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ABSTRACT

W. M. Gray's "How is Your Logic?" a Piagetian-based, group-administered written test of cognitive development, and B. Leadbeater's Livian Wars Task, a formal operations-based, written, social-cognition problem were given to 343 college undergraduate and graduate students to investigate the impact of chronological age and amount of formal education on the development of formal operations and social-cognitive relativistic reasoning. Gray's test included 13 items, five measuring three concrete operations and eight items measuring four formal operations. At a minimum, the Livian Wars Task required the use of various formal operations to successfully answer questions about a fictitious war between two neighboring countries. The task emphasized the relativity of thought necessary to adequately understand a complex social interaction (war) between two groups of people. The results indicated only weak evidence for changes in formal operations across ages and education, but social-cognition was affected by age and education. Social-cognition and formal operations were not related. (HOD)

Formal Operations and Social Relativistic Thinking

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Abstract

Gray's *How Is Your Logic?*, a Piagetian-based, group-administered written test of cognitive development and Leadbeater's Livian Wars Task, a formal operations-based, written, social-cognition problem were given to 348 college undergraduate and graduate students. There was only weak evidence for changes in formal operations across ages and education, but social-cognition was affected by age and education. Social-cognition and formal operations were not related.

Formal Operations and Social Relativistic Thinking

The major characteristic of formal operations is conception of possibilities where the possibilities do not have to be actualized. Accompanying the conception of possibilities are hypothetical-deductive reasoning, interpropositional thinking, and combinatorial (systematic) thinking which are used to solve complex abstract problems (Inhelder & Piaget, 1955/1958, pp. 251-266) as well as concrete, real-world problems. Traditionally, attempts at determining whether individuals demonstrate formal operations have used Inhelder's seemingly simple inductive physics problems (Inhelder & Piaget, 1955/1958, pp. 3-242) or some variation of the problems, physical or written (see Neimark, 1975, and Keating, 1980, for reviews). As such, the de facto assumption of this research tradition has been that formal operations are only appropriate for understanding possibilities associated with the physical world.

Piaget (Inhelder & Piaget, 1955/1958, pp. 334-350), however, believed that formal operations, like all of the other structures he hypothesized as defining different types of adaptational equilibriums with the world (i.e., the classic stages of cognitive development), also were appropriate for understanding the possibilities that can exist in the interpersonal or social world (Piaget, 1947/1966, pp. 156-166). In applying formal operations to the interpersonal or social world, Piaget (Inhelder & Piaget, 1955/1958, pp. 334-350) discussed the positive and negative effects of formal operations applied to the interpersonal or social world. However, with the publication of Elkind's (1967) discussion of adolescent egocentrism as a negative by-product of the emergence of formal operations, the emphasis shifted to the negative effects of formal operations applied to the interpersonal or social world. When data have been gathered on the

application of formal operations to the interpersonal or social world, the focus has tended to be on the negative aspects as manifested in formal operational egocentrism (e.g., Elkind & Bowen, 1979; Enright, Lapsley, & Shukla, 1979; Gray & Hudson, 1984). Aside from Elkind's discussion of the negative aspects of formal operations applied to the social world, part of the reason for formal operational research generally ignoring the social world has been the difficulty in creating abstract social problems that require conception of possibilities, hypothetical-deductive thinking, interpropositional thinking, and/or combinatorial thinking for a correct solution. Leadbeater's Livia Wars Task (Kuhn, Pennington, & Leadbeater, 1983; Leadbeater, Kuhn, & Meinke, 1982) is in opposition to this tradition of emphasizing the negative aspects of formal operations applied to the interpersonal or social world. At a *minimum,* the Livia Wars Task requires the use of various formal operations to successfully answer questions about a fictitious war between two neighboring countries and it appears to be a reasonable approach to measuring the positive aspects of formal operations in the social-cognitive realm. The task emphasizes the relativity of thought necessary to adequately understand a complex social interaction (war) between two groups of people. As such, it appears to require a social-cognition version of conceiving of abstract possibilities.

The present study focused on empirically describing the relationship between the use of formal operations with physical world content and the use of formal operations with social world content. As such, three questions were investigated: (a) What are the changes in operational thought and social-cognitive thought from young adulthood to "middle age"? (b) What are the changes in operational thought and social-cognitive thought from college freshmen to doctoral students? (c) What are the relationships between operational thought and social-cognitive

thought?

Method

Subjects

The total sample included 391 undergraduates and graduates who were involved in a study of operational thought, social reasoning, and sociomoral reasoning at the concrete, formal, and postformal levels. Subjects were freshmen through ABD doctoral students and included ages18-67 (M = 25.876, SD = 7.804) with approximately 75% of the undergraduates being education majors. Three hundred seventy-six subjects completed all or part of the social reasoning measure. The present study reports data on 348 subjects (111 males, 237 females) who answered all of the questions on the social reasoning task and the operational thought measure. Table 1 presents a description of the 348 subjects. The age classification was based on retaining as many different age levels as possible, but not having relatively small numbers per age level. Education level was determined by subjects' grade at the time of testing. UWD represents Undergraduate With Degree, and are individuals with a bachelor's degree in a specific content area who have returned to college as an undergraduate to prepare to become a teacher. Most of the UWD students tend to be in their late 20's+ and have worked in businesses or have raised a family after obtaining their original bachelor's degree.

Insert Table 1 about here

Procedure

Subjects were first given Form A of *How Is Your Logic?* (Gray, 1976), a Piagetian-based, group-administered, written test of cognitive development which

requires 30-60 minutes to answer all the questions. Immediately after completing *How Is Your Logic?*, subjects were given the Livian Wars Task (Leadbeater, et al., 1982), a test of social-cognitive development which requires less than thirty minutes to answer all the questions.

Instruments

How Is Your Logic? This test includes thirteen items, five items measuring three concrete operations (Multiplication of Classes, Addition of Asymmetrical Relations, Multiplication of Relations) and eight items measuring four formal operations (Make a Correct Inclusion, Make Correct Exclusions/Deny Incorrect Inclusions, Combinatorial Thought, Probability/Proportional Reasoning). All items are constructed response items. Because almost all subjects correctly answered the concrete operational items, and the formal operational probability/proportional reasoning items were extremely difficult, these items were excluded from further analyses, leaving six items measuring three formal operations (Make a Correct Inclusion, Make Correct Exclusions/Deny Incorrect Inclusions, Combinatorial Thought). The operations of Make a Correct Inclusion and Make Correct Exclusions/Deny Incorrect Inclusions included a judgment item immediately followed by a justification/explanation item measuring the same operation. This process of only using the Make a Correct Inclusion, Make Correct Exclusions/Deny Incorrect Inclusions, and the Combinatorial Thought items has been successfully used in previous studies (Gray & Hudson, 1984; Hudson & Gray, in press).

Scores on each of the six items can range from 1-7 or 1-8 (no attempt, preoperations, preoperations-concrete operations I, concrete operations I, concrete operations II, concrete operations II-formal operations I, formal operations I, formal operations II), depending on the level of formal operations the

item was designed to measure. Scoring criteria for each item are based on information in original Piagetian sources (see Gray, 1981, for a more complete description) and the maximum total score across the six items is 45. Interrater reliability for each item was measured by percent agreement on thirty-three randomly selected subjects. The item-based agreements between the first author and a second rater not affiliated with the study, but a person who has scored 500+ *How Is Your Logic?* tests, ranged from 91% to 100% with only two items having an agreement rate less than 100% (i.e., 91% & 94%). The coefficient *alpha* estimate of internal consistency was .76.

Livia Wars Task. This task involves reading two accounts of a fictitious historical event--The Fifth Livian War--where one account is written by the national historian of North Livia and the other account is written by the national historian of South Livia. In the original research (Kuhn, et al, 1983; Leadbeater, et al, 1982), the two accounts were individually read to subjects, who also silently read a copy of the accounts which was in front of them. After the accounts were read, subjects were asked to describe the Fifth Livian War in their own words. When they completed their description, they were then asked five questions about the war For the present study, the accounts and the questions were identical to those used by Kuhn, at al (1983) and Leadbeater, at al (1982) except that the questions, including describing the war in one's own words, were on separate sheets of paper immediately following the historians' accounts of the war, and each response was written on the same sheet of paper as its respective question.

Scoring of the responses is conducted from a number of perspectives. First, subjects' responses are classified as either a simple statement or a metastatement.

"A metastatement is a statement about one or both of the accounts; a simple

statement is a statement about the events described in the accounts.... Unlike the simple statement, the metastatement implies the speaker's recognition that there exists a varying position or point of view or at least that the truth status of the simple statement is not definitive. Metastatements may also be more complex statements describing differences between the two accounts or making statements regarding these differences" (Kuhn, et al, 1983, p. 178).

Second, based on the quality and quantity of their metastatements, subjects' responses to each of five specific questions about the Fifth Livian War are classified into one of five global levels. Level 0 is characterized by the lack of any metastatements and a distortion of the questions about the accounts of the war into questions about the actual events described in the accounts. In essence, an account of an event is considered synonymous with the event itself.

Level 1 is characterized by infrequent metastatements. The event is distinguished from an account of the event, but the two accounts are not perceived as being different from each other.

Level 2 responses are labeled as Realist responses. There is a beginning realization that the two accounts are, at least, partially different. However, the emphasis is on the facts, and only the facts. Each account is seen as emphasizing a different set of facts. In order to reconcile the two accounts an unbiased third party observer has to supply additional facts, or the two accounts are unreconcilable. At this level, there is a tendency not to judge one account as being better than the other.

Level 3 is labeled the Perspectivist as there is the realization that "two distinct realms of discourse are recognized, one of (subjective) perspective and the other of (objective) fact, with the former subordinated to the latter" (Kuhn, et al, 1983, p. 179). There is a belief that there is an underlying factual reality to

the war, and, thus, the two accounts are reconcilable.

The final level (4), the level of the Relativist, is one at which objective facts are subordinated to and considered only in relation to a subjective perspective, or frame of reference. Because each account is the result of a unique perspective it is not possible to reconcile the two accounts. Interrater reliability was obtained by percent agreement between the second author and a trained scorer for a subset of tests. Percent agreement for identical levels was 66% with differences resolved by discussion.

Results

Age Changes

Changes in operational thought and social-cognitive thought across ages were assessed by three 2 X 11 (Sex X Age) ANOVAs, two focusing on general operational thought, and one focusing on social-cognitive thought. Two measures of operational thought were generated from scores on *How Is Your Logic?* The first measure was created by adding subjects' scores on the six formal operational items producing a Formal score. The ANOVAs for this score were not significant for sex or age and the overall mean score (32.91) was almost identical to Gray and Hudson's (1984) 10/11 grade subjects. Figure 1 presents the mean Formal scores for both sexes by age.

A second measure of operational thought was generated from each subject's pattern of answers to the six formal operational items. Instead of producing a simple additive score as with Formal, scores on the second variable involved characterizing the pattern of responses into one of four stages. The decision-theoretic approach to creating this Stage variable has been successfully used in previous studies (Gray & Hudson, 1984; Hudson & Gray, in press) and is

relatively straightforward to program, but lengthy to describe in writing.[1] Subjects' response patterns were classified as Formal II, Formal I, Concrete-Formal I, or Concrete. A 2 X 11 (Sex X Age) ANOVA for the Stage variable was not significant for age but it was significant for sex, $F(1, 326) = 4.863$, $p = .028$, with males ($M = 6.79$) being higher than females ($M = 6.52$). This sex difference is in contrast to no sex difference reported by Gray and Hudson (1984) for junior high and senior high students on the same variable. Figure 2 presents the means on the Stage variable for both sexes by age.

For the Livia Task, the rounded average of the global level scores for the last two specific questions (4 & 5) about the war was subjected to a 2 X 11 (Sex X Age) ANOVA. This approach to producing an "objectively-based" overall global score on the Livia Task was used because Kuhn, et al (1983) indicated that the last two questions (4 & 5) seemed to produce the greatest number of metastatements as a function of the nature of the questions which focused subjects on the possibility of making metastatements if the subjects could make such statements. There was no siginificant sex effect, but there was a significant age effect, $F(10, 326) = 2.348$, $p = .011$. After collapsing the sex dimension, a one-way ANOVA produced a slightly stronger age effect, $F(10,337) = 2.359$, $p = .011$. A post hoc analysis ($p = .05$) using Least Significant Differences revealed that 18-22 year olds scored significantly lower than all other groups of students, and 20 year olds scored significantly lower than 37-40 year olds and 31-33 year olds. Two aspects of these significant differences among the different age groups are interesting. First, the four youngest ages had the lowest scores, suggesting that a certain amount of experience is necessary before being able to use the more sophisticated levels of social relativistic thinking. Second, although the means of the higher scoring age groups (25-27, 23-24, 28-30, 34-36, 37-40, 41+, 31-33) were not

significantly different from each other, they did not increase with age. For example, the group receiving the highest mean score was the 31-33 year olds, not the 41+ yea olds. Figure 3 presents the mean Livia scores for both sexes by age.

Insert Figures 1, 2, and 3 about here

Education Changes

As presented in Table 1, there were seven levels of college education represented in the sample. Although sex differences were investigated in conjunction with the analysis of age effects, the sex dimension was retained in the analysis of education level in the chance there may have been a Sex X Education interaction. A 2 X 7 (Sex X Education) ANOVA revealed no significant difference for either dimension on the Formal variable. Figure 4 presents the mean Formal scores for both sexes by education level.

For the Stage variable, there was a significant sex difference, $F(1, 334) = 3.898$, $p = .049$, but it was not as strong as when paired with age. The effect for educational level was similar, $F(6, 334) = 2.211$, $p = .042$. However, after collapsing the sex dimension, a one-way ANOVA across education level resulted in a moderate increase in effect of education level, $F(6,341) = 2.507$, $p = .022$. This effect was produced by the doctoral students mean score being significantly higher than the other students (Least Significant Difference post hoc analysis, $p = .05$). Figure 5 presents the mean Stage scores for both sexes by education level.

The Sex X Education Level ANOVA for the Livia Task score revealed no sex effect, but there was a strong effect for educational level, $F(6,334) = 3.115$, $p = .006$. Collapsing the sex dimension and conducting a one-way ANOVA across

education level produced no appreciable difference, $F(6,334) = 3.137$, $p = .00$. A Least Significant Difference post hoc analysis ($p = .05$) indicated that freshmen had a significantly lower mean score than any other education level and sophomores had a significantly lower mean score than master's students. Figure 6 presents the mean Livia scores for both sexes by education level.

Insert Figures 4, 5, and 6 about here

Operational Thought and Social-Cognition

Table 2 is the joint frequency distribution of the global Formal score on the Livia Task and the Stage variable measure of operational thought. There was no significant relationship between the two variables. The majority of subjects (75.9%) were considered Realists or Perspectivists, exactly what is expected of individuals whose mean Formal score (32.91) and mean Stage score (6.61) are indicative of subjects in transition between concrete operations and formal operations. In addition, 86.3% of subjects classified as Perspectivist or Relativist were classified as in transition to formal operations or already in formal operations. Compared to the percentages for the 0 (12.9%), 1 (9.7%), Realist (19.4), Perspectivist (35.4%), and Relativist (22.6%) global levels derived from Kuhn, et al (1983) middle-aged adults, our percentages for the 1, Perspectivist, and Relativist levels were similar at 6.3%, 37.4%, and 17.2%, respectively.

Insert Table 2 about here

Discussion

The first two purposes of the study were to investigate the impact of chronological age and amount of formal education on the development of formal operations and social-cognitive relativistic reasoning across the early and "middle" adult years. By considering the impact of age separately from the impact of educational level, which is virtually impossible to do for development prior to 18-19 years of age, it was thought possible to determine the impact of each on the development of formal operations beyond early and middle adolescence. The lack of any significant difference among the various age classifications on either the additive Formal variable or the more qualitatively-based Stage variable is surprising given Keating's (1980) statement that almost every study using problems based on Inhelder's tasks (Inhelder & Piaget, 1955/1958) have showed a significant age effect. But, the majority of studies cited by Keating included adolescents and did not include adults, or adults were a small percentage of the samples. In those studies where adults have been used (e.g., Capon & Kuhn, 1979; Sinnott, 1975), their performance has not been substantially better than performances by adolescents. Our results support this finding of a leveling of formal operational development during the early to middle adult years. In addition, the overall percentage of subjects classified as Formal I (28.7%) or Formal II (23%) is not incongruent with the general finding that 40-60% of tested subjects display formal operations when faced with problems that require formal operations for successful completion.

Assuming that the subjects put forth their best effort in answering the formal items on *How Is Your Logic?*,[2] and, thus, the lack of age trends across both variables are relatively accurate representations of the everyday application of

formal operations to problems (everyday or academic) people encounter in the world, then, with collapsing the sex variable, the essentially flat curves for the Formal variable (Figure 1) and the Stage variable (Figure 2) provide support for the view that formal operations are not necessarily better than concrete operations in adapting to the existing world (Blasi & Hoeffel, 1974). The results with a quantitatively-based variable (Formal) and qualitatively-based varable (Stage) suggest that from late adolescence-young adulthood through middle adulthood growing older does not guarantee the enhancement of formal operations.

With regard to the effect of education, the lack of a significant effect with the quantitative variable (Formal) suggests that education does not have an impact on the demonstration of formal operations, but the weak effect with the qualitative variable (Stage) suggests a different conclusion: Education does have an effect, but it is probably indirect and weak, at best. This "split decision" between a quantitative variable and a qualitative variable reinforces Neimark's (1975,1982) discussions and caveats regarding the importance of selecting appropriate tasks, variables, and level of analyses when attempting to assess formal operatons.

The significant differences on the Livia task for both age and education are different than Kuhn, et al's (1983) report of no effect for education, but they did report "a trend toward higher levels with increasing education" (p. 181). Our lack of a sex effect is congruent with Kuhn, at al's (1983) results. Our significant differences on the Livia Task for age and education suggest that social relativistic thinking is influenced by both social influences associated with growing older and obtaining more education. With respect to age, such influences probably come from social interactions associated with everyday living: For example, experiencing/listening/reading/etc different views about events for which there is more than one viewpoint and then having to decide which view, if any, is most

appropriate or correct. Intuitively, as these social problems become more complex it is reasonable to assume that the thinking/reasoning necessary to solve the problems also becomes more complex. Thus, the necessity for the development of more sophisticated social reasoning. This is in agreement with Piaget's (1974/1980, 1975/1985; Gallagher & Reid, 1981) ideas that the development of thought is inextricable intertwined with the relations between the demands of an environment on existing structures and the demands of the existing structures on an environment.

Educationally, the impact is similar to that provided from everyday living except that the environmental source of stimulation to which one must adapt is not just the social interactions associated with everyday living but also includes the environmental demands that come from interactions which are part of the social-intellectual challenges associated with increasing college education. These challenges are basically intellectual, but they involve justifying/explaining/etc one's views about academic content to peers and/or faculty. As one moves through the educational levels and the intellectual demands become more challenging and complex, intuitively, it is reasonable to assume that the thinking/reasoning necessary to solve the problems also becomes more complex.

The relationship between operational thought and social-cognition was the focus of the third question. The lack of a statistically significant relationship between operational thought and social-cognition is difficult to interpret. Obviously, one possible interpretation is that there is no relationship between operational thought and social-cognition as measured by the respective instruments. Another more plausible interpretation is that the analyses of operational thought and social-cognition in adults must focus on the specific

operations addressed by the various measures and not use general scores. An approach analogous to that used by Demetriou and Efklides (1985) in their analysis of various components of formal operations is a possibility. Such an analysis has the advantage of not masking important differences in response patterns that often are lost when creating and quantitatively-based variables such as Formal and the Livia Task score. If this more differentiated approach is productive, then Neimark's (1975,1982) warnings are even more appropriate.

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Table 1

Sample Demographics

Age	*n*	%	Education Level	*n*	%
18-19	52	14.9	Freshman	77	22.1
20	67	19.3	Sophomore	79	22.7
21	39	11.2	Junior	60	17.2
22	25	7.2	Senior	33	9.5
23-24	24	6.9	UWD	21	6.0
25-27	26	7.5	Master's	64	18.4
28-30	24	6.9	Doctoral	14	4.0
31-33	27	7.8			
34-36	24	6.9			
37-40	24	6.9			
41+	16	4.6			

Note. UWD = Undergraduate With Degree.

Table 2

Relation Between Performance on How Is Your Logic? and Livia Wars Task

	Social-Cognitive Level[a]					
Stage	0	1	Realist	Perspectivist	Relativist	Total
Concrete	1	8	16	18	8	51
Concrete-Formal	1	5	51	45	14	116
Formal I	0	4	36	36	24	100
Formal II	0	5	31	31	14	81
Total	2	22	134	130	60	348

[a]Kuhn, et al (1983) and Leadbeater, et al (1982) only provide a numeral for the first two levels and do not provide any descriptive title for those two levels.

Footnote

[1] A copy of the SPSS-X code necessary to produce the Stage variable is available from the first author by request.

[2] Observation of 80+% of the subjects during the testing, and the congruence of their response patterns with those of subjects who have been administered the test individually, where it is much more difficult to not put forth one's best effort, clearly suggest that the subjects considered the research important and, consequently, they put forth their best effort.

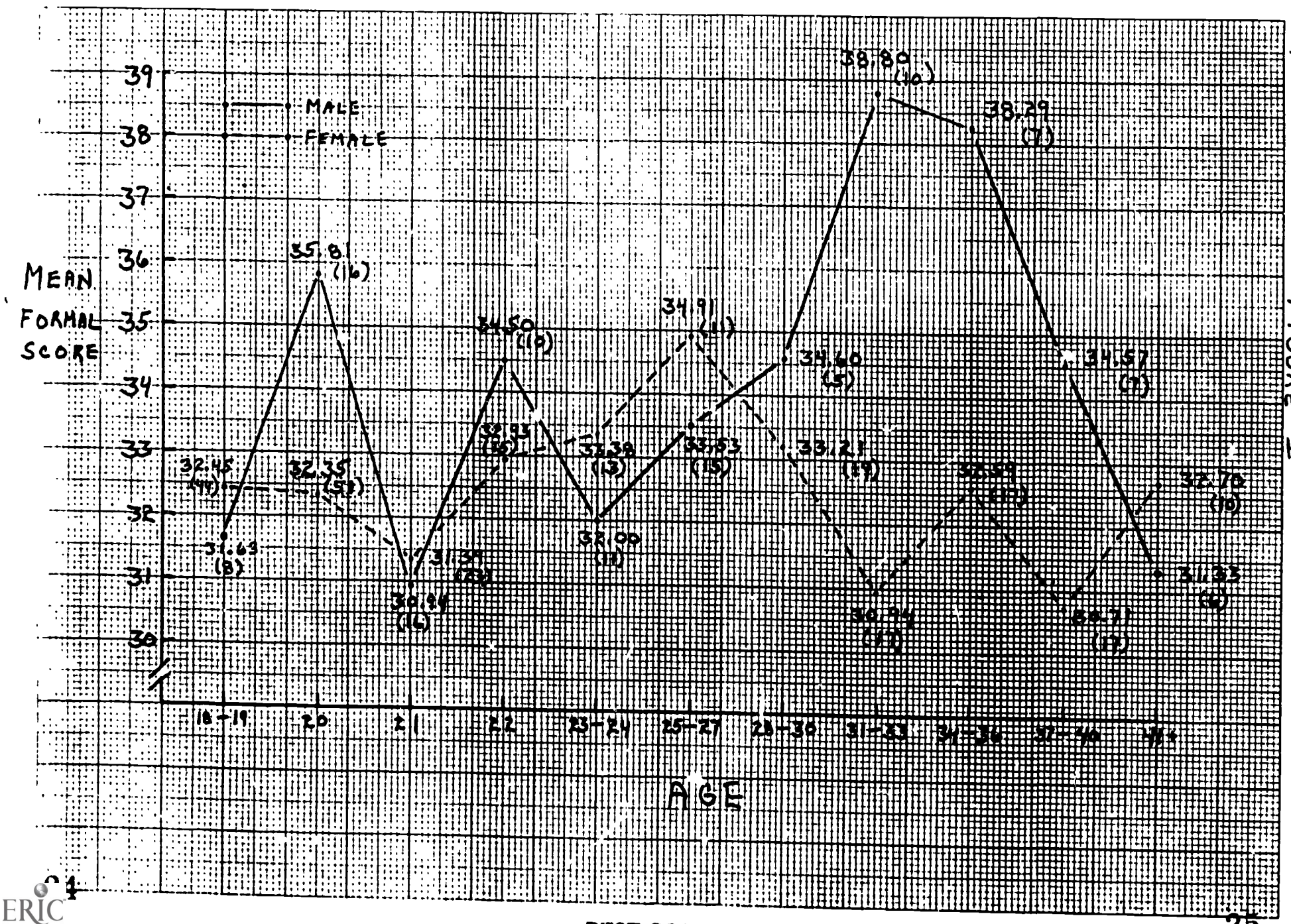


FIGURE 1

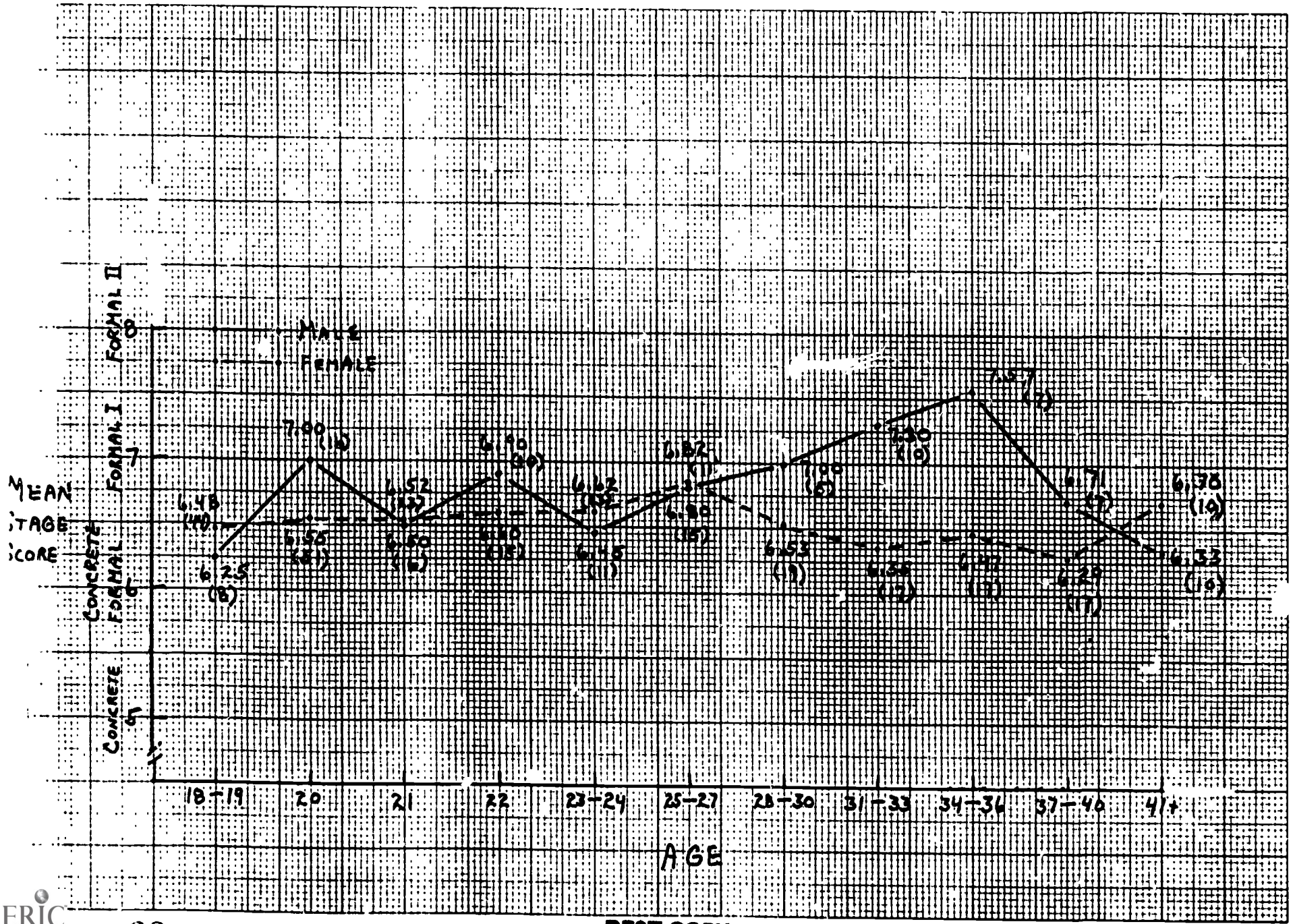
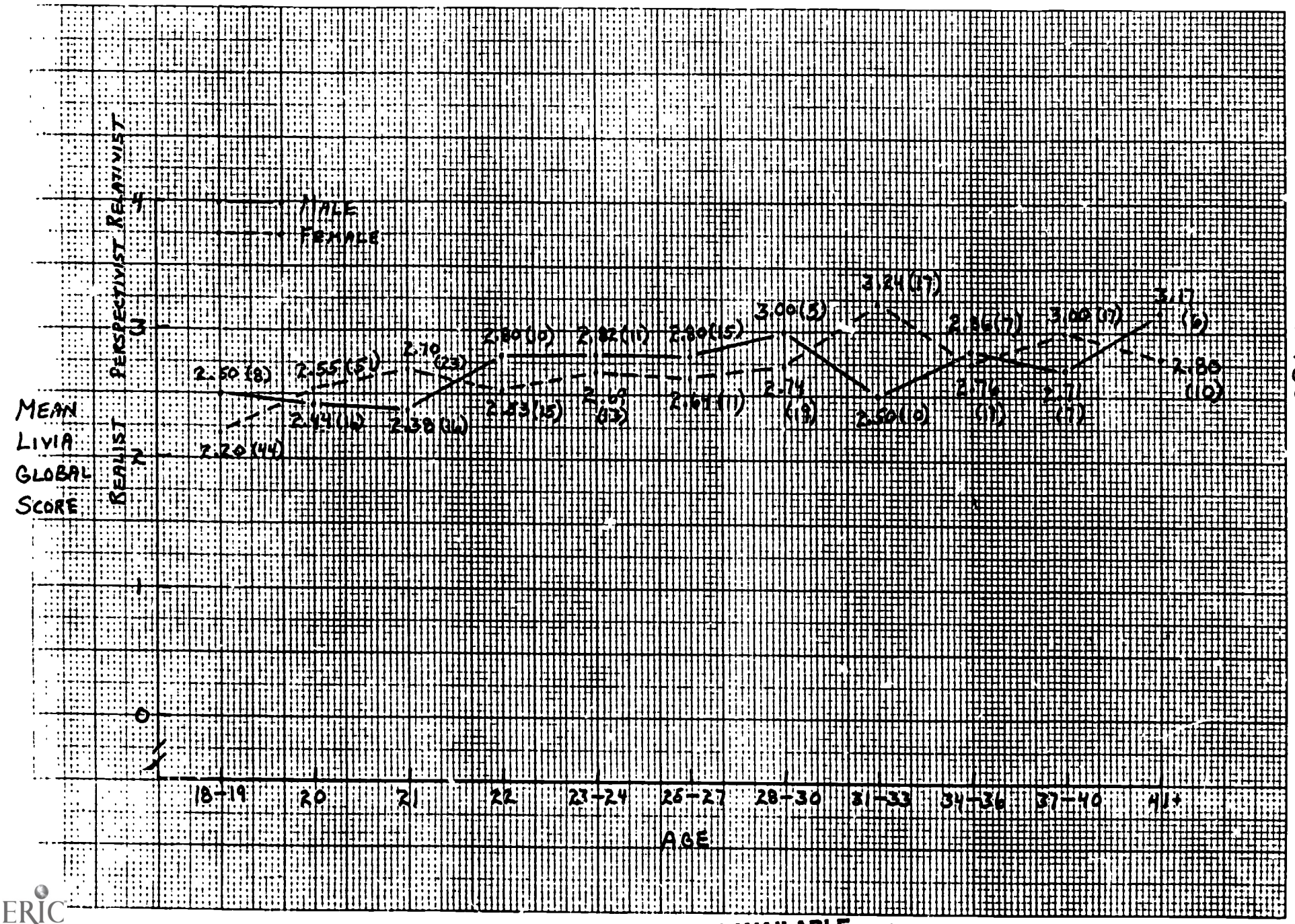


FIGURE 2



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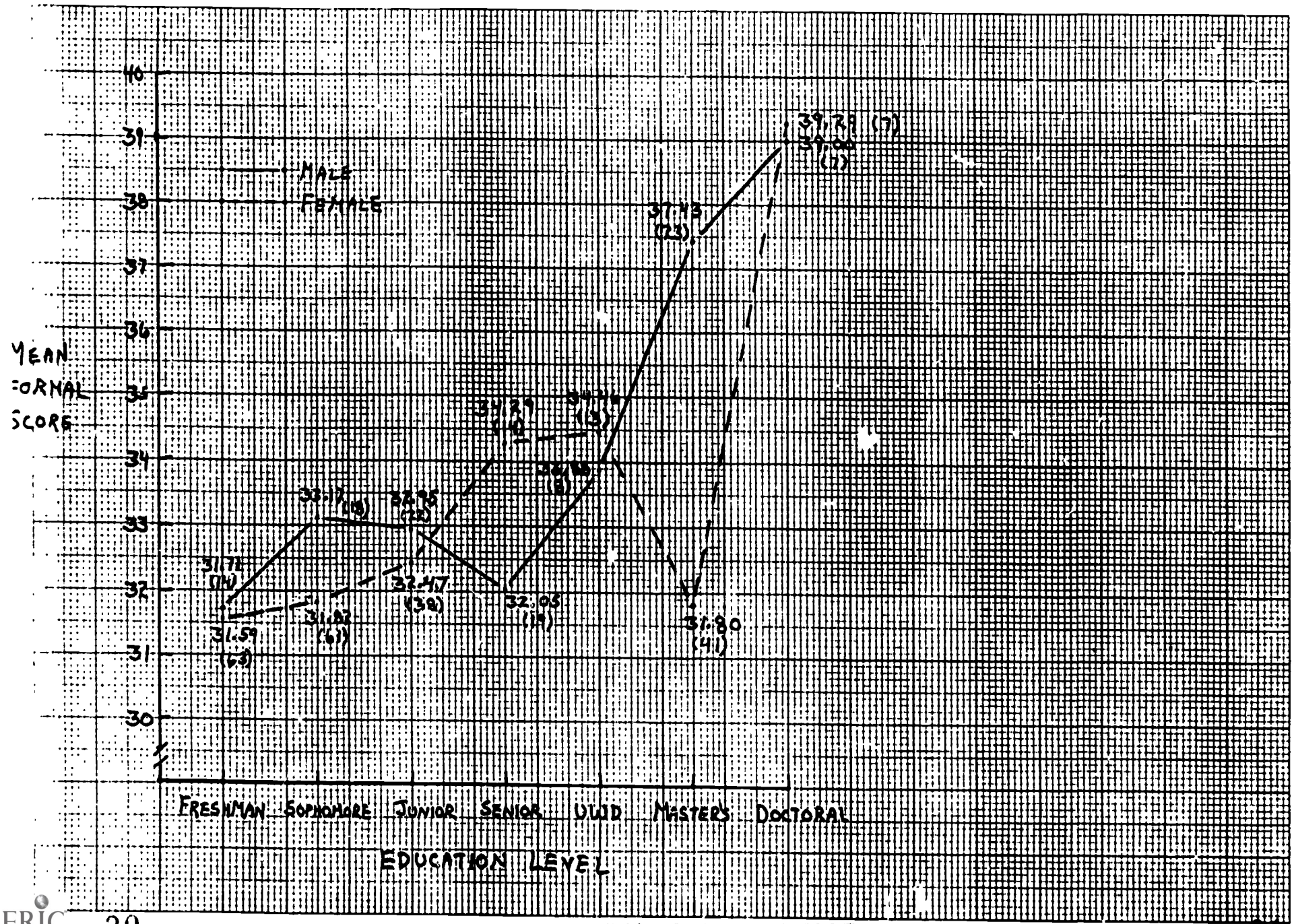

FIGURE 4

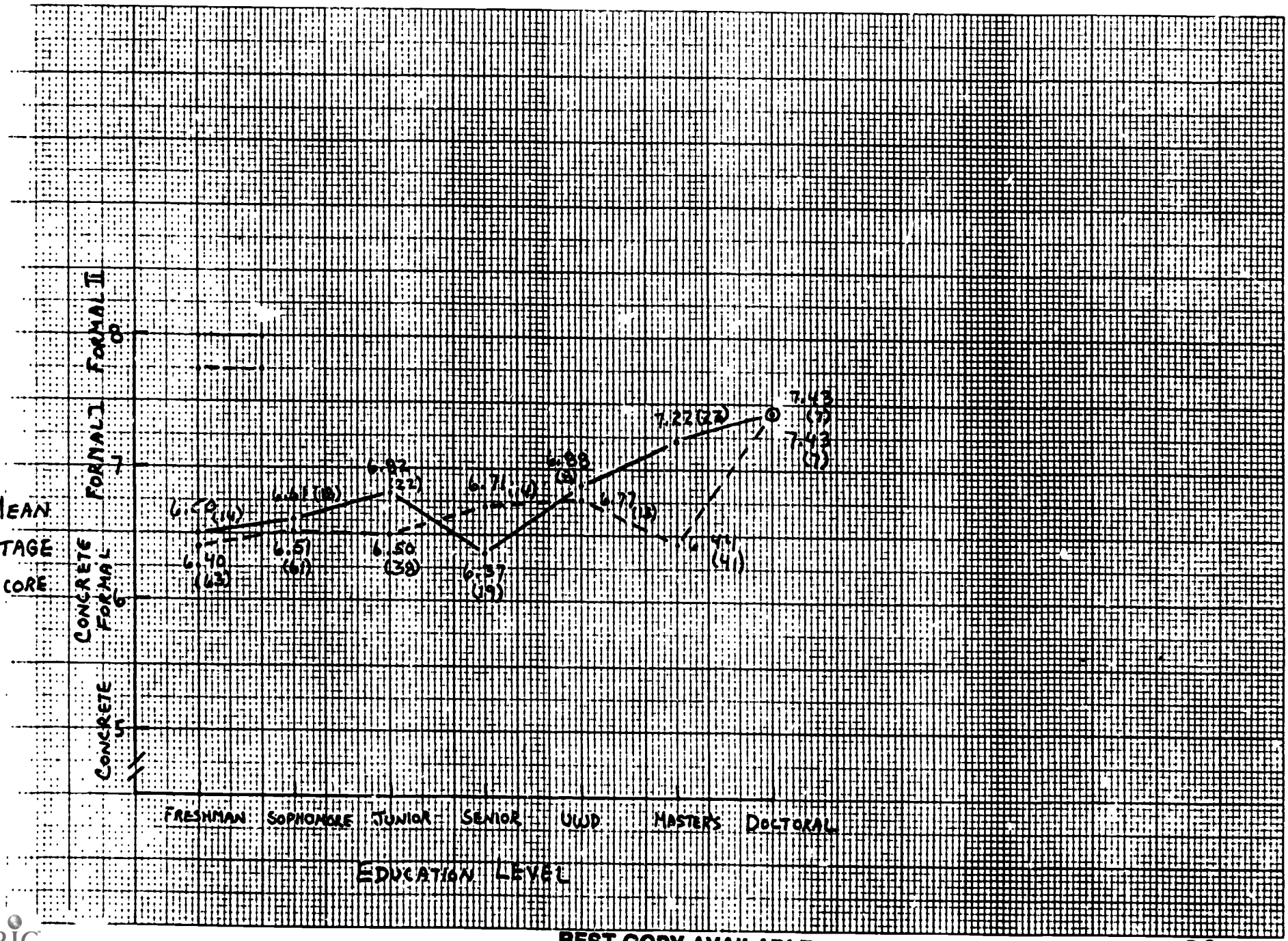

FIGURE 5

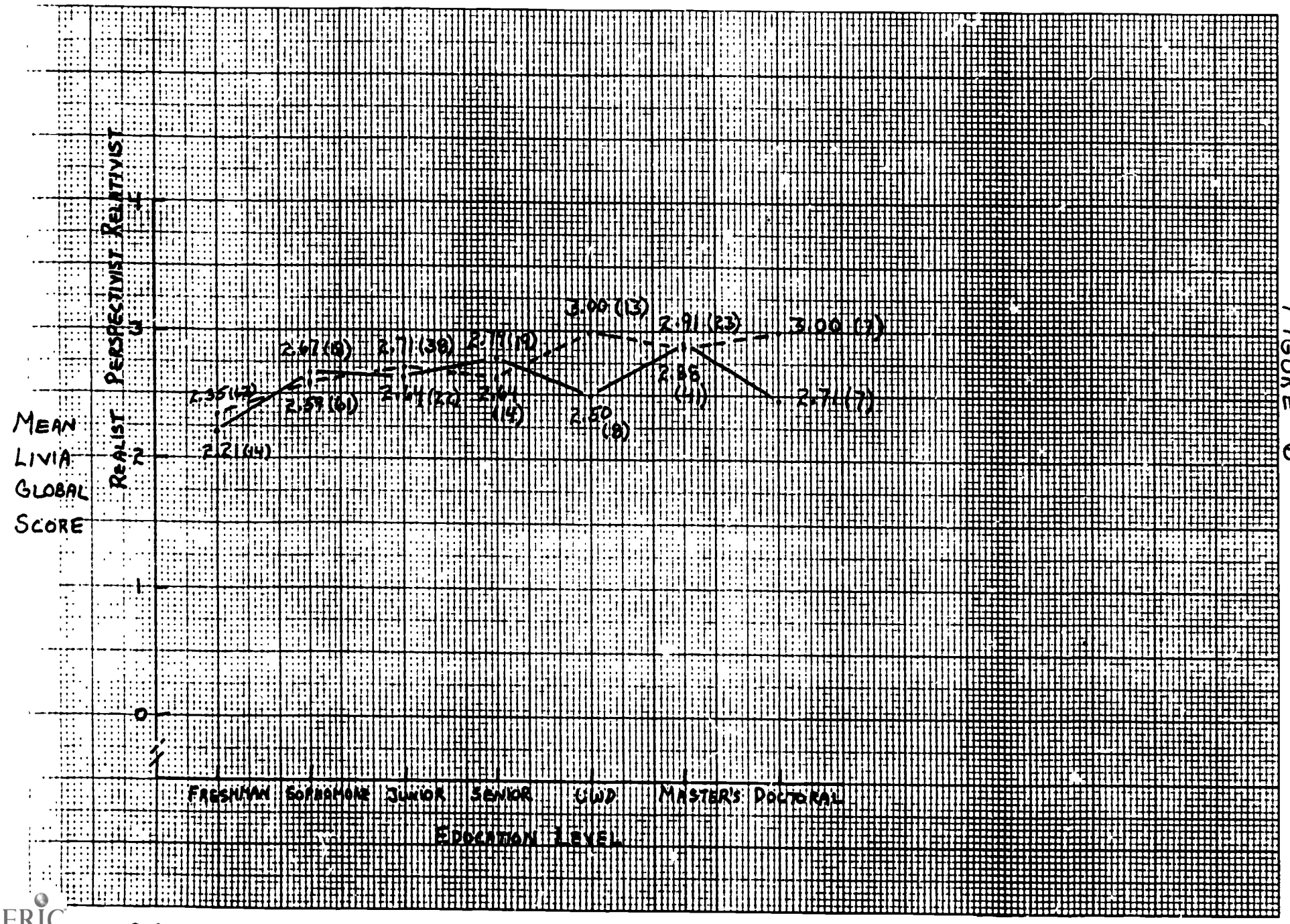

FIGURE 6