DOCUMENT RESUME

ED 052 257 | TM 000 663

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| AUTHOR | Freeberg, Norman E.; Rock, Donald A. |
| TITLE | Factorial Invariance of a Biographical Inventory for Adolescents: A Comparison of Longitudinal and Cross-Sectional Results. |
| INSTITUTION | Educational Testing Service, Princeton, N.J. |
| REPORT NO | RB-70-68 |
| PUB DATE | Dec 70 |
| NOTE | 24p. |
| EDRS PRICE | EDRS Price MF-$0.65 HC-$3.29 |
| DESCRIPTORS | Academic Aspiration, Behavioral Science Research, Behavior Change, *Biographical Inventories, *Comparative Analysis, Correlation, *Cross Sectional Studies, Data Analysis, Development, Factor Analysis, *Factor Structure, Grade 7, Grade 9, Grade 11, Leisure Time, *Longitudinal Studies, Recreation, Vocational Interests |
| IDENTIFIERS | *Background and Experience Questionnaire, BEQ, Growth Study |

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# FACTORIAL INVARIANCE OF A BIOGRAPHICAL INVENTORY FOR ADOLESCENTS: A COMPARISON OF LONGITUDINAL AND CROSS-SECTIONAL RESULTS

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Educational Testing Service
Princeton, New Jersey
December 1970

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# Factorial Invariance of a Biographical Inventory for Adolescents: A Comparison of Longitudinal and Cross-Sectional Results

Norman E. Freeberg and Donald A. Rock[1]

Educational Testing Service

Attempts to identify behavioral change at different age levels have forced psychologists to deal with problems of structural consistency in the measures applied. Wohlwill's (1970) argument for incorporation of the "age variable" as a dependent one in developmental research stresses a need to uncover broad sets of behaviors that transcend the "situation-bound measures--better suited to the needs of the experimentalist" (Wohlwill, 1970, p. 56). This goal of defining continuity of response patterns has, in turn, stimulated efforts to identify scales that are reasonably stable with respect to interpretation of their dimensionality over some defined developmental period.

Emmerich (1964, 1968) summarizes several approaches to defining consistency of emerging response patterns along with analytical techniques that have been applied in testing (and reconciling) the differing views. Factor-analytic procedures often are employed to demonstrate (a) similarities in factor designations or loading patterns, (b) intercorrelations among factors, and (c) agreement in the number of factors extracted and in the variance accounted for. Relatively few studies with young children or adolescents have applied factor-related indices to determine developmental changes on noncognitive measures (Black, 1965; Bronson, 1966; Emmerich, 1964), and these few have been based primarily on observer ratings of personality variables, relatively small samples in relation to the number of variables measured, and use of differing statistical methods for defining the extent of dimensional similarity. The variety of indices that have been utilized can be variable in interpretation [at times, admittedly difficult to interpret (Black, 1965)] and also serve to limit comparison of findings with similar samples across different studies.

More comprehensive and interpretable sets of indices are available from a recently developed technique (Meredith, 1964) that summarizes multidimensional stability and continuity over more than two points in time. (As utilized in this paper the term "stability" refers to the relative invariance of the patterns of correlations among factors across occasions, whereas the term "continuity" may refer either to the overall similarity of factor loading matrices on each occasion, to the average factor loading matrix or to the presence, or absence, of some particular factor on one or more occasions.) The advantages of Meredith's method become apparent when direct dimensional comparisons are to be made with the same measures applied to different individuals cross-sectionally or when a contrast is desired between cross-sectional and longitudinal samples.

Using the Meredith procedure, Rock and Freeberg (1969) examined factorial invariance for a biographical inventory administered to a cross-sectional sample of over 12,000 students in the 7th, 9th and 11th grades. That analysis, based on a modification of Meredith's technique, served to define biographical factors that are relatively invariant over several grade levels, to determine the relative presence of the factors over time, and to determine the extent of change in the stability of factor intercorrelations--i.e., whether the covariances between factor axes remain comparable over time. Results permitted identification of factored scales that tended to retain their consistency of interpretation (e.g., scales defining conventional masculine-feminine activities; various leisure time activities) and of factors that showed changes which cast doubt on their common "meaning" at different grade levels (e.g., academic, literary and social activity factors).

The present study deals with the application of the same analytical method to a longitudinal sample drawn from essentially the same student population utilizing item scores from the same biographical instrument. Thus, it is possible to determine areas of dimensional continuity for a biographical measure when used with a longitudinal sample and, at the same time, to contrast the results with the cross-sectional data previously reported. If extensive differences in factor patterns and stability are shown for the same instrument when used with either study design, then the case is strengthened for cautious application of measures, in any developmental framework, until the nature of those dimensional changes can be identified.

## Method

### Sample

One thousand fifty-one females and 1019 males who had participated in the Educational Testing Service Growth Study (Hilton & Myers, 1967) constituted the longitudinal sample on which the present analyses were based. Students who were in the 7th grade in 1963, the 9th grade in 1965 and the 11th grade in 1967 completed a biographical information blank designated as the Background and Experience Questionnaire or BEQ (Maier & Anderson, 1964). This 169-item inventory deals with academic and vocational preferences as well as a wide range of recreational and leisure activities. Responses to 124 items, common to the BEQ forms administered in grades 7, 9 and 11 between 1963 and 1967, provided the data for the present study.[2]

The 2070 students in this longitudinal sample consisted only of those for whom complete BEQ data were available from all three occasions. (That is, in addition to completing all items of the inventory, they had not left the school system by virtue of dropping out or moving away and were present in school at the time of the three test sessions.) In addition, it should be noted that there is an overlap, at the 7th grade level, between the present longitudinal sample and the cross-sectional sample with which comparisons are to be made. The overlap is approximately 32% since the 2070 subjects represent a subsample drawn from 6608 who were in grade 7 in the cross-sectional sample of 1963.

Data Analysis

The method developed by Meredith (1964), which, with minor modifications, was applied to the background inventory data used in the study by Rock and Freeberg (1969), is described in detail in the latter paper. Briefly, the method is one in which a single factor pattern matrix ("average matrix") is computed for purposes of describing the regression of observed scores on factor scores in different subpopulations. This average matrix represents the basic innovation of Meredith's technique and may be considered the single best fitting factor-pattern matrix derived from K factor patterns computed on K subpopulations. Specifically, the procedure for determining factors, which are relatively invariant over the three grade levels, involves the following analytical steps: (1) construction of a single average matrix which may be interpreted as the result of factoring the average reproduced covariance matrices; (2) rotation of the average matrix to a simple structure solution for interpretational ease; (3) rotation of the average matrix to similarity to the subpopulation factor matrices; (4) examination of the relative fit of the average matrix on each of the three occasions, and (5) computation of intercorrelations among the factors on each of the three occasions in order to determine the relative stability of those intercorrelations.

In the cross-sectional analyses (Rock & Freeberg, 1969), 11 factors were extracted from each subpopulation (i.e., grade level) matrix, based primarily on an a priori decision to extract one more dimension than the 10 originally hypothesized by the authors in their design of the BEQ (Maier & Anderson, 1964). Since 11 factors were adequate for defining the dominant dimensions of the measure, and because of the present study intention of contrasting the cross-sectional and longitudinal findings, 11 factors were extracted and retained.

Indices available from the above procedure for interpreting the extent of factorial invariance consist of: (1) Scaled factor variance estimates that appear as diagonal elements of variance-covariance matrices of the factors at each grade level. These define similarities in pattern for each factor based upon the extent to which a factor in the average pattern matrix is represented in the subpopulation matrices. Factor "presence" is defined by the pattern of change in these variance estimates over the time period of interest. (If a factor were equally present at each grade level each variance estimate would be 1.00.) (2) The trace value of the "error" matrices premultiplied by their transpose indicates the degree of overall similarity (i.e., goodness of fit) of the average matrix to each subpopulation matrix. (If the average matrix were exactly equal to a given subpopulation matrix the trace value would be zero.) (3) Correlations between factor axes within each subpopulation as an indication of the degree of orthogonality in structure.

Changes in correlations among factors over the three time periods represent the extent of dimensional stability.

## Results and Discussion

Results will be considered first for the present longitudinal study (LS) sample, to be followed by comparisons with the previously reported cross-sectional study (CS) results.

### Longitudinal Sample

Tables 1, 2 and 3 present the correlation matrices of the average matrix

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Insert Tables 1, 2 and 3 about here

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when rotated to fit each of the individual factor matrices for the 7th, 9th and 11th grades of the LS sample. In Table 4 the scaled factor variance estimates are listed, by factor and grade level, along with trace values for each subpopulation matrix, and below these the proportions of variance accounted for by the factors of the LS sample. The same indices, shown in Table 4, from prior CS study results are intended for use in subsequent CS and LS comparisons.

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Insert Table 4 about here

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Pattern similarity (specific factor patterns). The 11 factors extracted from the average matrix for the LS sample were readily interpretable and their designations are shown in Table 4.[3] These factors accounted for 31% of the variance in grade 7, 31% in grade 9 and 30% in grade 11. Several large shifts in the size of the scaled variance estimates, for each factor at the different grade levels, reflect marked changes in factor presence and imply some forms of instability in factor patterns over the course of the students' development. These differences center largely on changes at the 9th grade, in comparison to the other two grade levels. Thus, Factor II (Sports and Masculine Interest) is present to about the same extent in grades 7 and 11, but diminishes drastically for grade 9. The same result is apparent for Factor X (General TV Viewing), and Factor VII (Musical Activities, e.g., taking music lessons, going to concerts) also shows distinctly less presence at 9th grade than at either of the other two grades.

By contrast, Factor III, which deals with General Leisure and Social Activities (e.g., attendance at athletic events, movies, going skating, dancing, shopping, engaging in various hobbies), is accounted for almost entirely by the factor variance contribution of grade 9. This also tends to be the case (and logically so) for Factor VIII, designated as Lower-Level Social Activities (e.g., loafing, reading comic books and newspapers, listening to pop music on radio, watching teen-age music and dance programs on TV). The almost complete variance contribution of the 9th grade matrix that is seen for Factor XI (Academic Effort) is based on a factor that is highly specific--being defined by only three items--and is of interest here only as another example of the marked shifts that occurred in the grade 9 pattern.

Such radical changes in factor presence imply a different meaning or "focus of content" for the particular group of item responses that define a factor. Specifically, the changes seen here strongly suggest a transitional phase between ages 12 and 17 in student perceptions, or expressions of these interests and activities. Such a transitional period occurring between preand later adolescence (broadly conceived of as the onset of puberty) has been noted in the literature for a wide variety of attitudes and interests (Douvan & Gold, 1966).

Also of interest are the several changes in the pattern of factor presence that do not reflect the sharp transition at 9th grade. For example, there is an increase in estimated variance for the Feminine-Esthetic factor (Factor I) in the 9th and 11th grades when contrasted with grade 7, while somewhat of a reverse effect occurs for Talk with Others (Factor V) and Academic Course Interests (Factor VI), both of which tend to decline in presence when 7th grade is contrasted with the 9th and 11th grades.

Overall factor similarity. Trace values for the LS sample (Table 4) indicate not only goodness of fit for the average matrix to each of the subpopulation matrices, but, in effect, the degree of overall similarity of the subpopulation matrices to one another. Thus, the 9th grade matrix trace value of 13.06 shows those factor patterns to be least like the average matrix in comparison with the other two grades. In addition, the trace values for the 7th and 11th grade factor patterns (8.51 and 8.71) confirm their greater similarity to one another than to the 9th grade pattern--a result that might have been expected on the basis of the individual factor comparisons previously discussed.

Comparability (stability) of factor intercorrelations. The correlations among the axes (Tables 1, 2 and 3) show relatively greater orthogonality for the 7th and 11th grade occasions, with far more similar patterns of intercorrelations for those grades than is found when they are compared to the 9th grade. Instability over the three grade levels can be seen as attributable to a number of sizable factor intercorrelations found in the 9th grade matrix.

This is evident from an examination of Tables 1 and 3 which show relatively few correlations between factors exceeding .30 for either the 7th or 11th grade matrices. Correlational patterns on those occasions are not only more similar, but the interpretation of the correlations is fairly reasonable. For example, the strongest cluster in both matrices is formed by the intercorrelations of Factors I (Feminine-Esthetic Interest), II (Sports and Masculine Interests) and III (General Social and Leisure Activities), the Sports factor being negatively correlated with the Feminine-Esthetic factor at each of the two grade levels. The next strongest triad in each matrix involves Factors VI (Academic Course Interest), VIII (Lower Level Social Activities) and IX (Hobbies and Technical Interests). with Factors VI and IX negatively correlated with Factor VIII and to a lesser extent with each other. The fact that higher scores on a subscale of lower-level social activities tended to be associated with lower scores on academic course interests, and on technical interests or hobbies, is logical. By comparison, the 9th grade level (Table 2) shows greater obliqueness of structure in the fit of the average matrix. This is seen in the larger intercorrelations between axes which, in turn, make for relatively uninterpretable factor intercorrelations produced by the "forced fit." Thus, the dimensionality of the 9th grade does not appear to be similar to that of the other two occasions so that resulting correlations between dimensions differ considerably in size and sign.

On the basis of the above factor indices and their patterns of change, the picture for this longitudinal sample over grades 7 to 11 is one of several anomalous aspects of factor pattern and stability of factor intercorrelations (discontinuity?). Reasons for this would appear to stem from the students' item-response characteristics on the 9th grade occasion. If changes in pattern and stability of factor relationships may be conceived of as basic changes in either meaning or dimensionality, indiscriminate application and interpretation of the same biographical items and subscales may be questionable during even the relatively narrow developmental period of 12 to 17 years.

Longitudinal vs. Cross-Sectional Comparisons

The LS and CS comparisons considered in this section bear on the practical question of whether CS study results can serve as a reasonable substitute for the more costly and time consuming LS data. They also reflect on changes in dimensional stability for a biographical measure when essentially developmental (age) comparisons are added to the social changes that may have influenced the adolescent culture over some defined time span (in this case between 1963 and 1967). Areas of similarity as well as change are evident in the indices of factorial invariance discussed below.

Specific factor patterns. Similarities in factor designations between the CS and LS samples (Table 4) indicate similarity of item loadings on the dominant factors extracted from the two samples. Differences found in item loadings and associated designations occurred primarily for relatively specific or minor factors. Thus, a High-Level Literary factor is found exclusively in the CS sample and is defined by only four items, while the factor designated as Academic Effort (defined by three test items) emerges exclusively in the LS sample. The only shift on a major factor occurred for the High- and Low-Level TV Viewing factors of the CS data, which was extracted in the LS analysis as a single General TV Viewing factor. (This latter factor, however, was more like the Low-Level TV factor of the CS sample and is therefore matched with it in Table 4.)

Of particular interest in considering the specific factors are the comparative patterns of change over the three grade levels, as shown by the scaled factor variance estimates. Reasonably comparable patterns of change in factor presence for CS and LS data are found for the factors of Feminine-Esthetic Interest, Technical Hobbies and Interests, Talking with Others and Musical Activities. The developmental effects on those dimensions may be said to have some degree of similarity under either CS or LS designs. On the other hand, the pattern of change in factor presence for Sports and Masculine Interest, Social Activities, Reading Interests and Academic Interests differs for CS and LS data.

Overall factor patterns. When LS and CS samples are contrasted on the basis of the trace values, it is apparent that the average matrix is more similar to the subpopulation matrices for the CS data (i.e., trace values of 1.67, 2.67 and 4.04 for the 7th, 9th and 11th grades respectively). The greater disparity between the average matrix and subpopulation matrices for the LS sample (trace values of 8.51, 13.0 and 8.71) suggest surprisingly greater variation in its overall factor patterns. In accounting for such differences in factor pattern similarity one could focus on the effects of repeated administration of the same measure to the same individuals every other year (i.e., error attributable to test-retest reliability). However, if such errors were involved, one would expect the 7th grade factor pattern to be more like the 9th grade than the 11th since the time span is less. Perhaps social changes in the adolescent culture, between 1963 and 1967, had an impact on the structural consistency of interests and activities that exceeded the differences between adolescent groups at different grade levels during the same year (i.e., in 1963). Any speculation is confounded by the inability to separate the effects of those two sources of variance from "true" developmental effects.

Comparisons of the trace values also indicate that the extent and type of similarity between factor patterns of each subpopulation differs for LS and CS data. For the CS sample, the 9th grade factor pattern was most similar to the average pattern matrix, the 7th grade next in similarity and the 11th grade least similar. The LS sample results differ sharply, with dimensional similarities greater for 7th and 11th grades, while the 9th grade matrix was least like the average matrix.

Marked similarity in the proportion of total variance accounted for by the factors at each grade level is evident for the CS and LS samples. The factors uniformly accounted for about a third of the variance in this biographical instrument.

Factor intercorrelations. For the CS sample considerably greater orthogonality of factor structure was evident at each of the three grade levels, correlations between factors rarely having exceeded levels of .13 (Rock & Freeberg, 1969). However, more than a dozen correlations far exceeded that value for the factors of the LS sample subpopulations shown here, with some r's > .60.

In the CS study, the rotated average matrix provided a close fit to all three subpopulation matrices with no sacrifice in orthogonality. Thus, the sample reflected relative stability of dimensionality over the three grade levels under consideration. A comparable level of stability and continuity is lacking for the LS sample, particularly because of the gross departure from an orthogonal structure occurring at the 9th grade occasion. Such differences indicate that the changes in dimensionality in LS data, which do not appear in

CS data, can occur despite similarities in the designations that define the subscales at each developmental level.

## Conclusions

This analysis of factorial invariance for a self-report measure of biographical information has dealt with a relatively short, but apparently significant, period of development between early and late adolescence (i.e., between grades 7, 9 and 11). Changes in underlying configurations of responses to items dealing with interests and experiences could be assumed by the relative strength of dimensions that define the same measure at different grade levels and by changes in the factor intercorrelations over time. However, any interpretations regarding dimensional continuity drawn from the above results should not imply stability of level for any given individual response characteristics.[4]

For the longitudinal sample, there were marked changes in factor presence over the three grade levels, centering particularly on the factor pattern of the 9th grade. These transitional changes were evident, primarily, for the more recreational-leisure types of activities (e.g., social activities, sports, TV viewing preferences) and to a lesser degree for the esthetic-artistic, intellectual and technical areas. Comparisons of the total factor pattern of each grade level (as opposed to specific factor pattern comparisons) lend additional support to the importance of the 9th grade as the focus of a transitional phase for this particular developmental time segment. Thus, 7th and 11th grade factor patterns were found to be somewhat more similar to one another than they were to the 9th grade patterns. Further, an analysis of factor stability or consistency, defined by factor axis intercorrelations over the three grade levels, confirms the transitional quality of the dimensions that underlie the 9th grade responses.

Comparisons of cross-sectional and longitudinal findings have represented a perennial area of interest in the choice of measures (and their interpretation) when studying developmental change. For many forms of measurement, longitudinal and cross-sectional data have produced rather diverse, even conflicting, results (Tyler, 1956). Findings obtained with the biographical measure applied here would, similarly, fail to justify the interchangeability of one data source for another, at least where the research intent is to identify the extent and locus of dimensional continuity.

There were similarities between CS and LS findings with regard to the number of major dimensions found, their designations or meaning, and in the total variance that they accounted for on each occasion. However, there was no reasonable hint in the CS analysis of the unique transitional role of 9th grade factor patterns. In addition the relatively stable factor intercorrelations and greater overall similarity of factor patterns across different grade levels found for a CS sample contrast sharply with the findings for the LS data. Biasing influences that could stem from the selection of the LS sample, however, must be considered. For example, family mobility may have operated selectively in the sample of students who remained in the school system over a five-year period. Also chronic absenteeism on a student's likelihood of inclusion over three test sessions, or willingness to complete the biographical measure at each session were, unfortunately, unknown in their influence on the LS sample composition.

Results of the type reported here may have implications for the construction of developmentally meaningful scales beyond simply specifying the extent of dimensional continuity. There is the possibility that, in addition, these results reflect differential response patterns attributable to developmental effects on perceived stimulus (item) quality. In other words, it is suggested that the structural changes derived from patterns of item interrelationships may reflect transformations or changes in perception of item meaning (i.e., respondent interpretations) at different developmental levels. If so, comparable scales may require modified item material in order to tap dimensionally stable sets of attributes at differing developmental periods. Possible sex differences in dimensional patterns and continuity also remain to be explored for greater precision in the application of BIB scales. Strongly sex-linked factors found with the present data suggest the importance of extending these analyses.

Choice of appropriate analytical techniques and the matter of interpreting results remain as difficulties that are likely to be resolved only by continued research applied to a variety of measurement methods and areas of behavior. The present approach does, however, provide a more fruitful alternative for long-term research planning (especially for long-term longitudinal studies than the all too frequent one of choosing measures that may be in vogue at the inception of a study but lose their developmental "relevance" and intended dimensional qualities before data collection is even completed.

References

Black, M. S. The development of personality factors in children and adolescents. Educational and Psychological Measurement, 1965, 25, 767-785.

Bronson, W. C. Central orientations: A study of behavior organization from childhood to adolescence. Child Development, 1966, 37, 125-155.

Douvan, E., & Gold, M. Modal patterns in American adolescence. In L. W. Hoffman and M. L. Hoffman (Eds.), Review of child development research, Vol. 2. New York: Russell Sage Foundation, 1966. Pp. 469-528.

Emmerich, W. Continuity and stability in early social development. Child Development, 1964, 35, 311-332.

Emmerich, W. Personality development and concepts of structure. Child Development, 1968, 39, 671-690.

Hilton, T. L., & Myers, A. E. Personal background experience and school achievement: An investigation of the contribution of questionnaire data to academic predictor. Journal of Educational Measurement, 1967, 4, 69-80.

Maier, M., & Anderson, S. B. Growth Study I: Adolescent behavior and interests. Research Bulletin 64-52. Princeton, N. J.: Educational Testing Service, 1964.

Meredith, W. Rotation to achieve factorial invariance. Psychometrika, 1964, 29, 187-206.

Rock, D. A., & Freeberg, N. E. Factorial invariance of biographical factors. Multivariate Behavioral Research, 1969, 4, 195-210.

Tyler, L. E. The psychology of human differences. New York: Appleton-Century-Crofts, 1956.

Wohlwill, J. F. The age variable in psychological research. Psychological Review, 1970, 77, 49-64.

Footnotes

[1]The authors would like to acknowledge the many helpful suggestions and constructive criticisms provided by Drs. Walter Emmerich and Robert Linn.

[2]The prior study of a cross-sectional sample (Rock & Freeberg, 1969) had used 130 items common to the forms available in 1963 for grades 7, 9 and 11. Included in those 130 were the 124 items of the present study. The six noncommon items were scattered through various factored subscales and are considered insignificant in their effects on the structural comparisons to be reported between cross-sectional and longitudinal study data.

[3]For the factor loading pattern of the average matrix order NAPS Document #__________ from ASPS, National Auxiliary Publications Services.

[4]As a possible way of bridging this gap between individual distinctiveness (relative standing) and changes in behavioral content, or dimensional meaning over time, Emmerich's (1964) concept of "developmental transformation" is of interest.

Table 1

Correlations between Factor Axes

(7th Grade)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | -0.2500 | 0.6341 | -0.0827 | 0.0691 | 0.0501 | 0.0928 | -0.0322 | 0.0490 | 0.0097 | 0.0085 |
| | | 0.4185 | -0.0100 | -0.0115 | 0.0719 | 0.0931 | 0.0662 | 0.0862 | -0.0587 | -0.2235 |
| | | | 0.0376 | 0.2408 | -0.0464 | 0.0676 | 0.0367 | 0.0936 | 0.0672 | -0.0850 |
| | | | | 0.0517 | 0.0601 | 0.2007 | 0.1422 | 0.1629 | -0.0164 | -0.1200 |
| | | | | | -0.0111 | -0.0581 | 0.0456 | 0.0141 | 0.0314 | -0.1821 |
| | | | | | | -0.0749 | -0.2369 | -0.1767 | -0.0220 | 0.0372 |
| | | | | | | | -0.0102 | -0.1279 | -0.0981 | 0.0692 |
| | | | | | | | | -0.2906 | 0.1994 | -0.5501 |
| | | | | | | | | | 0.0486 | 0.3107 |
| | | | | | | | | | | 0.0531 |

Table 2

Correlations between Factor Axes

(9th Grade)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 0.8519 | -0.4580 | 0.2379 | -0.0345 | -0.1123 | -0.0467 | -0.1381 | 0.0600 | 0.3415 | -0.0379 |
| | | -0.4779 | 0.4724 | 0.0546 | -0.2847 | -0.2523 | -0.1918 | -0.1781 | 0.3970 | 0.1370 |
| | | | 0.0268 | -0.1195 | -0.0073 | -0.0397 | -0.1239 | -0.0366 | 0.0418 | 0.0087 |
| | | | | -0.2945 | 0.4228 | -0.7779 | -0.1531 | -0.1546 | -0.1757 | 0.0457 |
| | | | | | 0.0009 | -0.0080 | 0.0129 | -0.1180 | -0.2613 | 0.0729 |
| | | | | | | 0.1369 | 0.5904 | 0.5730 | -0.2197 | -0.0157 |
| | | | | | | | 0.1706 | 0.3303 | 0.4402 | -0.0509 |
| | | | | | | | | 0.7400 | -0.4565 | 0.1268 |
| | | | | | | | | | -0.3930 | -0.0146 |
| | | | | | | | | | | 0.0067 |

Table 3

Correlations between Factor Axes

(11th Grade)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | -0.3984 | 0.6138 | -0.1150 | -0.0363 | 0.0564 | -0.0425 | 0.1982 | -0.0980 | -0.1442 | 0.2574 |
| | | 0.3759 | -0.2118 | -0.0194 | 0.0947 | 0.0357 | 0.0913 | 0.0229 | -0.0483 | -0.3087 |
| | | | -0.0795 | -0.0461 | 0.0946 | -0.1484 | 0.3350 | -0.0245 | -0.1141 | -0.0082 |
| | | | | 0.1284 | 0.2241 | 0.2315 | 0.0147 | -0.0350 | 0.0582 | -0.0724 |
| | | | | | 0.0177 | 0.0707 | -0.0653 | 0.0744 | 0.0517 | -0.1152 |
| | | | | | | 0.0071 | -0.3663 | -0.2527 | 0.1157 | 0.0269 |
| | | | | | | | -0.1367 | -0.0839 | -0.0282 | 0.1478 |
| | | | | | | | | -0.4865 | 0.0154 | -0.2023 |
| | | | | | | | | | 0.0855 | -0.3876 |
| | | | | | | | | | | -0.0946 |

Table 4

Scaled Factor Variance Estimates, Trace Values and

Total Variance Accounted for at Each Grade Level

(Longitudinal and Cross-Sectional Samples)

| | Factor | GRADE 7th LS | 7th CS | 9th LS | 9th CS | 11th LS | 11th CS |
|---|---|---|---|---|---|---|---|
| I | Feminine-Esthetic Interests | .77 | .94 | 1.16 | 1.05 | 1.07 | 1.01 |
| II | Sports and Masculine Interests | 1.16 | .94 | .58 | 1.05 | 1.26 | 1.00 |
| III | General Social and Leisure Activities | .43 | .82 | 2.23 | 1.08 | .34 | 1.10 |
| IV | Broad Reading Interests | .87 | 1.05 | .68 | .98 | 1.45 | .98 |
| V | Talk with Others (about Plans and Interests) | 1.29 | 1.23 | .73 | .90 | .98 | .86 |
| VI | Academic Course Interests | 1.53 | 1.18 | .74 | 1.30 | .73 | .52 |
| VII | Musical Activities | 1.17 | 1.07 | .63 | .91 | 1.20 | 1.02 |
| VIII | Lower-Level Social and Leisure Activities[a] | .87 | | 1.24 | | .88 | |
| IX | Technical Hobbies and Interests | 1.10 | .96 | .84 | 1.02 | 1.06 | 1.01 |
| X | General TV Viewing | 1.35 | 1.05 | .21 | 1.01 | 1.44 | .94 |
| XI | Academic Effort[a] | .14 | | 2.80 | | .06 | |
| | High-Level Literary Activities (X)[b] | | 1.63 | | 1.05 | | .32 |
| | High-Level TV Viewing (XI)[b] | | 1.05 | | 1.07 | | .88 |
| | Trace Values | 8.51 | 1.67 | 13.06 | 2.67 | 8.71 | 4.04 |
| | Total Variance Accounted for | 31% | 32% | 31% | 34% | 30% | 33% |

[a]Factor extracted from LS sample only.

[b]Factor extracted from CS sample only.