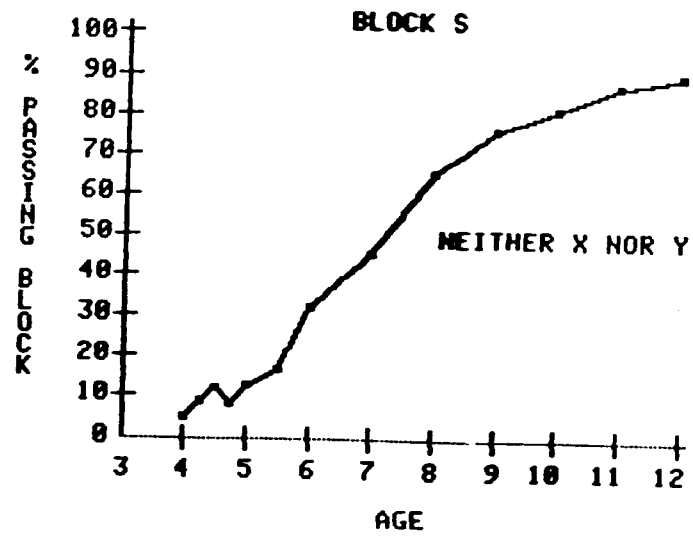


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