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ABSTRACT

To investigate the factors determining why some children succeed at certain intellectual tasks while others of equal or near equal IQ, age, and motivation are unable to master the same task, 145 female and 144 male eighth grade students were administered "An Inventory of Piaget's Developmental Tasks" (IPDT). Labeled as concrete, operational, transitional, or formal operational thinkers according to inventory scores, the students were then given one of two grammar tests. Findings revealed significant correlation between grammar test scores, Piagetian stages, and IQ scores--indicating first, that the Piagetian stage as revealed by the IPDT is useful in predicting grammar test scores, especially when considered with IQ; and, second, that the task of identifying simple subjects and predicates is too difficult for most of the eighth grade students, including 47% of the students at the formal operations level, and a total of 74% of all students who took the test. The findings support Piaget's principle that children's cognitive development is a limiting factor in what they can learn at any given time. Results suggest that the abstract quality of grammar rules makes them too difficult for eighth grade students. (MM)

The Interaction of Piagetian Stages of Development in Early Adolescents, IQ Levels and Other Variables in Predicting Success on a Grammar Task

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The Interaction of Piagetian Stages of Development in Early Adolescents, IQ Levels and Other Variables in Predicting Success on a Grammar Task

The performance of students in the English classroom varies widely on certain tasks. For example, some seventh and eighth grade students are unable to compare two stories in order to show how they are similar and how they are different, and will, instead, simply retell the two plots. Other students will show similarities and differences between two stories; but, given more than two stories, they will pair stories poorly or compare unimportant details, omitting obvious or important ones. Finally, a few students in the same class will produce clear, accurate, well-reasoned comparisons.

Inspection of IQ scores reveals that variable alone does not account for the wide variation in student responses to the same task. In the study of grammar such topics as formation and use of plural possessives and accurate identification of simple subjects and predicates and subject-verb agreement will produce, within a classroom of seemingly average students, widely ranging displays of differing levels of understanding of the task.

Cognitive development, which is related to but different from IQ (Eson and Walmsley, 1980), would appear to be the factor which affects the students' ability to perform intellectual tasks. Piagetian research provided the labels "concrete operational stage" and "formal operational stage" to distinguish the

kind of thought which is limited to a very few variables from the kind of thought which can think about thinking and produce hypotheses and abstractions (Piaget, 1981).

The purpose of the study was to add to the body of information additional factors or variables which would explain why some children succeed at certain intellectual tasks while others of equal or near equal IQ, age, and motivation are unable to master the same task.

Questions

The research provided answers to the following questions:

1. Does Piagetian stage account for significant variance on the grammar task?
2. Does Piagetian stage account for significant variance of grammar scores when co-varying IQ?
3. Is there significant interaction between sex and Piagetian stage in predicting grammar test score?
4. Is there significant interaction between IQ and Piagetian stage in predicting grammar test score?
5. Is there significant interaction between IQ and Piagetian stage in predicting presence in enriched English class?

Background

According to Piaget (1981), mental development advances in four specific stages: sensori-motor, before language; pre-operational, from about twenty-four months to seven years; concrete operations, extending to the beginning of adolescence; and formal operations, during which the child achieves mature thinking. The third and fourth stages of cognitive development are the two by which nearly every early adolescent could be

characterized. Rather than being conceived as a bipolar relationship, either concrete or formal operations, levels of thinking resemble a continuum extending from manifestations of concrete operations through demonstrations of some of the thinking described as formal operations and on to achievement of most of the abilities characteristic of formal operations.

In the concrete operations stage the child can observe and manipulate concrete objects in order to solve problems but finds it difficult to determine which variables are relevant. Concrete evidence is important to him/her, but not hypothetical situations which require more than simple interpolations. In the formal operations stage, hypothetical circumstances can be as relevant as reality. Relevant variables are distinguishable from irrelevant. In this stage, there is thinking about thought, during which there is manipulation of verbal and other symbols and propositions in place of the concrete objects of the previous stage.

Karplus (1981) indicates that an instructional concept can be clear to a child on the concrete level of thinking or understandable to a child on the formal level, according to the way in which the meaning of that concept is expressed. Cognitive levels of subject matter need to be matched with students' levels of thinking. Teachers need to be aware of these levels and their effect on student learning.

The Grammatical Task

Tradition

The English profession defines grammar as the "laws" governing the function of words to produce understandable messages, incorporating usage, semantics, and syntax. The problem of how much grammar to teach, its value, and how to teach it has been with the profession most of this century. Discussing the proper forms of language study, Hosic (1917) in Reorganization of English in Secondary Schools commented on the need for experience in the language and recommended that instruction in English should draw forth the active powers of boys and girls. During the same time period, however, others were proposing that grammar lessons would eliminate errors in young people's language. From 1908 through 1930 error studies were published (Botts, 1979). Thus the question has been stated: is language best learned through learning about it as in error studies, or is it best learned through exploring language and thus experiencing its power? The leadership in the profession has favored the latter position. Unfortunately practice in the nation's classrooms usually favors the former.

Andrew Wilkinson (1971) cites several studies which point up the phenomenon that grammar is taught to children before they have the levels of cognitive development to understand it.

The Student's Cognitive Development as A Variable

More recently than Wilkinson's work Fraser and Hodson (1978)

have suggested that although grammar was taught, "it simply wasn't learned" (p. 50). Here is the crux of the problem of many English/language arts curricula for early adolescents. Has the student's thinking matured sufficuently for him/her to learn what is taught?

With one exception the language arts textbooks adopted since 1962 at the site of this study have begun the grammar section for eighth grade students with identification of subjects and predicates and labeling the simple subject and verb phrase. In spite of failure of most eighth grade students on that lesson, many language arts textbooks and teachers continue to include this and other grammatical objectives in the curriculum for early adolescents. Fraser and Hodson (1978) had pinpointed the most likely cause: a mismatch of the students and their studies.

Prosser (1979), Karplus (1970, 1977, 1981), Lawson (1975, 1980), Lawson and Renner (1974), and Howe and Early (1979), for example, have used adaptations of Piaget and Inhelder's tasks to analyze task requirements and student responses to those tasks in the disciplines of science and math. Although these studies have been undertaken over the past decade, Prosser (1979) still laments that task analysis of science materials has received so little attention from science educators. The English profession has yet to develop a similar methodology, although this study is a beginning.

Ginsburg and Opper (1979) warn that when the task is too difficult, it is performed poorly with little or no understanding. In fact, what the student learns is either not what was intended or has little strength or permanence.

Cognitive Level of Instructional Materials

Difficulty of the grammar task was determined in two ways. Following Prosser's (1979) methodology, an analysis of the task of identifying simple subjects and verb phrases revealed the following steps:

A. Read the sentence.

B. Find the word which can be changed by adding ed or show present and past time by a spelling change.

C. Look at the two or three words in front of the word you found in item B.

D. If one of the words is may, can, shall, will or must, might, could, should, would, or ought, it is also a verb.

E. Any word between the word in D and the word in B is a verb, unless it ends in ly or is a negative like not or tells when. (If the sentence is a question, the subject will be in that position quite often.)

F. Any forms of be, do or have are always verbs.

G. To find the simple subject, say "who?" or "what?" and repeat the verb phrase you have just found. The simple subject answers the question. Note: if of or with is one or two words in front of the word you found in answer to your question, then you have found the object of a preposition. Look at the noun or pronoun just in front of of or with. That will be the simple subject.

The concepts to be mastered include the following:

A. Recognize nouns.

B. Distinguish nouns used as subjects from nouns used as objects of prepositions.

C. Recognize main verbs, forms of be, and auxiliary verbs.

D. Recognize the conjunctive power of and.

E. Recognize and understand the sentence patterns and their components:
   1. Subject-Verb.
   2. Subject-Verb-Direct Object.
   3. Subject-Form of Be-Adverb of Place.
   4. Subject-Linking verb-Complement.
   5. Use of there as an expletive in an inverted sentence.
   6. Inverted order of questions.

Prosser (1979) used a classification scheme based upon Piaget's theory of cognitive development and developed by Collea, Fuller, Karplus, Paldy and Renner (1975). The referent is specifically science. However, the types of thinking are useful here.

Concrete reasoning patterns:

C1: Understands concepts defined in terms of familiar actions and examples.

C2: Applies conservative reasoning.

C3: Establishes one-to-one correspondences and arranges data in increasing or decreasing sequence.

C4: Makes simple classifications and successfully relates systems to subsystems, classes to sub-classes.

Formal reasoning patterns:

F1: Understands concepts defined in terms of other concepts or through abstract relationships such as mathematical limits.

F2: Imagines all possible combinations of conditions even though not all may be realized in nature.

F3: Separates the effects of several variables by holding all but one constant.

F4: Recognizes and applies functional relationships, such as direct and inverse proportion (Prosser,1979, pl 681).

When the sentence is in normal order with the subject near the beginning of the sentence and the verb phrase very closely following it, the cognitive level of thinking needed to identify that subject and predicate would be Concrete 1: "understands

concepts defined in terms of familiar actions and examples" (Prosser, 1979, p. 679). When the word order is changed so that there are nouns other than the subject at the beginning of the sentence, the level of cognitive development needed to correctly identify the simple subject and verb phrases requires thinking similar to the steps given earlier. The level of thinking becomes Formal 1: "understands concepts defined in terms of other concepts or through abstract relationships such as mathematical limits" (Prosser, 1979, p. 679).

A second way of determining the degree of difficulty of this task of identification required the construction of a value system. In a pilot study, twenty-seven students of above average IQ identified simple subjects and predicates in the pretest at the beginning of the grammar section of the adopted text. Table 1 presents a summary of the difficulties encountered by students in that study. Analysis of the data permitted construction of a hierarchy of difficulty.

Summary of Complexity Counts:

0 Count structures:

A. Subject precedes the verb and is the first noun in the sentence.
B. Question with a two-word verb phrase using a form of be or have.
C. Verb phrase is a single word and follows the subject.

1 Count

A. Subject consists of two or more nouns or pronouns of equal importance.
B. Question uses who or what as an interrogative.
C. Verb phrase consists of two adjacent words following the subject or a single word following a prepositional phrase modifying the subject.
D. Verb phrase contains a form of have or be or a modal as an auxiliary, but is not a question.

2 Count
A. Subject is a noun of quantity followed by a prepositional phrase containing a concrete noun as object.
B. Subject is preceded by one or more prepositional phrases telling where or when.
C. The question word is when, where, how or why.
D. Question begins with a modal: may, can, will, shall, must, would, could, should, or might.
E. Verb phrase is two words separated by an adverb.
F. Verb phrase is compound.
G. Verb phrase contains ought or a form of do as auxiliary.

3 Count
A. There inversion.
B. Sentence is in inverted order with subject following one or more prepositional phrases and the verb phrase.
C. Subject is a verbal, like running or thinking.

4 Count
A. Subject is an entire phrase.
B. Subject is preceded by a subordinate clause.

Seven teachers who made up the English department staff at the site of the study rated sixteen sentences according to the hierarchy above with a correlation coefficient of .73, p .0025.

Insert Table 1
about here

The first nine sentences below are the textbook ones with a mean difficulty of 2.4, according to the scale above. The last seven are simplified versions of the same sentences in which subjects and verbs have been placed as close together as possible and in normal order. They have a mean difficulty of 1.3. Although this would appear to be a small difference in degree of difficulty, the difference was found to be statistically significant, F (3,252) = 49.11 $p < .000$. Numbers fol-

lowing the sentences are the mean scores of the raters.

1. The hemlock makes a good hedge. 0
2. In the fruit bowl were an orange and a tangerine. 4
3. Have you ever eaten a mango? 1
4. There was a sudden outburst of laughter from the gymnasium. 3
5. Just before the sound of the starter's gun, spectators at the relay race became quiet and tense. 3+
6. Behind the clock on the mantle are the extra keys for the front door. 4
7. Did you buy that old envelope at the stamp show? 2
8. One one side of the country road a fire had blackened trees and shrubs. 3
9. The ill-tempered wolverine bared his teeth and chased the wolves away from his store of food. 2 (Modern English in Action, 1978. Reprinted by permission of D. C. Heath and Company.)
10. An orange and a tangerine were in the fruit bowl. 1
11. You have never eaten a mango. 2
12. A sudden outburst of laughter came from the gymnasium. 1
13. Spectators at the relay race became quiet and tense just before the sound of the starter's gun. 1
14. The extra keys for the front door are on the mantle behind the clock. 1
15. You did buy that old envelope at the stamp show. 2
16. A fire had blackened trees and shrubs on one side of the country road. 1

This study investigated the responses of eighth grade students to two versions of a test requiring the identification of simple subjects and verb phrases. What makes the task so very difficult? Part of the problem lies with the grammar in school textbooks.

Brengelman (1970) reveals that definitions of parts of speech are frequently ambiguous, and words can perform many functions. Verb forms can function as subjects, as can phrases and whole clauses. In addition, school grammar "provides . . . an abstracted semantic structure of sentences, often

limited by an arbitrary and constricted technical vocabulary" (p. 17). The conditions under which most eighth grade students can successfully identify subjects and verbs are: sentence order normal (subject bofore the verb or a question); verb immediately following the subject and consisting of one word. The conditions are those requiring concrete level of thinking.

This study investigated hypotheses stating that success of eighth graders on an abstract grammar task was positively correlated with levels of thinking and that students in the formal operations stage of cognitive development would respond significantly differently from students at lower stages of cognitive development.

Method

Subjects

The population whose responses provided data for this study attended eighth grade during the 1981-82 school year. Only those students present October 22, 1981, were included. Table 2 contains a summary of their sex, ages, IQ's, and standardized test scores. There were 282 students in the study.

Insert Table 2 about here.

The site of the study was a two-year junior high school in a city of 20,000 located in a rural county in the midwest. All seventh and eighth grade students in the city attend that school, which has more than the usual number of children coming from well-educated, professional parents. Minority families make

up less than 10% of the families in the community.

Procedure

On testing day all eighth grade students responded to the eighteen subtests of An Inventory of Piaget's Developmental Tasks. The test was developed by the Center for Research in Thinking and Language, Department of Psychology, Catholic University. It provides assessment of eighteen different "problems" in five main areas. Very little reading is required, permitting assessment of "minority and culturally deprived students with reading problems" (Patterson and Milakofsky, 1980, p. 349). Mastery of a problem area subtest is defined as 75% or more correct responses.

Administration of the paper-and-pencil test took place in students' regular second period class, their teachers being monitors. The test was not timed, and students who had not completed all items in forty-five minutes were allowed to complete the test the following day at the same time.

Results of scoring permitted students to be assigned to a Piagetian stage. Four subtests were found to be predictors of formal operational thinking. Students not achieving success on any one of the four were designated concrete operational. Students who were successful on one or two of the subtests were labeled transitional, while students who were successful on three or four of the predictor subtests were designated formal operational.

Half of the students in each of the three stages received the grammar test as it had been published in the textbook (sen-

tences 1 - 9 above). The other half were given the simplified form (sentences 1,9, 10 - 16 above). The testing for this second phase of the study was administered by the students' English teachers during the regular class time sometime the final week of the first semester (Jan. 17 - 23, 1982). Instructions requested only the noun or nouns functioning as subjects and the verb phrases without modifiers be identified.

Variables

Sex, age in months, IQ, scores on individual subtests of the Inventory of Piaget's Developmental Tasks, Piagetian stage, raw score on the grammar test, placement in English classes, and percentiles from the Stanford Achievement Test: Science, Math, and Reading were the variables. Hypotheses were tested using multiple linear regression.

Results

Findings reveal that the eighth grade class did differ widely across IQ, Piagetian stages, total IPDT test scores, grammar test scores, and academic placement and achievement. There were 145 females and 144 males in the study. Sex was not found to be a predictor of Piagetian stage. However, grammar test scores and IQ were found to be statistically significant predictors of Piagetian stage. On the other hand, Piagetian stage and subtests Classes and Inclusion of the IPDT did predict grammar test scores. Table 3 contains a summary of the results, answering the questions posed earlier.

Insert Table 3 about here.

Only the question of the interaction of sex and Piagetian stage in predicting grammar test scores received a non-significant result. The rest of the answers were highly significant. Piagetian stage accounst for 9% of the variance on the grammar task: F (1,243) = 26.12, p <.0. Piagetian stage accounts for 28% of the variance of grammar scores when co-varying IQ: F (2,242) = 48.13, p <.000. Results do not indicate significant interaction between sex and Piagetian stage in predicting grammar test scores: F (3,241) = .89, p >.38. There is significant interaction between IQ and Piagetian stage in predicting grammar test scores: F (3,241) = 52.83, p<0. There is significant interaction between IQ and Piagetian stage in predicting presence in enriched English class: F (3,267) +102.74, p < 0. In addition, a significant difference was predicted in grammar test scores when Piagetian stage was held constant and the sentence forms were varied: F (2,229) = 20.10, p <.000.

Discussion

This empirical study was ex post facto in design, dependent upon Piaget's developmental stages and prior research in cognitive development for its theoretical base. Data for the population were collected by means of paper-and-pencil tests, rather than the clinical interviews used by Piaget and his associates. In addition, the students responded to one of two forms of a grammar test consisting of nine sentences in which students were asked to identify the simple subject and verb phrase.

Taken as a single predictor of achievement in the middle grades, IQ is the best single predictor of success in school. Where IQ is held constant, Piagetian stage accounts for 10% of the variance in grammar test scores. When IQ is added, it accounts for an additional 18%, increasing the total to 28% of the variance. When interaction between IQ and Piagetian stage are added, the total becomes 45% of the variance in the test scores. (See table 4 for a summary of grammar test scores by Piagetian stage.)

Insert Table 4 about here

Two conclusions can be reached: (a) Piagetian stage, as revealed by the Inventory of Piaget's Developmental Tasks, is useful in predicting grammar test scores, expecially when considered with IQ and in interaction with IQ; and (b) the task of identifying simple subjects and predicates is too difficult for most of the eighth grade students, including 47% of the students at formal operations, and a total of 74 % of all eighth graders who took the test. This failure is in spite of the fact that simple subjects and verb phrases are introduced to students in fourth or fifth grade in the school system of the study site. (See Table 5).

Insert Table 5 about here.

Implications

One of the most important of Piaget's principles is that the child's cognitive development is a limiting factor to what

he or she can learn at any given time. Here learn means understand, not memorize. Students who are in concrete operations will find it impossible to perform tasks which require thinking about thought, holding more than two or three variables or circumstances in mind at one time, or explaining an event in terms of its causes, for example (Dale, 1975).

A great deal of what is taught in the middle grades, in particular, ignores the developmental limitations of the students. This study has shown that in a grade in which the mean IQ is 105, and many of the parents have Ph.D. degrees and are staff members of a small liberal arts college, the state agricultural research center, a two-year technical school, and a branch of a nearby university, from 35 to 58% of the eighth grade students, depending on how Piagetian stage is determined, are still in the concrete operational stage and should have school work which reflects that level of thinking. (See Figure 1.)

Insert Figure 1 about here.

The dysfunction between learner and activity can be remedied. By an analysis of the task, the teacher can plan activities that take into account students' cognitive levels and abilities. The researchers of our profession have shown that the teaching of grammar does not contribute to improvement in writing. This study has shown that the abstractness of grammar rules is too difficult for most eighth graders, when it is taught directly and in isolation. Weaver (1979) reminds us:

> Those who comprehend and use language well are those who have a good intuitive grasp of grammar. It would seem logical that poor readers and writers could be helped by a generous dose of grammar, so that they can do consciously what the better readers do unconsciously. However, this is generally not the case. . . .
>
> The message seems clear. Students do need to develop a good intuitive sense of grammar, but they can do this best through indirect rather than direct instruction. Instead of formally teaching them grammar, we need to give them plenty of structured and unstructured opportunities to deal with language directly. If we want them to improve their reading, they must read; if we want them to improve their writing, they must write. This does not mean, of course, that grammar is of no use whatsoever, or that grammatical terminology should be entirely avoided. Rather, it means that teachers need not teach grammar so much as use their own knowledge of grammar in helping students understand and use language more effectively.
>
> Language arts teachers and English teachers need, then, not only a knowledge of language structure (grammar), but an understanding of the language processes (listening, speaking, reading, and writing) (p. 5 ff.).

The ability to think and use language becomes more important than collecting and retaining facts. This emphasis on the process of learning is important at all levels, but it is especially crucial in the middle grades, when a child's cognitive development is in a transitional stage. The English profession, in 1966, at the Dartmouth Conference defined language as a process not a product. Early adolescents need activities which require language production, not studies about the rules of language, especially since they require levels of thinking not attained by many early adolescents.

Table 1

Summary of Difficulties Encountered by Students in the Pilot Study of the Grammar Task

n = 27 Characteristics \ Sentences	1	2	3	4	5	6	7	8	9
1. Subject is first noun or pronoun in the sentence.	x		x	x			x		x
2. Number of students correctly identifying subject.	* 27	5	* 24	10	10	10	17	8	* 25
3. Verb comes before the subject.		x		x		x			
4. Number of words preceding the subject.	1	6	1	4	8	9	1	8	2
5. Sentence is a transform.		x	0 x	x	x	x	0 x	x	
6. Prepositional phrase before the subject.		x			x	x		x	
7. Verb is one word.	x	x		x	x	x			x
8. Number of students correctly identifying verbs.	* 23	* 22	8	15	17	* 23	3	12	13
9. Verb parts separated.			x				x		x
10. Clause length.	6	10	6	10	17	14	10	14	16

Notes. * at least 75% of the students responded correctly.

0 x question transform. Numbers are actual numbers of student responding correctly.

Table 2

Eighth Grade Students

Means and Standard Deviations

of IQ, Age, Sex, and Achievement

	n	$\bar{X}$	SD	range	%
IQ	274	105.27	14.51	73 - 145	
Sex					
males	142				49.3
females	146				50.7
Age	282	13.8		12.3 - 16.0	
Stanford Achievement Test					
science %ile	283	56.25	28.59	1 - 99	
Stanford Achievement Test					
math %ile	282	55.00	28.97	1 - 99	
Stanford Achievement Test					
reading %ile	282	56.29	28.30	1 - 99	

Table 3

Summary Table of Models Tested to Answer Research Questions Relating to Validation of the IPDT, R^2 Values, F-Ratios, and Significance Levels for Testing Differences

Question	Models Tested	R^2_f	R^2_n	df	F	p	Sign.
1.	1 vs 99	.093	.00	1/243	26.12	0	Sign.
2.	2 vs 51	.279	.093	2/242	48.13	.000	Sign.
3.	7 vs 15	.003	.134	3/241	.866	.353	NS
4.	9 vs 2	.179	.124	3/241	52.83	0	Sign.
5.	11 vs 17	.276	.174	3/267	102.74	0	Sign.

Note.

Sign. = significant at probability level .05

NS = nonsignificant at probability level .05

Table 4

Summary of the Results of the Grammar Test

Piagetian Stage	n	Raw Scores		
		0 - 11	12 - 13	14 - 18
Concrete	94	85%	1%	14%
Transitional	133	74%	10%	16%
Formal	38	47%	3%	50%

Note. A raw score of 0 - 11 was failing, 12 - 13 was above-failing, but less than 75% or success.

Table 5

Summary of Students' IQ Levels

and Grammar Test Scores

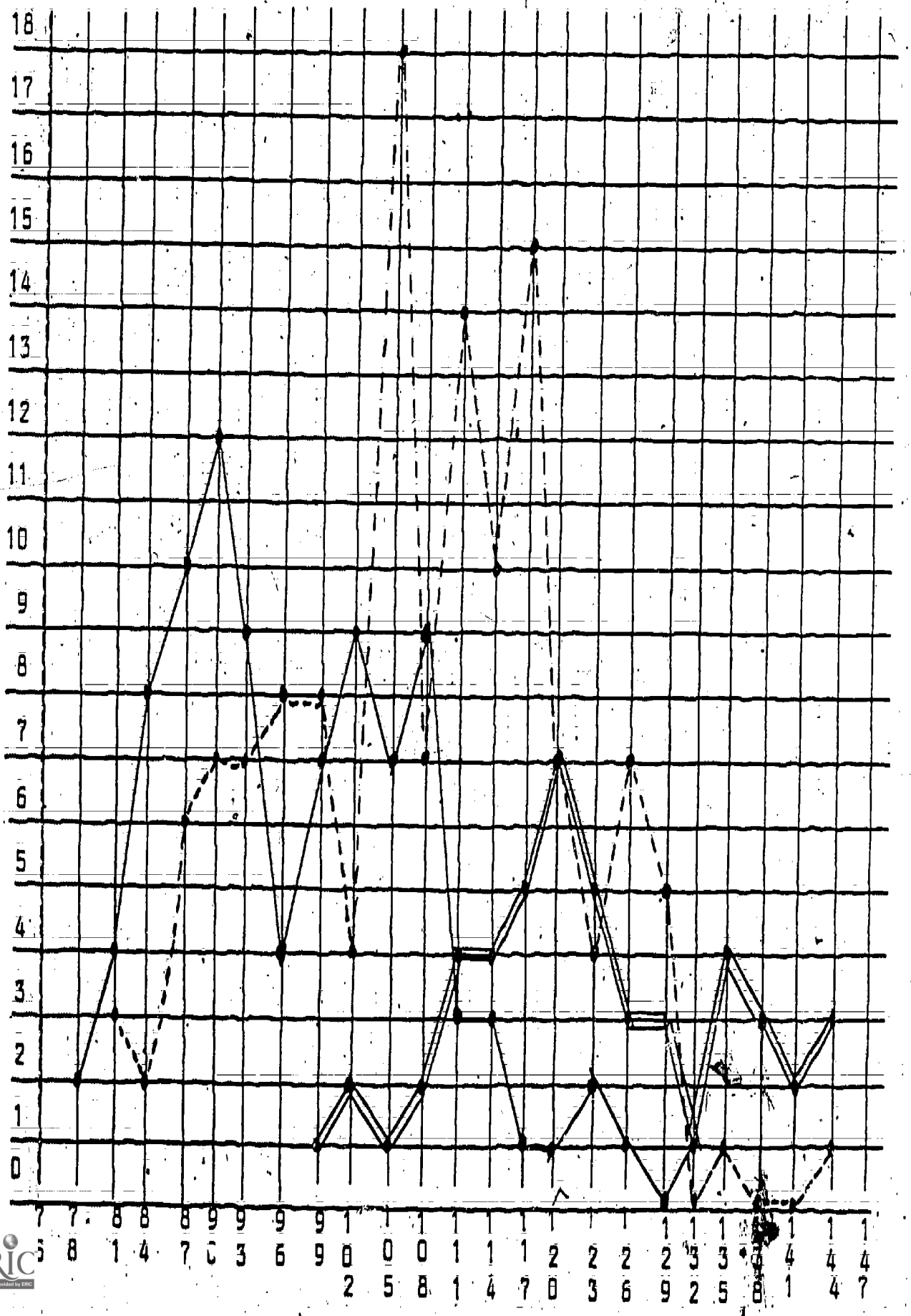
Grammar Test Score	IQ Range			% of Total
	Below 95	95 - 114	Above 114	
0	16	12	2	12.2
1	8	4	1	5.3
2	6	14	1	8.5
3	5	15	3	9.3
4	4	12	3	7.7
5	10	13	4	11.0
6	5	7	4	6.5
7	1	6	3	4.1
8	4	2	2	3.3
9	0	7	3	4.1
10	1	8	1	4.1
11	1	0	2	1.2
12	1	1	3	2.0
13	1	2	2	2.0
14	2	1	4	2.8
15	0	5	4	3.7
16	0	2	10	4.9
17	0	1	10	4.5
18	0	0	7	2.8

Note. A score of 0 - 11 was below 60% or failing.

A score of 12 - 13 was above failing, but less than 75% or success.

FREQUENCIES: IQ AND STAGES

Figure 1



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