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ABSTRACT

The objective of this study was to compare an information processing based measure of television program form to a measure of form based on the perception of the organization of program production elements. Three hypotheses were set up to test the presumption that the two program measures are related to the same underlying dimension: show scores for entropy and structure were expected to be correlated, viewing and liking of both measures of program form was expected to be non-random in the same way, and differences in viewing and liking patterns were expected to be similar. The DYNUFAM scores for program form entropy and the Structure measures of program organization were found to be correlated at a statistically significant level, and it appears that two measures of program form are tapping the same underlying dimensions. One hypothesis failed to receive support: although liking of both measures of program form was expected to be non-random so that programs were tightly clustered, the data indicate that the opposite is true. (RB)

PROGRAM ENTROPY AND STRUCTURE: TWO FACTORS IN TELEVISION VIEWERSHIP

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PROGRAM ENTROPY AND STRUCTURE: TWO FACTORS IN TELEVISION VIEWERSHIP

A measure of television program complexity conceptualized in terms of Information Theory has been developed. The measure, called DYNUFAM in its present form, has been compared to other program variables for their relative efficacy in predicting viewer selectivity (Watt and Krull, 1974) and attention levels (Wackman and Ward, 1973; Wartella and Ettema, 1973). It has also been used to examine the effects of watching television on aggressive behavior (Krull and Watt, 1973).

While the measure of entropy was based on human information processing concepts, program form is more often discussed in terms of the organization and timing of program elements. A measure of program form in isolation of content, called "structure," has been developed by Lichty and others (Lichty and Ripley, 1970; Lichty, Banks and Kois, 1973). This measure may be tapping the same underlying viewer information handling processes as the Information Theory measure.

It is our intention to examine the relationships between these two conceptualizations. Since program form may be a predictor of viewing, the relationships will be examined in light of actual viewer preference for, and viewing of, programs. To test this presumption, three general conditions need to be observed:

1. Program scores for form entropy and structure should be similar.
2. On an individual basis, viewing patterns should be non-random on both form measures (indicating that form affects the choice of program), and non-random in the same way.
3. Tests of hypotheses about differences in viewing patterns between viewers should produce similar results if the differential viewership is attributed to human information processing variables.

THE PROGRAM FORM MEASURES

The Entropy Variables

The DYNUFAM indicators are based on Shannon's conceptualization of entropy in terms of the probability of the appearance of message digits (Shannon and Weaver, 1949). This way of looking at "information" does not involve the meaning or content of communication, but rather its form. The DYNUFAM indicators attempt to measure dimensions of the form of television programming. The indicators are relatively concrete, and were designed to be tied closely to television production techniques. Their definitions are as follows:

Set Time Entropy is defined as the degree of randomness of the time of visual duration of discrete physical locations in a program.

Set Incidence Entropy is defined as the degree of randomness of the appearance of discrete physical locations in a program.

Verbal Time Entropy is defined as the degree of randomness of the time of audible behavior on the part of characters in a program.

Verbal Incidence Entropy is defined as the degree of randomness of the performance of audible behavior on the part of characters in a program.

Set Constraint Entropy is defined as the degree of randomness of the constraints of the discrete physical locations in a program.

Non-Verbal Dependence Entropy is defined as the degree of randomness of the time of non-verbalization by the characters in a program.

A factor analysis reduced the variables to two factors which we call Dynamics and Unfamiliarity. The former factor is made up mainly of indicators of auditory and visual activity, while the latter is highly dependent on the dominance of certain characters and sets in the program, and hence, the viewers' familiarity with them. Hypothesis testing will be done using the composite two-dimensional measure called DYNUFAM.

The Structure Variables

Structure is not conceptualized here as the absence of entropy in Information Theory terms. Instead, structure is seen as an aspect of the organization of a program which may include entropic qualities. The basic structural elements are conceptualized at a high level of abstraction, but they do seem to be based primarily on program form.

A full description of these variables is available elsewhere (Lichty and Ripley, 1970), so their explication will be kept to a minimum here. In addition, the relationship between the structure variables and their entropy reformulations has been fully developed (Krull, 1973), but is of such length that its inclusion would be prohibitive. However, we will provide theoretical definitions for the structure indicators based on the operational definitions used by Lichty, et al., (1973). These definitions are as follows:

Unity is defined as the degree of correspondence of the dominant structural sub-elements among program units.

Variety is defined as the amount of change of the sub-dominant, structural sub-elements among program units.

Pace is defined as the average length of units in a series.

Unit-to-Unit Transition is defined as the average degree of correspondence of structural sub-elements between adjacent program units in a series.

Building is defined as the perceived slope of increase in tension due to program form.

Climax is defined as the perceived amount of difference between the least and greatest degrees of tension due to program form.

These definitions become considerably less abstract when they are read in terms of one lower-order term, the unit:

> A unit is a short segment of a broadcast program in which some one type of material is presented, in which one idea dominates the action, in which the location remains the same, or in which the characters remain the same. The material or idea in one unit is different, no matter how slightly, from that which immediately precedes and that which immediately follows. (Lichty and Ripley, 1970)

The structural sub-elements referred to in many of the definitions are the "type of material presented," the location's remaining the same, etc. While these variables still do seem to be more abstract and viewer oriented than the DYNUFAM indicators, there also seems to be sufficient similarity for us to suspect that they are tapping the same underlying dimensions of program form.

The indicators of structure were factor analyzed in the same way as were the indicators of entropy. The data for 47 prime time series yielded two factors which we have not attempted to name. The composite measure of program structure provided by the factor analysis will be called "Structure" in this paper, and tests of hypotheses will be in terms of this measure of the two individual factors.

Correlations Among Program Measures

The first condition to be met, correlation between the entropy and structure scores for shows, is a necessary condition if the program entropy and structure measures do tap the same underlying dimension of program form. The hypothesis is as follows:

H1. Theoretical level: The greater the show entropy, the greater the show structure.

VIEWING PATTERNS

The second condition to be satisfied is that of similar non-random clustering of program selection for entropy and structure. To test this condition it is necessary to get a measure of viewing behavior which may be conceptualized in a number of rather different ways. The label "viewing" has been used to refer to objects of analysis as diverse as the choice of medium and the attention paid to segments of programs. We used two measures of viewing: habitually tuning in programs for watching (reduced to "viewing" in this paper), and preference for programs ("liking").

There is some evidence that program selection (viewing) and program liking are related. Snare, Bednall, and Sullivan (1972) offer the following rationale:

> Most attitude theories suggest that people tend to seek consistency between their attitudes and behavior. It may reasonably be expected that this applies in the particular case of television viewing, so that a consistency between watching and liking programs may be predicted; thus it is expected that people like the programs they watch.

To test our hypotheses it was necessary to assume that our respondents had established a stable pattern of viewing and liking. However, some degree of association between watching and liking does not necessarily mean that the two overlap exactly. As Snare, et al., point out:

> The various situational constraints, however, undoubtedly operate to reduce such association. Insufficient viewing time, competition from other liked programs and deference to others' viewing choices will limit the watching of liked programs.

The last of these, "deference to others' viewing choices," is the main reason for operationalizing liking. Liking is expected to be more specific than viewing (clustering of show selection should be tighter), and the relationship between viewer characteristics and viewing behavior is also likely to be stronger for liking than for viewing.

Two different kinds of indices were constructed using the viewing and liking dimensions. One of these kinds, consisting of the Viewing Vector Dispersion and the Liking Vector Dispersion, measures viewers' clustering of program preference on each of the form measures. The other kind consists of indices weighted on each of the form measures by the amount of viewing or liking of programs. These weighted indices will be used to tap viewing of different levels of entropy and structure.

The Vector Dispersions

The linear vector dispersions are simply the distance between all data points on a set of dimensions. In this case, the DYNUFAM show factors and the Structure show fators form a pair of two-dimensional spaces. The individual series are the defined points; and the differences between the factor scores for each pair of series are the vector distances. The mean of all the distances among series viewed or liked by each respondent provides a measure of the degree of discrimination of each viewer with regard to the entropy and structure of programs. A mean for all respondents is computed for each degree of liking and viewing, and the tests for the degree of clustering are made at each of these levels. More detailed descriptions of these dispersions are available elsewhere (Watt and Krull, 1972).

Viewing and Liking dispersions were constructed for both the DYNUFAM and Structure scores. The four indices are theoretically defined as follows:

The DYNUFAM Viewing Dispersion is defined as the average degree of discrimination on entropy among series watched.

The DYNUFAM Liking Dispersion is defined as the average degree of discrimination on entropy among series evaluated favorably.

The Structure Viewing Dispersion is defined as the average degree of discrimination on structure among series watched.

The Structure Liking Dispersion is defined as the average degree of discrimination on structure among series evaluated favorably.

Tests for Viewing Randomness

Viewers are expected to discriminate among programs with different levels of entropy and structure. It is expected that the closer programs are to the viewer's desired level of entropy or structure, the more likely he is to view them. At this point it is not important where the optimum point is. If entropy and structure tap the same underlying dimension, viewers' program selections should show a similar pattern with smaller mean distance than a random selection of programs would produce.

The rationale and test for the randomness of liking is parallel to that for viewing. Actually four kinds of tests can be made. The corresponding hypotheses are given below:

H2. Theoretical level: Viewers discriminate among series on the basis of entropy.

H3. Theoretical level: Favorable evaluation of series is discriminant on the basis of entropy.

H4. Theoretical level: Viewers discriminate among series on the basis of structure.

H5. Theoretical level: Favorable evaluation of series is discriminant on the basis of structure.

DIFFERENCES IN LEVELS OF VIEWING

The third condition to be satisfied is that of similar patterns of differences between viewers in the amounts of entropy and structure they watch and like. In order to do this we need variables with which to correlate viewership. Most generally we are seeking variables which would provide an answer to the question, Why do viewers select different levels of program complexity? The answer seems to lie in the direction of the theory on which the entropy indicators are based.

As used in Information Theory, entropy is a measure of the amount of "information" in the encoded messages. Conversely, it is also a measure of the amount of decoding which has to be done by the receiver in order to understand the message. The DYNUFAM indicators of entropy presumably measure aspects of television programs which have to be decoded by the viewers to understand the program. Since programs have varying amounts of entropy, as indicated by variability in the DYNUFAM scores for shows, the amount of decoding to be done by viewers also probabl. varies. The question regarding reasons for viewing then seems to be: Why do different viewers choose programming requiring different levels of decoding?

To begin with, there is probably an upper limit on the amount of information which can be decoded by viewers (an audio/visual capacity). Also, there is probably a lower limit on the amount of decoding required so that viewers do not lose interest. Viewers are probably going to be less likely to watch programs as they approach either of these limits and the reason would seem to be decoding effort.

Garner (1962) concluded that response time in experimental studies increased as task complexity increased. Berlyne (1963) and Hanneman (1971) found that physiological arousal, as indicated by galvanic skin response, increased under conditions of high stimulus uncertainty in films. Burdick (in press) concluded that at least two studies (Blitz, Hoogstraten, and Mulder, 1970; Ettema and Zielhuis, 1971) show a relationship between mental load and heart rate.

Taken together, these findings seem to indicate that information processing takes physiological work. One would imagine that as information processing became more difficult, the processor also would have a higher sense of effort. It seems reasonable to conclude that television viewers are likely to feel an increase in decoding effort as form complexity increases. After decoding effort reaches a certain point, they are likely to start tuning out.

The converse also would seem to hold. Hsia (1971) points out that several studies have shown that understimulation has detrimental effects. While television programming is unlikely to be so bland as to cause sensory deprivation, a lower limit on the information level necessary to captivate viewers seems to have merit. An appropriate name for this lower limit might be "boredom."

There is probably variation among viewers as to where these limits lie. One factor instrumental in fixing these limits would seem to be information handling capability. Two characteristics of viewers likely to influence this capability will be used in this paper. Age will be taken to be an indicator of innate information handling capability; education will be used as an indicator of acquired information handling capability. The definitions and operationalizations of these variables are exceedingly familiar from the research literature. However, their use in this context is a little different.

Age

The variation of mental capacities with age has a copius literature. While there seems to be agreement that there is rapid growth in mental ability up to around age 25, there is controversy over the level of mental performance after that age. Bayley (1968) attempted to reconcile the contradictory findings by pointing out a qualitative difference between the earlier studies of intelligence which showed a decline in mental ability after the middle twenties (Thorndike, Bergman, Tilton and Woodyard, 1928; Foulds and Raven, 1948; Jones and Conrad, 1933; Miles, 1942; Vincent, 1952; and Wechsler, 1944) and the later ones which showed a maintenance of mental abilities well into middle age (Bayley and Oden, 1955; Bradway and Thompson, 1962; Corsini and Fassett, 1953; Nisbet, 1957; and Owens, 1953, 1966). Apparently the earlier studies concentrated on fluid factors in intelligence, characterized by discriminating and reasoning powers; and the later ones on crystallized factors, characterized by accumulated and retained knowledge (Horn and Cattell, 1966).

The kind of information processing tapped by the measures of program form would seem to be similar to that measured by indicators of fluid mental ability. Since the fluid mental abilities decline after the middle twenties, it seems reasonable to conclude that the ability to decode the form of television programming would show a similar decline.

In this paper age will be used as an indicator of fluid mental ability, and the curve of the relationship between age and fluid mental ability will be assumed to be that defined by Bayley. There would no doubt be variation in intelligence among individuals at any age level in most random samples of respondents. Since we had no control for intelligence, this variation should appear as within group variance in our data. Age is theoretically defined as follows:

Age is defined as the number of years since birth.

Relationships between Age and Television Viewership

To satisfy the third condition set for comparing the two form measures it is necessary to test hypotheses using both entropy and structure and to compare the results. The relationship between age and television viewership will be one way in which this will be done. Let us summarize the rationale here before formulating the hypotheses.

Age and information handling capacity are assumed to be related in the same way as age and fluid mental ability. Viewers are expected to experience increasing decoding effort as the information level of television programs approaches their channel capacity. Viewers are also expected to feel bored as the information level of programs falls far below their channel capacity. Their optimum level of mental activity is presumed to be between these two bounds. Given the assumed relationship between information handling capability and fluid mental abilities, the desired level of mental activity of viewers is expected to vary curvilinearly with age. This would mean that the levels of structure and entropy at the desired level of mental activity would also vary curvilinearly with the age of viewers.

A parallel set of hypotheses for entropy, structure, viewing and liking will be given below. The rationale in each case is the same as that given above.

H6. Theoretical level: As age increases, the level of entropy of programs viewed will show a peak for viewers in their middle 20s followed by a slow decline into old age.

H7. Theoretical level: As age increases, the level of program entropy positively evaluated will show a peak for respondents in their middle 20s followed by a slow decline as old age is approached.

H8. Theoretical level: As age increases, the level of program structure watched will show a peak for viewers in their middle 20s followed by a slow decline as old age is approached.

H9. Theoretical level: As age increases, the level of program structure positively evaluated will show a peak for viewers in their middle 20s followed by a slow decline as old age is approached.

Education

While age will be used as an indicator of innate mental ability, education will be used as an indicator of acquired mental ability. The rationale for the use of education in this way is largely that the effects of formal schooling appear to be reflected in performance on tests tapping mental ability. It is presumed that education operates on both the fluid and crystallized mental factors described in the preceding section. While the increase in the latter ability would be expected to be greater because of the nature of formal education, the fluid factors, discriminating and reasoning powers, should be enhanced by education through practice in abstract machinations. Education is defined as follows:

Education is defined as the number of years of formal schooling.

Relationships between Education and Television Viewership

The expected effect of education on program selection follows from the same line of reasoning as that for a relationship between age and program selection. Education increases the fluid mental abilities and as a result the capacity to handle information. The effect on the amounts of structure and entropy viewed and liked should be a linear increase. The hypotheses are as follows (only liking can be tested because of an absence of data):

H10. Theoretical level: The higher the education, the higher the level of entropy positively evaluated.

H11. Theoretical level: The higher the education, the higher the level of structure positively evaluated.

METHOD

Viewing Samples

Three separate data sets of viewer behavior were used. McLeod, et al., (1971a, 1971b) gathered data from schoolchildren and their mothers in Middleton, Wisconsin with two waves of questionnaires. The second of these waves, conducted in October 1970, yielded 150 usable pairs of forms. A single wave, of adolescents only, was also conducted in Prince Georges County, Maryland in 1970. This yielded an additional 450 usable questionnaires. McLeod, et al., asked both groups of respondents specifically about selection of programs for watching.

The third set of data were collected by Lichty, et al., (1973) in the first part of 1972. Their stratified sample, drawn from among shoppers at two shopping centers in Madison, Wisconsin, yielded 232 usable forms. Respondents were asked for program preferences rather than about actual viewing behavior. The age and education, among other characteristics of the respondents, were also noted.

While the McLeod and Lichty data were gathered two years apart, there was still substantial overlap among the television shows being broadcast. Since there is some indication that the DYNUFAM measures are stable over long periods of time, it is assumed that the shows did not vary on entropy during the two years. It is also highly likely that the shows did not vary on structure during that time.

Show Samples

DYNUFAM. The sample of television shows scored for entropy consisted of virtually all the series broadcast by the three commercial networks in 1971 and 1972 between the hours of 6:30 and 10:00 p.m. Central Standard Time. Specials, sports, and movies were not included. A total of 168 individual shows in 58 series were coded between the last week of March and the first week of July, 1971. An additional set of 33 shows in 13 series were scored during the winter of 1971-72. With only a few exceptions, due to show cancellations, three shows from each series were scored. This makes a total of 71 series for which entropy scores are available.

The shows were coded with a specially constructed machine, descriptions of which are available elsewhere (Watt and Krull, 1974). Check-coding done on a sample of program segments from a wide variety of show types indicates high inter-coder reliability (r = .88).

Structure. Lichty and two trained coders scored structure for one show of a large number of series during the Spring of 1972. Of this set, there are 47 prime time series for which DYNUFAM scores are also available (see Appendix A). Again, this constitutes nearly all of the prime time commercial series being broadcast in Madison, Wisconsin at that time.

The coders individually scored each show, after which a single score for each structure variable was derived from the three by a method of agreement. Although no inter-coder reliabilities were computed, the coders said they found little difficulty in coming to mutually satisfactory scores. Unfortunately, this procedure will not allow an assessment of intercoder reliability.

The structure score data were collected two years after the McLeod, et al. viewing data, and one year after the bulk of the DYNUFAM data. Since there is some evidence that television series do not vary much on entropy, and given the probable interplay between entropy and structure, it is likely that the structure scores are also reasonably stable. This is, television series referred to by name by viewers in the McLeod, et al. samples are not substantially different from those from which Lichty, et al. got their structure scores.

Distribution of Show Scores. In order to discriminate among programs, the indicators of entropy and structure should have a large range of values within the limits of possible values. It would not be useful to have a set of indicators which in theory allow for many values, but of which only a few values are actually found.

The form entropy indicators have already been found to distribute well over the range of their possible values. A full discussion of these descriptive statistics can be found in Watt and Krull (1974).

Table I shows the corresponding statistics for the indicators of structure. Although Lichty, et al. used a few other indicators, they showed severely constrained distributions of only one or two points for prime time shows. Those indicators were dropped from further analyses. The remaining indicators show wider distributions, as one can see from Table I, but even these are still fairly leptokurtic. Only one of the indicators shows a full distribution of scores from

1 to 9. The mean for all indicators is above the middle of the allowable range, and the standard deviations of all indicators is below one quarter of the total possible range of scores. This may somewhat limit their discriminatory power.

Multivariate Treatment of the Television Measures

Factor Analysis of the Entropy Indicators. The indicators of entropy were found to be intercorrelated. Since non-independence could make for rather complex interpretation of data, principal components factor analysis was performed on the initial 58 series. This produced two factors, called Dynamics and Unfamiliarity, which explain over 75 percent of the variance. Set Time Entropy, Verbal Incidence Entropy, and Verbal Time Entropy have heavy loadings on Dynamics; and Non-Verbal Dependence Entropy and Set Constraint Entropy are loaded most heavily on Unfamiliarity. Again, details can be found in Watt and Krull (1974).

Since shows were coded for entropy during two different time periods it was necessary to integrate the two groups of shows. The factor coefficients obtained from the factor analysis on the first set of 168 shows over 58 series were considered reliable estimates of the population values, and were used to compute the factor scores on the second set of 33 shows in 13 series.

Factor Analysis for the Structure Sample. Table II shows the correlations among the seven structure variables. As with entropy, there is a pattern of substantial correlation (over half the correlations are significant beyond the .05 level). A principal components factor analysis, parallel to the one done for entropy, was performed on the structure show scores.

Table III shows that four of the variables — Unit-to-Unit transition, Building, Climax and Unity — load on Factor 1; and that three variables — Pace, Variety, and Visual Structure — load on Factor 2. These factors account for more than 70 percent of the variance among the variables. No attempt will be made here to name the two factors.

The Viewing Indices

The DYNUFAM Viewing Measures. Viewing indices were operationalized for the Middleton and Maryland samples only. McLeod, *et al.*, asked their respondents which programs they watched: "almost always — nearly every week," "often — at least half the time," "sometimes," or "never." These levels were weighted for amount of viewing (Krull and Watt, 1973; McLeod, Atkin and Chaffee, 1971b).

The weights for the levels were: 0 — never watch
2 — sometimes watch
3 — often watch
4 — almost always watch

These weights for viewing levels were then multiplied by the DYNUFAM factor scores for each show watched. This gave a value which consisted of factor scores weighted by viewing level. The three non-zero values were summed to give an overall viewing index for each factor. They Dynamics Viewing Index, for example, was computed as follows:

$$\text{Dynamics Viewing Index} = \sum_{i=1}^{3} \sum_{j=1}^{n} \text{Dynamics score for viewed show}_j \times \text{level wt.}_i$$

where n = the number of shows viewed at level i.

The same procedure was used for the Unfamiliarity viewing indices.

The Structure Viewing Measures. A corresponding set of viewing measures were produced for the structure scores by substituting the structure factor scores in the same place as the dynamics scores in the equations above. Again, separate structure viewing indices were computed for each factor.

The Liking Indices

The DYNUFAM Liking Measures. The procedure used to generate liking measures was essentially the same as that used for the DYNUFAM Viewing indices. The only difference was that the levels were weighted for the amount of program liking, rather than the amount of viewing. Lichty, et al., asked their respondents which programs were: "one of my two or three very favorite programs," "a favorite," "like the program," "do not like or am not familiar with the program." These items were then substituted in the equations using the following weights:

0 — do not like the program
2 — like the program
3 — a favorite
4 — one of my two or three favorites

The Structure Liking Measures. This index is exactly like the Structure Viewing Index in construction except for the substitution of liking levels for viewing levels.

The Viewing Dispersions

The DYNUFAM Viewing Dispersions. A full description of the generation of the vector dispersions is given elsewhere (Watt and Krull, 1972). The dispersions are a measure, on a dimension or a set of orthogonal dimensions, among a set of data points. In this instance the dispersion is a measure of the average distance between shows with respect to entropy or structure. To use the dispersion as an indicator of the selectivity of viewers one compares the average dispersion among shows watched to a null viewing distribution. The null distribution gives the dispersion expected for a completely random selection of programs. The null distributions were estimated by a computer simulation (details in Watt and Krull, 1972).

The test for significance of the viewing dispersion was a t-test for the difference between the mean viewing dispersions for the respondents in the samples and the null mean. These tests were made at the separate levels of viewing and liking.

The Structure Viewing Dispersion. This dispersion corresponds to that described above with the exception of distances being computed among the structure scores for shows.

The DYNUFAM and Structure Liking Dispersions. The DYNUFAM and Structure Liking Dispersions are of the same form as the viewing dispersions. The only difference is that the distances are computed among the shows liked rather than the ones viewed.

Construction of the Age and Education Measures

Age. For the Middleton and Maryland samples the age of adolescents was defined in terms of their grade levels (they were selected for the sample on this basis). The sixth graders were about 11 years old and the tenth graders about 15 years old. The Middleton mothers were 39 years of age with a standard deviation of 5.3 years. The mothers were treated using their mean age for two reasons: because the standard deviation is so small and to provide a measure comparable to that of the adolescents.

The average age of the Madison sample was 30.2 years with a standard deviation of 14.6 years. We felt that this provided a sufficiently wide distribution to use the measure in its continuous form.

Education. Meaningful education measures were only available for the Madison sample. Lichty, et al., categorized the education levels of their respondents in the following way: 8 years of high school or less; more than eight years but without diploma; high school graduate; college or vocational school attendance; college graduate; and advanced degree.

Testing the Non-Linear Hypotheses

Polynomial Regression. The relationships between age and other variables were expected to be distinctly non-linear. Polynomial regression was used to test these hypotheses with the continuous measures available from the Madison sample. This regression produces a curve of the form: $y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + \ldots$

The program which ran the polynomials added a higher order exponential term to the regression equation for each successive level, and re-aligned the previously included terms, to produce the least squares non-linear fit of the regression curve to the data. The program produced a plot of the observed points and the curve fitted through the points by the regression equation. The figures included in this paper show the fitted curve only.

Since the program available handled the bivariate case only, it was necessary to run the entropy and structure indices one factor at a time. The curve expected was the same in each case, however. Given the predicted relationship between age and program form viewing, the expected regression was one of second or third degree (two or three terms plus a constant). Since a second degree regression produces a hyperbolic function, and since the expected curve was expected to be asymmetrical, a third degree polynomial seemed most likely.

Test on Mean Differences. It was necessary to employ a stop-gap procedure for the non-linear curve tests for the Middleton and Maryland data sets. The age measures were essentially categorical, the means for the groups being taken as the value applicable to all members of the group. T-tests for the differences between the means were used to determine if the groups conformed to the parameters of the curve hypothesized. This technique is substantially weaker than polynomial regression, but it was the only viable alternative considering the limitations of the data.

The parameters of the expected curve of the relationship between age and the amount of entropy viewing would seem to imply a significant increase from the younger to the older adolescents. The difference between the senior high school students and the mothers is indeterminate, since the maximum value attained by the curve is likely to be at the age between these two groups. However, one would expect a significant increase from the juniors to the mothers.

RESULTS

Correlations among the DYNUFAM and Structure Show Scores

It was argued that the DYNUFAM factors and the structure factors tap the same underlying dimension. This could be demonstrated through correlations among show scores (H1) and through replication of the pattern of relationships among the show scores and other variables.

Table IV gives the simple and canonical correlations among the scores for the 47 shows which were coded for both entropy and structure. The simple correlations seem to indicate that Dynamics and Structure Factor 2 ($r = .29$, p $.05$), and Unfamiliarity and Structure Factor 1 ($r = .51$, p $.001$), are related. Correlations for the other combinations among the factors are far from significant. The canonical correlation among the factors around a main dimension is .52 (p $.005$), and around a second dimension is .28 (p $.06$).

These results seem to provide strong support for a link between entropy and structure (hl). Both kinds of correlations also seem to indicate that there are two underlying dimensions, rather than one.

Program Selection

Viewing and Liking Dispersions. Viewers were expected to view clusters of shows on the basis of entropy and structure, as measured by the dispersions. Respondents were expected to be at least as discriminating in their liking as in their viewing.

Table V shows the DYNUFAM Viewing Dispersions for the Middleton adolescents and mothers, and for the Maryland adolescents. The Middleton adolescents are the most consistent with the hypothesis (H12), being significantly less dispersed than random at all levels of viewing. The Middleton mothers and the Maryland adolescents are less consistent. The dispersions for the mothers are only significantly less than random at the highest viewing level, and the adolescents' dispersions are significant at the lowest and the highest viewing level. The results are at least partially supportive of the hypothesis since the greatest degree of discrimination would be expected for those shows watched most regularly, i.e., those watched at the highest viewing level.

Table VI shows the Structure Viewing Dispersions to be less supportive of the hypothesis (H14). Only three of the eight dispersions are significant in the predicted direction. Of the three, two are at the highest viewing level, however.

Table 7 shows the reverse of the pattern expected for liking dispersions (H3, H5). The DYNUFAM Liking Dispersions go from significantly less than random at the lowest level, to significantly more than random at the highest. The Structural Liking Dispersions show a similar trend, but the highest viewing level does not reach significance.

Although the DYNUFAM and structure dispersions are slightly dissimilar, it is the Viewing and Liking dispersions which truly fail to follow the same pattern. So far there seems to be only marginal evidence that viewing and liking tap the same dimensions of program selection.

Age and Program Selection. Age was expected to be related to the levels of entropy and structure watched in the same way as to the level of fluid mental ability (H6, H8). The same was expected for liking (H7, H9). Polynomial regression was used to test for these relationships where there was continuous variable data, and t-tests were used with the categorized measures. Since the polynomial regression program available could only handle the bivariate case, it was necessary to run each of the factors of structure and entropy individually. A comparable procedure was used with the t-tests.

Figure 1 shows the curve for the regression of Dynamics Liking on Age. The curve was hypothesized to be a skewed quadratic. Since a second-degree polynomial gives a hyperbola, the skew of the hypothesized relationship was expected to require more than two coefficients to reproduce. The curve fitted by the program is a third-degree polynomial with approximately the parameters expected ($F = 13.37$, $p < .001$). The curve has an unexpected inflection point for respondents past age sixty. Since few respondents in the sample were in this age group, this change in slope is probably not significant, but may be the result of fitting the curve to the entire set of data. Like linear regression, the curve fitted by polynomial regression is most accurate at the center of the range of values, and least accurate at the extremes. Figure 2 shows that the corresponding t-tests for Middleton and Maryland give the significant differences hypothesized.

The curve fit also given in Figure 1 for the regression of Unfamiliarity Liking on Age does not conform to expectations at all. The curve appears to be linear although the regression is not statistically significant. The corresponding t-tests for viewing differences given in Figure 2 indicate a negative linear relationship which is significant. It seems that Unfamiliarity operates in a way radically different from Dynamics.

Figure 4 shows the curve fit for the regression of Structure Factor 1 Liking on Age. This structure factor was found to correlate with Unfamiliarity. While the curve fitted is a third degree polynomial the percent of variance accounted for is small ($F = 2.39$, $p < .08$). Figure 5 shows that the corresponding t-tests for the Middleton and Maryland viewers indicate a significant, linear negative relationship again. Neither of these tests conforms to expectations (H8, H9).

The regression of Structure Factor 2 Liking on Age for the Madison sample is also given in Figure 4. The third degree polynomial fitted has an inflection point around the late twenties of the Age variable, skew to the right, and is highly significant ($F = 10.25$, $p < .005$). There is a slight, unpredicted upward slope at the right-hand end of the curve. However, since there are only four data points in that area, this deviation from the prediction is negligible. Although the means for the Middleton sample follow the hypothesized shape, none of the t-tests are significant (see Figure 6). However, the corresponding t-test for the Maryland adolescents is strongly in the predicted direction ($p < .001$).

There seems to be consistency between the viewing and liking tests of the hypothesized curve. Where the polynomial indicates a significant regression of the form predicted, the t-tests come out the same way three out of four times. Where the polynomial does not fit the hypothesis, the t-tests show a significant, negative linear relationship three out of four times. While the different tests replicate one another with respect to Age, only half of the curves have the predicted form. More specifically, Unfamiliarity and Structure Factor 1 are not related to Age in the way expected.

Education and Program Selection. It was hypothesized that the relationships between education and the levels of structure and entropy liked would be linearly positive ones (H10, H11). Table VIII shows the multiple regression of DYNUFAM and Structure Liking on Education for the Madison sample. The correlation coefficient for DYNUFAM ($R^2 = .30$) is significant beyond the .001 level, which seems to support the hypothesis. However, a closer look at the partial correlations indicates that the strongest factor in the relationship is Dynamics.

The table also shows the multiple regression for Structure Liking. The regression for both factors is significant ($R^2 = .21$, $p < .05$), but the result is not strong. In addition, only one factor, Structure Factor 2 Liking, accounts for the bulk of the variance explained.

DISCUSSION

The objective of this study was to compare an information processing based measure of television program form to a measure of form based on the perception of the organization of program production elements. The relationship between certain viewer characteristics and viewing behavior were examined in the process.

Three conditions were set up to test the presumption that the two program measures are related to the same underlying dimension: show scores for entropy and structure were expected to be correlated, viewing and liking of both measures of program form was expected to be non-random in the same way, and differences in viewing and liking patterns were expected to be similar. Tests of the hypotheses regarding viewing behavior were made using measures of actual viewing behavior and of program liking.

The bulk of the hypotheses were confirmed. The DYNUFAM scores for program form entropy and the Structure measures of program organization were found to be correlated at a statistically significant level. Patterns of viewing of entropy and structure generally showed clustering of shows significantly less than random. The relationships between viewer characteristics and differences between viewers in the amounts of entropy and structure viewed were very consistent although the shapes of the relationships did not conform to expectations with respect to one of the factors expected to produce differences.

One of the failures to support the hypotheses was that, although liking of both measures of program form was expected to be non-random in such a way that programs were tightly clustered, the data indicate that the opposite actually goes on. Liking of form entropy was found to be significantly more dispersed than a random distribution at the highest level, and liking of program structure was found to exhibit a trend towards greater dispersion of preference although the highest level did not reach statistical significance. While these dispersions indicate a similarity between entropy and structure measures, they do not seem to support the expectation of greater specificity of program liking over viewing.

The relationships between viewer characteristics and two factors of entropy and Structure, Unfamiliarity and Strucutre Factor 1, are very consistent. However, they do not conform to the expected relationship share. Both of these correlated factors appeared to show linear rather than curvilinear relationships with age. In addition, the regression coefficients between these factors and education were found to be non-significant. Two interpretations of these results seem viable at this point: the range of the raw scores on these dimensions are not sufficiently large, or these dimensions are not related to viewer decoding effort. It is not possible to assess these alternatives without additional data.

On the whole, it appears that the two measures of program form are tapping the same underlying dimension. Where the results do not conform to expectations, there is at least consistency between the entropy and structure measures. The findings reported in this paper will be used as the basis of a number of logical extensions of the rationales reported here.

One analysis will be the relationship between viewer characteristics and aggregate viewership of television programs. For example, we are currently investigating the curve of the relationship between age of viewers and television show ratings. Another analysis will be the detailed examination of the amount of information processing required to decode television programming. This relationship will be examined using psychophysiological techniques. Both of these sets of analyses should give more strength to the contention that television viewership may at least partially be explained in terms of information processing models. The results reported in this paper indicate that these models, although they appear a somewhat strange conceptualization of form, are strongly related to more "common sense" form conceptualizations which consider the program production elements.

TABLE I

DESCRIPTIVE STATISTICS

FOR INDICATORS OF STRUCTURE

INDICATOR	MEAN	STD. DEV.	MINIMUM	MAXIMUM
Unit-to Unit Trans.	5.79	1.14	4.00	8.00
Building	5.98	1.78	3.00	9.00
Pace	6.13	1.13	3.00	8.00
Climax	6.40	1.87	1.00	9.00
Unity	5.81	1.12	3.00	8.00
Variety	5.96	1.64	3.00	9.00
Visual Structure	5.19	1.21	4.00	9.00

N = 47

TABLE II

INTERCORRELATIONS AMONG INDICATORS OF STRUCTURE

	Trans.	Build	Pace	Climax	Unity	Variety	Vis. Struc.
Trans.	1.00						
Build	.79	1.00					
Pace	.12	-.01	1.00				
Climax	.63**	.82**	.09	1.00			
Unity	.53**	.44**	-.02	.58**	1.00		
Variety	-.38**	-.55**	.32*	-.49**	-.30*	1.00	
Vis. Struc.	.08	-.07	.43**	-.10	.16	.31*	1.00

N = 47

* = p <.05
** = p <.01

TABLE III

ROTATED FACTOR MATRIX FOR
INDICATORS OF STRUCTURE

INDICATOR	FACTOR ONE	FACTOR TWO
Unit-to-Unit Transition	.865	.106
Building	.908	-.117
Pace	.081	.806
Climax	.890	-.064
Unity	.710	.116
Variety	-.589	.569
Visual Structure	.031	.822
Percent of Variance Explained	46.0	24.1

Total 70.2

TABLE IV

SIMPLE AND CANONICAL CORRELATION BETWEEN DYNUFAM FACTORS AND STRUCTURE FACTORS

SIMPLE CORRELATIONS

	STRUCTURE		DYNUFAM	
	Factor One	Factor Two	Dynamics	Unfamil.
Structure				
Factor One	1.00			
Factor Two	.00	1.00		
DYNUFAM				
Dynamics	-.02	.29**	1.00	
Unfamil.	.51****	-.04	.09	1.00

CANONICAL CORRELATION

Number of Eigenvalues Removed	Largest Eigenvalue Remaining	Corresponding Canonical Correlation	Chi-Square	Degrees of Freedom
0	.27	.52	17.78***	4
1	.08	.28	3.73*	1

N = 47
* = p < .06
** = p < .05
*** = p < .005
**** = p < .001

TABLE V

AGGREGATE D-SCORE SIGNIFICANCE OF THE DYNUFAM VIEWING DISPERSIONS FOR THE MIDDLETON AND MARYLAND SAMPLES

MIDDLETON ADOLESCENTS

Viewing Level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	-1.00	.14	149	7.14	$.15 \times 10^{-5}$
Often watch	-1.03	.13	141	7.92	$.80 \times 10^{-6}$
Almost always watch	-1.51	.17	119	9.47	$.21 \times 10^{-6}$

MIDDLETON MOTHERS

Viewing Level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	.34	.20	146	1.76	.04
Often watch	.41	.16	107	2.51	$.60 \times 10^{-2}$
Almost always watch	-1.03	.24	59	4.37	$.12 \times 10^{-4}$

MARYLAND ADOLESCENTS

Viewing Level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	-.50	.09	462	6.30	$.15 \times 10^{-3}$
Often watch	.49	.08	433	5.74	$.35 \times 10^{-6}$
Almost always watch	-.47	.10	417	4.75	$.19 \times 10^{-5}$

TABLE VI

AGGREGATE D-SCORE SIGNIFICANCE OF THE STRUCTURE VIEWING DISPERSIONS FOR THE MIDDLETON AND MARYLAND SAMPLES

MIDDLETON ADOLESCENTS

Viewing Level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	-.41	.10	149	3.95	$.30 \times 10^{-4}$
Often watch	.00	.09	144	.06	.48
Almost always watch	-.38	.12	119	3.11	$.90 \times 10^{-3}$

MIDDLETON MOTHERS

Viewing Level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	.55	.11	145	3.16	$.30 \times 10^{-3}$
Often watch	.01	.11	102	.06	.48
Almost always watch	-.05	.12	53	.43	.33

MARYLAND ADOLESCENTS

Viewing level	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Sometimes watch	.10	.06	451	1.79	.04
Often watch	.04	.05	397	.73	.23
Almost always watch	-.27	.07	393	4.06	$.46 \times 10^{-4}$

TABLE VII

AGGREGATE D-SCORE SIGNIFICANCE OF THE DYNUFAM AND STRUCTURE LIKING DISPERSIONS FOR THE MADISON SAMPLE

DYNUFAM LIKING

Degree of Liking	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Like program	-.31	.12	161	2.60	$.47\times10^{-2}$
A favorite	-.02	.14	177	.16	.44
One of two or three favorites	.64	.12	146	5.20	$.50\times10^{-6}$

STRUCTURE LIKING

Degree of Liking	Mean Dif.	Std. Err. Mean	Total	Z-Val.	Sig.
Like program	-.26	.09	160	2.77	$.28\times10^{-2}$
A favorite	-.26	.10	177	2.60	$.45\times10^{-2}$
One of two or three favorites	.00	.07	141	.04	.48

TABLE VIII

MULTIPLE CORRELATIONS BETWEEN EDUCATION AND THE DYNUFAM AND STRUCTURE LIKING INDICATES

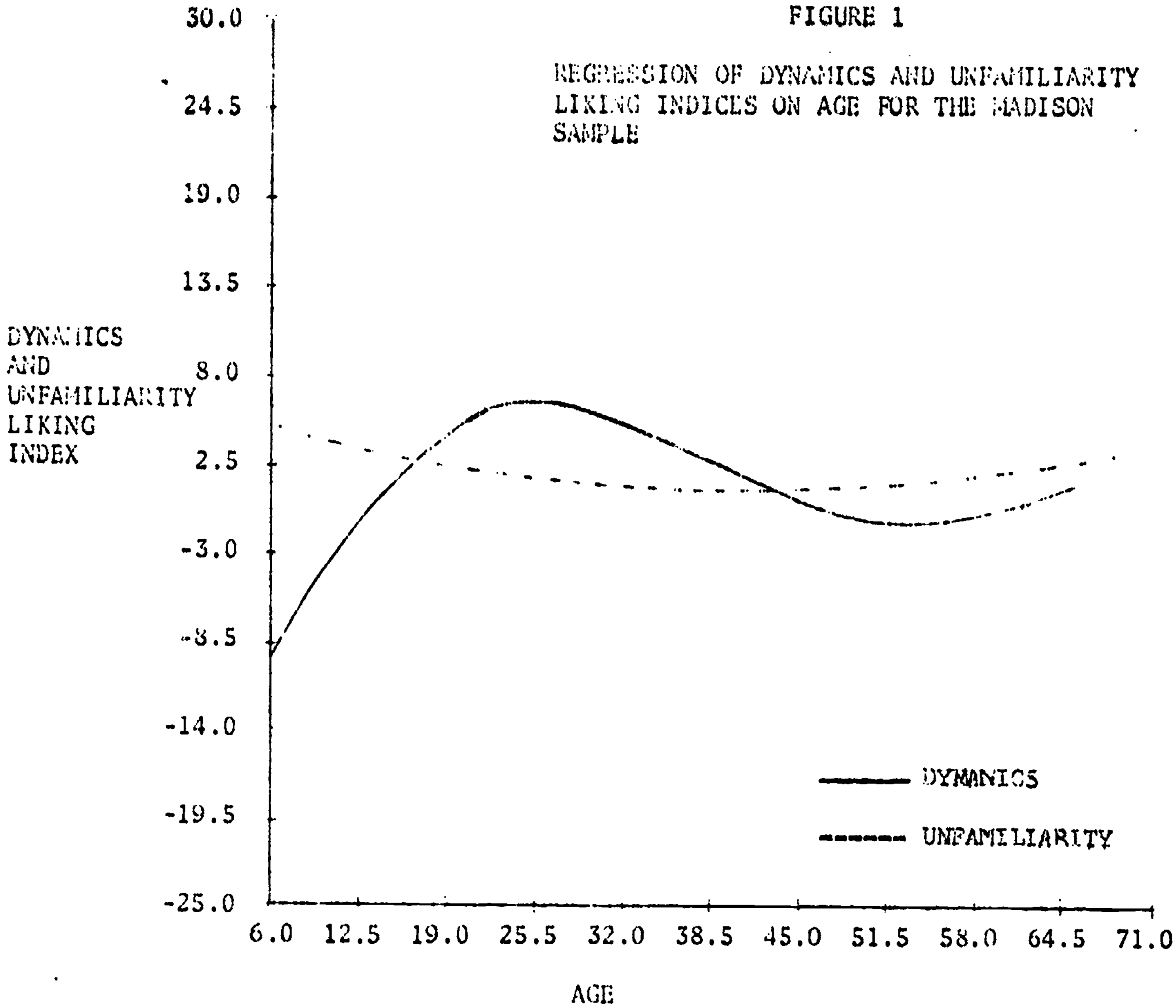
Dependent Variable: Education

Independent Variable	Regression Coeff.	T-Value of Reg. Coeff.	Multiple R	F. Value
Dynamics Liking	.05	4.46	.30	11.01**
Unfamiliarity Liking	-.02	-2.64		
Structure Factor 1 Liking	.006	.79	.21	5.55*
Structure Factor 2 Liking	.04	3.16		

N = 232
*p < .05
**p < .001

FIGURE 1

REGRESSION OF DYNAMICS AND UNFAMILIARITY LIKING INDICES ON AGE FOR THE MADISON SAMPLE



DYNAMICS LIKING

POLYNOMIAL REGRESSION OF DEGREE: 3

PREDICTION EQUATION: $Y = -24.27 + 2.87X - .08X^2 + .01X^3$

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	F VALUE	SIG. LEVEL
Due to Regr.	3	2714.79	13.37	$p < .001$
Dev. about Regr.	228	15429.42		

UNFAMILIARITY LIKING

POLYNOMIAL REGRESSION OF DEGREE: 2

PREDICTION EQUATION: $Y = 42.28 - .53X + .01X^2$

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	F VALUE	SIG. LEVEL
Due to Regr.	3	876.57	2.04	n.s.
Dev. about Regr.	228	49120.90		

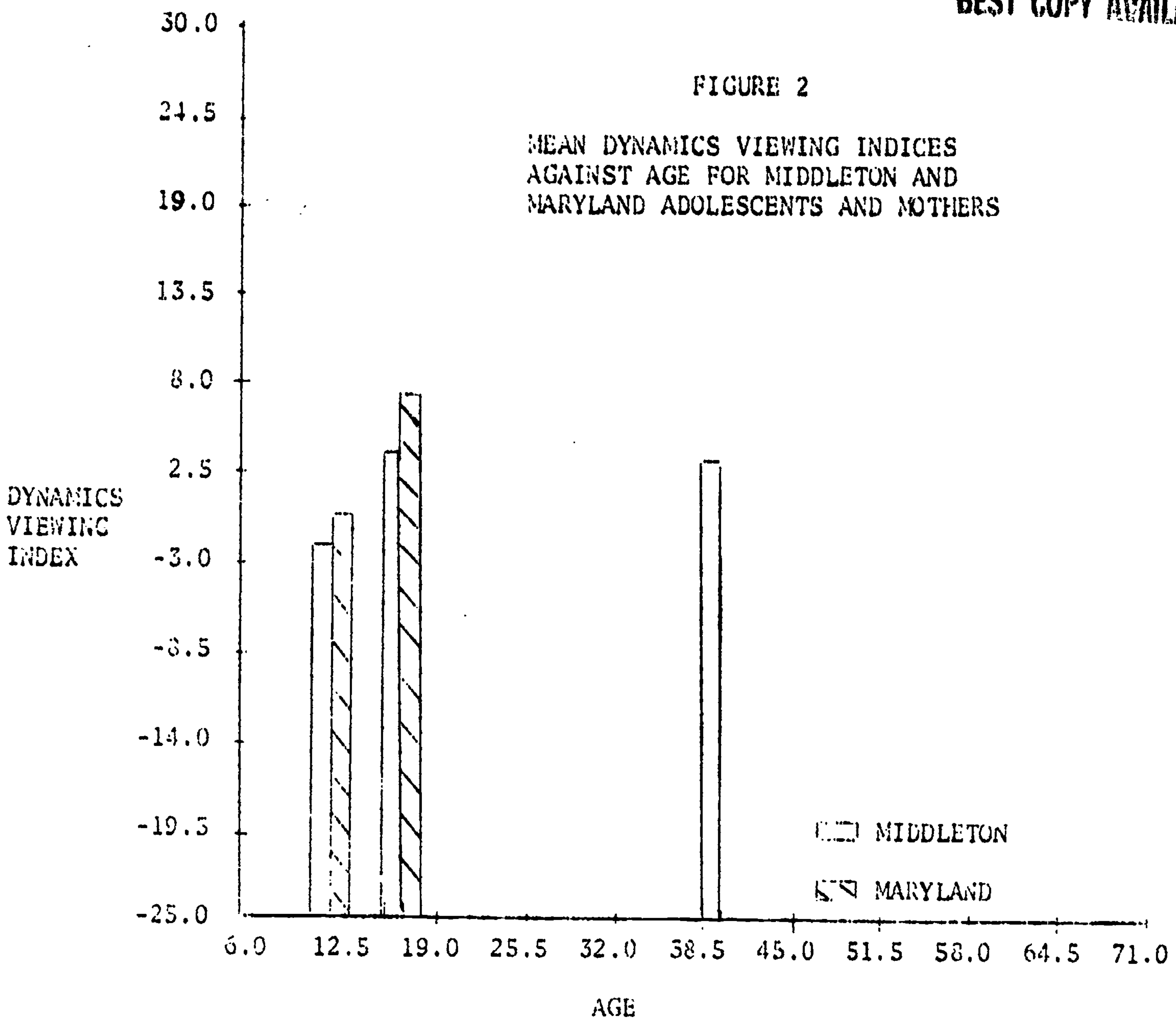


FIGURE 2

MEAN DYNAMICS VIEWING INDICES AGAINST AGE FOR MIDDLETON AND MARYLAND ADOLESCENTS AND MOTHERS

Middleton

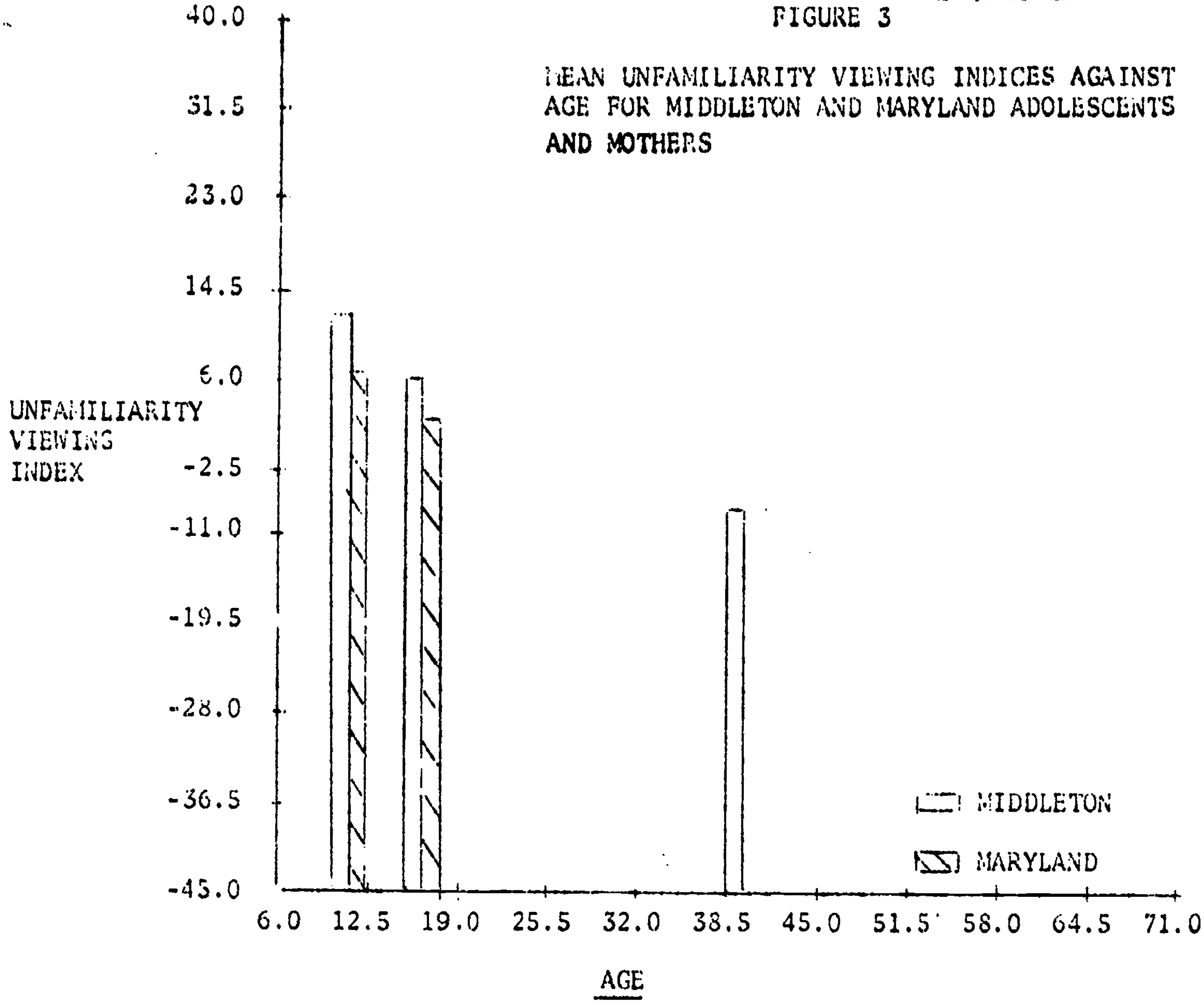
SUB-SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG
Juniors	-2.11	16.52	68	-2.71	p < .01
Seniors	4.32	12.34	82	3.26	p < .01
Mothers	3.73	9.61	148	0.26	n.s.

Maryland

SUB SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	0.46	11.07	228	-6.44	
Seniors	7.59	12.77	242		p < .01

FIGURE 3

MEAN UNFAMILIARITY VIEWING INDICES AGAINST AGE FOR MIDDLETON AND MARYLAND ADOLESCENTS AND MOTHERS



Middleton

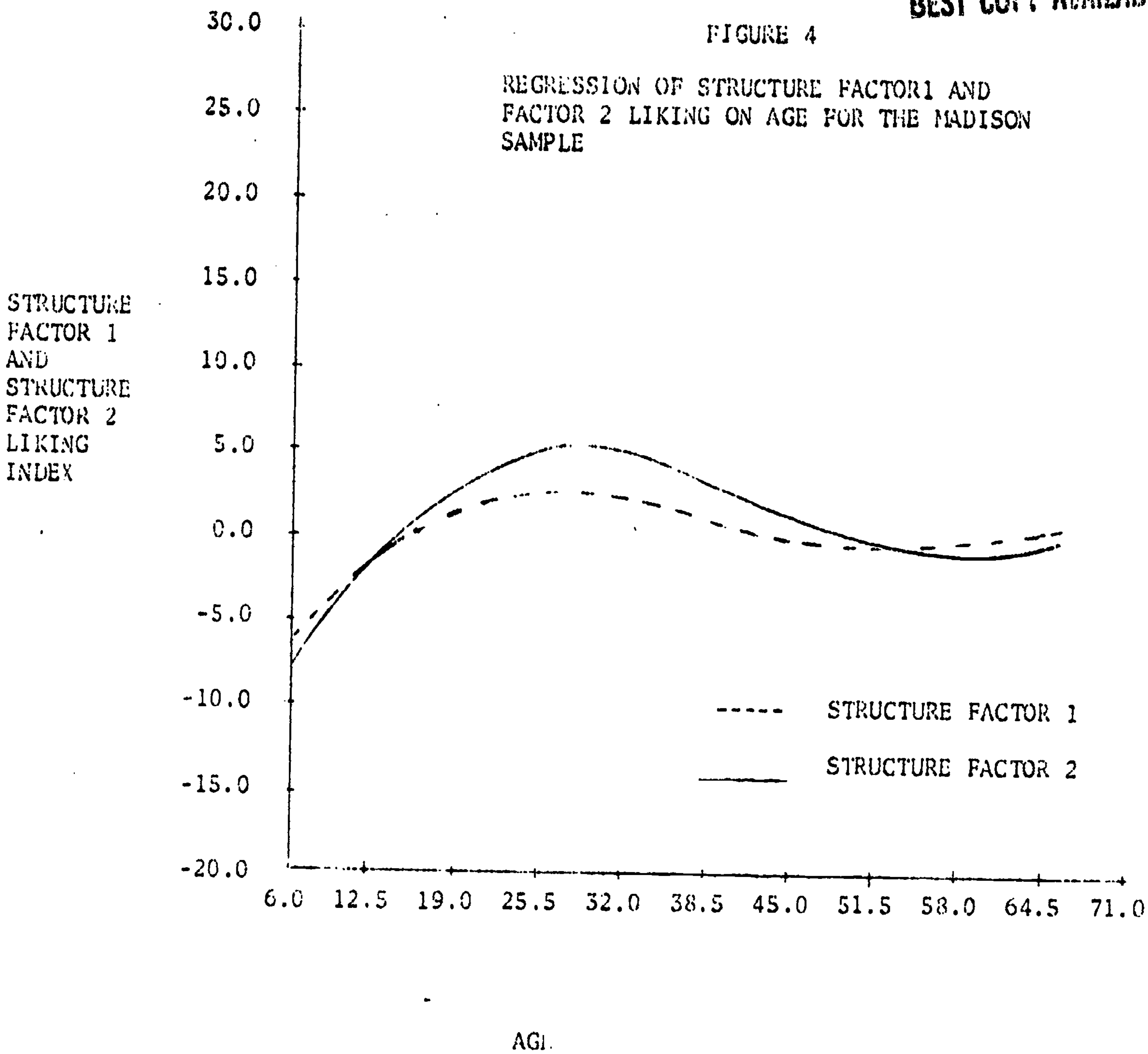
SUB-SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	11.22	15.22	68	2.02 (Juniors–Seniors)	$p < .05$
Seniors	6.44	13.56	82	7.00 (Juniors–Mothers)	$p < .01$
Mothers	-3.80	13.71	148	5.11 (Seniors–Mothers)	$p < .01$

Maryland

SUB-SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	7.56	13.88	228	3.16	$p < .01$
Seniors	3.55	13.58	242		

FIGURE 4

REGRESSION OF STRUCTURE FACTOR1 AND FACTOR 2 LIKING ON AGE FOR THE MADISON SAMPLE



STRUCTURE FACTOR 1 LIKING

POLYNOMIAL REGRESSION OF DEGREE: 3
PREDICTION EQUATION: $Y = - 13.85 + 1.72X - .05^2 + .004X^3$

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	F VALUE	SIG. LEVEL
Due to Regres.	3	877.95	2.39	$p < .08$
Dev. about Regr.	228	27880.51		

STRUCTURE FACTOR 2 LIKING

POLYNOMIAL REGRESSION OF DEGREE: 3
PREDICTION EQUATION: $Y = - 17.10 + 1.94X - .05X^2 + .004X^3$

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	F VALUE	SIG. LEVEL
Due to Regres.	3	1602.58	10.25	$p < .005$
Dev. about Regr.	228	11899.79		

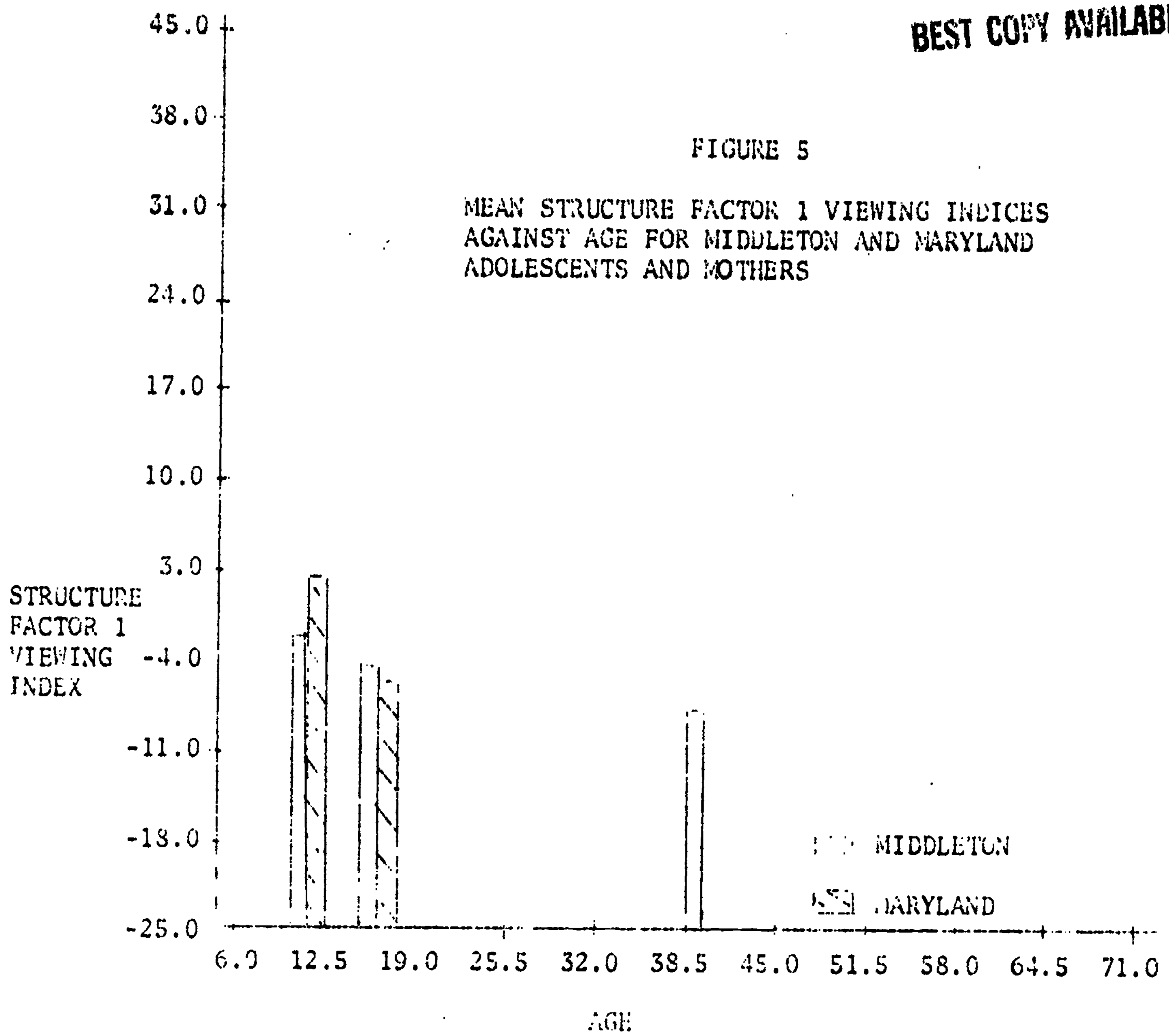


FIGURE 5

MEAN STRUCTURE FACTOR 1 VIEWING INDICES AGAINST AGE FOR MIDDLETON AND MARYLAND ADOLESCENTS AND MOTHERS

MIDDLETON

SUB-SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	-2.32	11.18	68		
				0.83	n.s.
Seniors	-3.90	12.79	32	2.61	p < .01
				1.48	n.s.
Mothers	-6.35	10.21	143		

MARYLAND

SUB SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	2.19	8.71	228		
				8.12	p < .001
Seniors	-5.29	11.02	242		

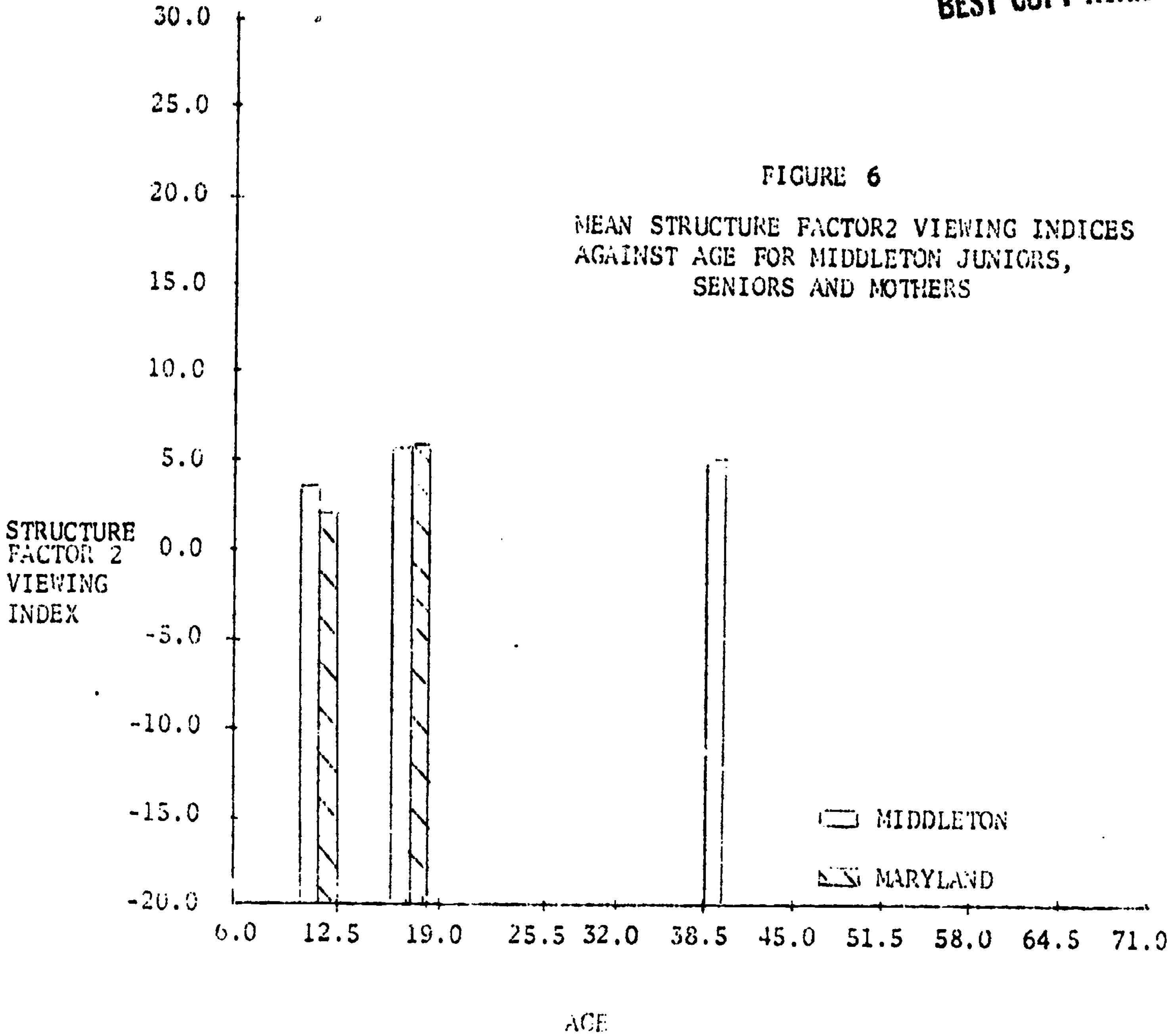


FIGURE 6

MEAN STRUCTURE FACTOR2 VIEWING INDICES AGAINST AGE FOR MIDDLETON JUNIORS, SENIORS AND MOTHERS

MIDDLETON

SUB SAMPLE	MEANS	STD. DEV.	N	T VALUE		SIG.
Juniors	3.98	10.39	68			
				1.95		n.s.
Seniors	7.09	9.01	83		1.31	n.s
				1.27		n.s
Mothers	5.60	7.31	148			

MARYLAND

SUB-SAMPLE	MEANS	STD. DEV.	N	T VALUE	SIG.
Juniors	2.19	8.72	228		
				-6.35	$p < .01$
Seniors	7.23	8.45	242		

APPENDIX A

DYNUFAM AND STRUCTURE SCORES FOR ALL SERIES

SHOW NAME	DYNUFAM		Structure	
	Dynamics	Unfamiliarity	Factor 1	Factor 2
Gunsmoke	.4564	.6738	.5098	1.4730
Laugh-In	1.4601	-.3213	-1.4739	2.7525
Here's Lucy	-.6047	-1.0178	-.7285	-1.5155
Doris Day	-1.0826	.1558	-.0637	-1.2073
Carol Burnett	-.6037	-.4405	-.9358	.6822
Mod Squad	.5863	.6059	1.0653	-.4232
Marcus Welby M.D.	-.1259	.8343	1.3639	1.6783
Eddie's Father	-1.0630	.4094	-.2645	-.8234
Room 222	.0829	.5495	.0348	.0367
Medical Center	-.0653	.4514	.1225	-.5375
Hawaii Five-O	.4391	.9930	1.0653	-.4232
Family Affair	.1945	.5144	.5746	-.6873
Flip Wilson	-1.6405	-.7414	-1.4380	.1664
Ironside	.3033	.7960	.9673	-.2310
Bewitched	-.6076	.5719	-.0451	.4214

APPENDIX A (CONTINUED)

SHOW NAME	DYNUFAM Dynamics	DYNUFAM Unfamiliarity	Structure Factor 1	Structure Factor 2
Odd Couple	-.9059	-.1933	.2791	-.2648
Dean Martin	-.1824	-1.8097	-1.7576	1.0736
Brady Bunch	-.1769	1.1735	-1.7576	1.0360
Partridge Family	-.0648	-.0593	-1.3199	-.9675
Love American Style	1.6361	-.4314	-1.0203	.4173
Mission Impossible	1.2409	.3391	1.3417	2.3202
Let's Make a Deal	-2.0335	-1.6229	-.1511	-.2697
Newlywed Game	-.9778	-1.2277	-.1888	-.2681
My Three Sons	-.0653	.6201	-.1737	-.3977
Arnie	-.3308	.5895	.2782	.5096
Mary Tyler Moore	-.8127	-.9192	.6717	-.5140
Mannix	.2938	.7778	1.0123	-.8506
World of Disney	-.2327	1.2058	1.0558	1.2450
FBI	1.4620	.9118	1.1559	.4113
Glen Campbell	-.3588	-2.7411	-1.7127	-.2031
Bonanza	.1131	.7230	-.1299	.3207

APPENDIX B (CONTINUED)

SHOW NAME	DYNUFAM Dynamics	DYNUFAM Unfamiliarity	Structure Factor 1	Structure Factor 2
Bold Ones	.0175	.4729	.9041	.2833
First Tuesday	4.0535	-2.2335	-2.0971	.6737
60 Minutes	.8417	-.6934	-2.0971	.6737
Adam-12	.0306	.8277	-.3297	-.4633
Alias Smith and Jones	.3931	1.1309	-.6444	-1.0013
All in the Family	-.2222	-5.0359	.2408	-.4703
Cannon	.2815	1.0894	1.0633	-.4232
Dick Van Dyke	-.7601	-.7896	-.1666	-.4430
Jimmy Stewart	.3601	-.3529	-.2207	-2.5552
Nichols	.2649	1.0991	.3981	.1320
Night Gallery	.6116	.7956	1.0663	1.0780
O'Hara U.S. Treasury	.8202	1.2419	1.2694	-.3333
Owen Marshall	.3031	.4799	1.7198	.0569
Longstreet	.3159	1.16[illegible]	.7212	-1.3402
Persuaders	.1166	.9135	-.0748	.0520
Sonny & Cher	-.2231	-1.7255	-.9109	1.4968

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