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ABSTRACT

This study used species diversity indices developed in ecology as a measure of socioethnic diversity, and compared them to Coleman's Index of Segregation. The twelve indices were Simpson's Concentration Index ("ell"), Simpson's Index of Diversity, Hurlbert's Probability of Interspecific Encounter (PIE), Simpson's Probability of Individual Interspecific Encounter, the complement to Simpson's Concentration Index (1-"ell"), McIntosh's Index, the Shannon-Weiner Diversity Index, Number of Species (and its complement), and Importance Values (relative importance, unrelative importance, and equitability). Intercorrelation matrices were formed for racial and ethnic segregation and diversity measures. Coleman's segregation index and its expected value do not correlate strongly with each other or any of the diversity measures. Correlations approaching unity do exist between many of the racial and ethnic diversity measures. The indices using evenness, equitability, and importance of racial and ethnic characteristics to measure similarity-dissimilarity were the most effective measures of racial and ethnic diversity of schools. All the measures except Coleman's index showed public schools to be more racially and ethnically diverse than private schools. (BW)

# Measures of School Integration: Comparing Coleman's Index to Measures of Species Diversity

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In a highly publicized study, Coleman, Hoffman and Kilgore (1981) concluded that public schools were "less effective" than either Catholic or private schools. Indeed, they claimed that private schools were slightly less segregated than public schools. This latter finding seems to fly in the face of minute minority, and particularly black, enrollments in private schools. Such an interpretation calls for a close inspection of their methodology and their choice of an index to measure segregation. Additionally, their interpretation brings into focus the controversy regarding measures of segregation.

The responsibility of school systems in the United States to provide quality education to all students underscores the need to develop unambiguous measures of integration. A review of the educational literature reveals a collage of definitions and methods used to describe integration. Taeuben and Taeuben (1969) provided a detailed analysis of segregation indices. The Index of Dissimilarity presented by Duncan and Duncan (1955) became the most popular measure of segregation. This index uses the Lorenz curve to measure the unevenness of distribution of two groups. Dissimilarity indices are affected by the size of the analysis unit and the group composition of the aggregate (Cortese, Falk and Cohen, 1976). This affect can cause and observed dissimilarity index value to be misinterpreted. Based on information theory Theil and Finizza (1971) developed an index that measures race entropy, a measure of the contribution a school district's racial composition makes to segregation throughout the whole system (Zoloth, 1976). The difficulty with this measurement is that the results do not provide easy direct interpretation. Coleman (1981) describes his index of segregation as a "variance" measure. Page (1981) criticizes this index with favoring the private sector by emphasizing the within-sector variance and suggests an "Index of Integration".

Ecologists use the concept of species number, richness, equitability or evenness, and importance to measure similarity-dissimilarity in biological communities. Peet (1975) provides a review of species diversity concepts regarding species number and distribution. Similar concepts appear in several biological, physical and social sciences (Patil and Taille, 1982). Whether measuring segregation of schools or species diversity of biological communities it is difficult to understand the complex phenomena that affect diversity. This has led to various interpretations of the diversity concept. As a result, diversity is largely defined by the instrument used to measure it. The lack of universal agreement on the concept of diversity prevents the scientific community from clarifying controversial issues for the public.

This study uses species diversity indices developed in ecology as a measure of socioethnic diversity, comparing these to Coleman's Index of Segregation.

## Coleman's Index

Coleman, Kelly and Moore (1975) measure between-school-sector segregation as a function of interacial contact and measures within-school-sector segregation by standardizing the interacial contact. The measure of interacial contact ($S_{ij}$) is a measure of the average proportion of a student's schoolmates who are from another group. It is constructed as follows for any groups i and j:

$$S_{ij} = \frac{\Sigma_k n_{ki} P_{kj}}{\Sigma_k n_{ki}}, \text{ where}$$

$n_{ki}$ = number of students in group i in school k

$P_{kj}$ = proportion of students in group i in school k

Schools in the sector are numbered 1, . . . . k, . . . . n.

Segregation ($r_{ij}$) within a sector is constructed by standardizing the measure of interacial contact by the proportion of students of the other group in the sector:

$$r_{ij} = \frac{P_j - S_{ij}}{P_j}, \text{ where} \qquad (1)$$

$P_j$ = proportion of students in group j.

The measure of interacial contact ($S_{ij}$) is affected by the degree of segregation between groups of students in the sector and by the overall proportion of each group of students. The segregation index ($r_{ij}$) is affected by the distribution of students among the schools within a sector. Coleman (1981) concluded public schools have higher proportions of blacks and are less interacially segregated than private schools but are more internally segregated within the sector than private schools. The lesser degree of segregation within the private sector counteracts the higher degree of interacial contact and overall private schools contribute slightly less to segregation. Coleman concluded that these two tendencies would cancel each other out if the private school students were absorbed into public schools with exactly the same distribution among schools that is currently found in public schools.

### Expected Value of $r_{ij}$

Researchers have demonstrated that Coleman's index is not a function of the proportion of the universe population in a group (Becker, McPortland, and Thomas 1978). Becker et al. demonstrated the expected value of $r_{ij}$ is equal to m/N, where m is the number of units in the universe and N is the total population in the universe. For a universe of equal size $E[r_{ij}]=1/n$, where n = N/m. This study uses this relationship to measure the effect a school population has on $E[r_{ij}]$.

$$E[S] = 1/n = M_j/N_{ij}, \text{ where} \quad (2)$$

$M_j$ = total schools in type j

$N_{ij}$ = total students in school i, type j.

## Socioethnic Diversity Measures

This study uses 12 measures of socioethnic diversity derived from species diversity used in ecology. A brief presentation of the equation are given here; for a review of these indices see Peet (1975).

### Simpson's $\ell$

Simpson (1949) interpreted $\ell$ as the probability that two individuals chosen at random and independently from a population will belong to the same group. He considered an infinite population such that each individual belongs on one of z groups, let $\Pi_1,...\Pi_z$ ($\Sigma\Pi = 1$) be the proportions of individuals in the various groups.

Given a sample of N individuals chosen at random from a population, let $n_1, n_2 . . . n_z$ ($\Sigma n = N$) be the number of individuals in different groups. The combined estimator of $\ell$ is given as:

$$D_1 = \ell = \Sigma \frac{n(n-1)}{N(N-1)}; \quad (3)$$

since 1/2 N(N-1) is the number of pairs in the sample and 1/2 $\Sigma n(n-1)$ is the number of pairs drawn from the same groups.

This index is inversely proportional to diversity. For a community consisting of one group with nine individuals and a second group with one individual the index would be .8 For a community with two groups each having five individuals the index would equal .44. Simpson calls this statistic a measurement of concentration and treats it synonymously with diversity.

Simpson's Index of Diversity

Cox (1976) referred to Simpson's index as corresponding to the number of randomly selected pairs of individuals that must be drawn from a community in order to have an even chance of obtaining a pair with both individuals of the same species. This index is calculated by the following equation:

$$D_2 = \Sigma\frac{N(N-1)}{n(n-1)}. \qquad (4)$$

This index is proportional to diversity. A careful inspection shows that $D_2 = 1/D_1$. For a community of two groups containing nine and one individuals the index would equal 1.25. A community of two groups each containing five individuals would equal 2.25. This index can have values between one and infinity.

Hurlbert's Probability of Interspecific Encounter (PIE)

Hurlbert (1971) criticized ecologists for advancing the diversity concept into a nonconcept unrelated to meaningful biological properties. He proposed ecologists develop meaningful biological properties using species composition parameters; the probability of interspecific encounter

(PIE), a measure of an individual moving at random in a community was devised by Hurlbert. A community will have (N) (N-1)/2 potential encounters of N individuals; $\Sigma(n)(N-n)/2$ would involve individuals belonging to different groups.

$$D_3 = PIE = \Sigma(\frac{n}{N})(\frac{N-n}{N-1}) = (\frac{N}{N-1})(1-\Sigma\Pi^2), \text{ where} \quad (5)$$

$\Pi = \frac{n}{N}$.

Simpson's $1 - \Sigma\Pi^2$

Hurlbert (1971) referred to $D_4 = 1 - \Sigma\Pi^2$ (6)

as a compliment of Simpson's index. This measures the probability of individual interspecific encounter.

Simpson's $1 - \ell$

The compliment of $\ell$ is considered:

$$D_5 = 1 - D_1 \quad (7)$$

The relationship of $D_5$ to $D_4$ and PIE is due to the direct relationship of $\ell$ to $\Sigma\,\Pi^2$, which is $1 - \ell = (n/N)\Sigma(\frac{n}{N})^2$.

Consider $D_5 = 1 - D_1$:

$1 - \ell = 1 - [\Sigma n(n-1)/N(N-1)]$;

$1 - \ell = [N(N-1) - \Sigma n(n-1)]/N(N-1)$;

$1 - \ell = [N^2 - N - \Sigma n^2 + \Sigma n]/N(N-1)$;

$1 - \ell = [N^2 - N - \Sigma n^2 + N]/N(N-1)$;

$1 - \ell = [N^2 - \Sigma n^2]/N(N-1)$;

$1 - \ell = N/N-1 \cdot [1 - (\Sigma n^2/N^2)]$;

$1 - \ell = N/N-1 \cdot (1 - \Sigma\Pi^2)$;

This last expression is identical to $D_3$, Hurlbert's measure of PIE.

McIntosh's Index

McIntosh (1967) proposed a variation of Simpson's index that is derived from a distance measure. This index is given by:

$$D_6 = (N - \sqrt{\Sigma n^2})/(N - \sqrt{N}) \quad (8)$$

Distance is a measure of the ecological relationship suggested by the similarity of two communities or samples. Two communities in which three groups are represented appear as points in a three-dimensional space. The equation is valid beyond three dimensions in an n-dimensional space. Each group is theoretically represented by an axis in such a hypothetical space. The similarity of a set of communities is represented by the matrix of distance values between the communities.

## Shannon-Weiner Diversity Index

The Shannon-Weiner Index uses information about the degree of uncertainty in choosing the group membership of an individual drawn at random (Shannon and Weaver, 1949). The uncertainty increases both as the number of groups increases and as the individuals are distributed more equitably among the group already present. The index is given by:

$$D_7 = -\Sigma \left(\frac{n}{N}\right) \log \left(\frac{n}{N}\right). \quad (9)$$

## Number of Species

Species number is a fundamental concept of diversity used to define the functional relation of species-abundance to estimate species richness and equitability of a community. Mork (1967) used a second degree polynomial to show a strong relation between the Shannon-Weiner Index and number of species. This study used $D_7 = S$, where S = the number of groups (groups are analogous to species) and $D_8 = 1 - \frac{1}{S}$ as a measure of diversity. (11)

## Importance Values

Whittaker (1972) examined diversity patterns based on the slope of the dominance diversity curves or importance value sequence. The curves are constructed such that the ordinate represents the logarithm of some importance value (e.g. abundance) while the abscissa is simply the included species sequence from most to least important (Peet, 1974). Equitability may be conceived as a function of the variance of species importance values: the wider the dispersion of the importance values, the lower the equitability. Three measures of importance (relative importance, unrelative importance and equitability) are the final measures used in this study. Using Whittaker's (1972) notation the variance for relative importance values is related to Simpson's index, $V_e = C - 1/S$, where C was the notation used by Whittaker for Simpson's $\ell$.

$D_{10} = \ell - 1/S$, measures relative importance (12)

$D_{11} = \frac{\Sigma n^2 - (N^2/S)}{(1-1/S)(N-S)^2}$, measures unrelative importance (13)

$D_{12} = 1 - D_{11}$, measures equitability (14)

Date Set Used

The data collected in 1980 by the National Opinion Research Center at the University of Chicago for the National Center for Educational Statistics served as the data base for this study. An auxiliary data set was generated using the school as the unit of analysis and card images were built by school for number of students by race or ethnic group. From this set another data set was generated with card images containing school ID, school type, and the calculated values of the 14 indices by race and ethnic origin.

Methods

A factor analysis for both racial and ethnicity were completed and intercorrelation matrices were formed. ANOVA's by schooltype were completed.

Results

Intercorrelation matrices were formed for racial and ethnic segregation and diversity measures (Table 1). Coleman's segregation index and E[S] do not correlate strongly with each other or any of the racial or ethnic diversity measures. Correlations approaching unity do exist between many of the race and ethnic diversity measures. Racial diversity measures: Simpson's ($D_1$), Simpson's Index of Diversity ($D_2$), PIE ($D_3$), Simpson's $1-\Sigma\pi^2$ ($D_4$), Simpson's $1-\ell$ ($D_5$), McIntosh's Index ($D_6$), and Shannon-Weiner's Diversity Index ($D_7$) all correlate strongly, the lowest absolute correlation value of this set being .942. Ethnic diversity measures $D_1$ through $D_7$ also are strongly correlated. Of the 21 possible correlations for this set of seven indices six are between the absolute values of .672 and .768. The other 15 have absolute values above .922. The number of groups measured by S ($D_8$) correlates strongly with 1-1/S ($D_9$). These two measures correlate moderately with measures $D_1$ through $D_7$. Among this set of correlations the lowest absolute value occurs between $D_9$ and $D_2$. Relative importance, $\ell$-1/S ($D_{10}$), does not correlate strongly with any of the racial diversity measures but does correlate with ethnic diversity measures. Correlations approaching unity occur with $D_{10}$ involving $D_1$, $D_3$, $D_4$, $D_5$ $D_6$, $D_7$, $D_{11}$, and $D_{12}$. The absolute value of the correlations of unrelative importance ($D_{11}$) and equitability ($D_{12}$) approach unity with all racial diversity measures except $D_8$, $D_9$, and $D_{10}$. Ethnic diversity measures $D_{11}$ and $D_{12}$ approach unity with $D_1$, $D_3$, $D_4$, $D_5$, $D_6$, $D_7$, and $D_{10}$.

Factor analyses were used to examine these correlations further. A principle components solution with a varimax rotation was conducted using the 14 measures. For racial data the measurements loaded in three factors. These factors accounted for 92.2 percent of the total variance in the data, 70.2 percent by Factor 1, 14.6 percent by Factor 11, and 7.5 percent by

Factor III. Only Coleman's Index E[S], $S(D_8)$, $1-1/S(D_9)$ and $\ell-1/S(D_{10})$ do not load substantially on Factor 1. Coleman's index and E[S] load partially on Factor 1 but more highly on Factor III. The racial diversity indices $D_8$, $D_9$, and $D_{10}$ load highly on Factor II.

For ethnic data the measurements loaded only on two factors. Factor 1, being the most significant factor, accounted for 71.2 percent of the total variance in the data. Similar to the race data all variables loaded highly on Factor I, except for Coleman's index, E[S] loaded evenly on both factors but in the same direction as Coleman's index; $S(D_8)$ and $1-1/S(D_9)$ load evenly across both factors.

ANOVA's by sector were completed for each measure of racial and ethnic diversity (Tables 4 and 5). As a measure of racial segregation Coleman's index and $\ell-1/S$ $(D_{10})$ are not significantly different by sector. All other measures show public schools to be more racially diverse (Table 4). Ethnic diversity doesn't differ significantly between public, private and catholic schools except as measurement by E[S], $S(D_8)$, $1-1/S(D_9)$, and $\ell-1/S(D_{10})$. Means for each sector for each measure are shown in Tables 6 and 7.

Discussion

Coleman's Index of segregation $(r_{ij})$ using the school as the unit of analysis is a variance measure of the proportion of students in a group within a sector. In this case $S_{ij}$ is not a measure of interacial contact because the number of students in group 1 divide out of the equation. This results in $S_{ij} = P_{kj}$, the proportion of students in group j and school k. Coleman's index measures school deviation from the overall proportion of a group in a sector. Coleman's index $(r_{ij})$ is not significantly different between sectors (Tables 4 and 5), therefore white students are distributed within sectors. Because white students are "somewhat" evenly distributed within sectors, the within sector distribution of non-white students would have to vary significantly to arrive at Coleman's conclusion that the within segregation was higher in public schools. Under the above conditions the relationship between Coleman's index ($r_{ij}$) and E[S] no longer exists. E[S] measures the size of the unit in a sector in terms of the number of students in a school. Although E[S] and $r_{ij}$ don't correlate strongly they are the only measurements that load high on Factor III. Since E[S] is only affected by the number of students in a school Factor III is likely a measure of students ($n_i$) in a school. If the number of schools are held constant in a sector, only shifts in $n_i$ would affect E[S].

Several measures of diversity are combinations of other measures. These include; $D_1$, $D_2=1/D_1$, $D_3=PIE=D_5$, $D_4=1-\Sigma TT^2$, $D_5=1-D_1$. In addition to these indices, $D_6$=McIntosh's Index, $D_7$=Shannon-Weiner Index, $D_{11}$ and $D_{12}$ all load significantly on Factor I for race and ethnic data (Tables 2 and 3). The calculations using these measurements all involve the manipulation of the number of individuals in a group and the total population. Based on correlations and factor loading the concept of diversity is measured by these indices. The measurements involving the number of groups present, $S(n_8)$, $D_9=1-1/S$ and $D_{10}=\ell - 1/S$ all load strongly on Factor II. This suggests Factor II measures, race and ethnic membership.

The concept of racial and ethnic diversity of schools appear to be best measured by $D_1$, $D_2$, $D_3$, $D_4$, $D_5$, $D_6$, $D_7$, $D_{11}$ and $D_{12}$. These indices use evenness, equitability and importance of racial and ethnic characteristics to measure similarity-dissimilarity. Coleman's index is strongly influenced by the proportion of one group. It does not account for the race and ethnic characteristics of all other groups. Coleman's index is the only index in this study that allows the conclusion that public schools and private schools are equally diverse. All other measures show public schools to be more racially and ethnically diverse. In fact, if the question, what sector allows the highest interacial interaction, then the PIE measure of racial diversity would appropriately best answer that question. The public and Catholic sectors are approximately equal in PIE, with probabilities of .251 and .261 respectively. However, the private sector is significantly less diverse (integrated); the PIE for the private sector is .160. These outcomes are more consonent with the common sense notion that those schools that have the highest proportions of minorities will have the highest degree of diversity.

Further, if social class is considered (see Table 8) public schools enroll far more low income (social status) students than do either the Catholic schools or the private schools. The contrast of public to private schools is 31.72 percent to 6.96 percent in terms of low status students. In light of these findings, Coleman's interpretation of the data together with his measure of so-called "integration" are not just ironic; they are so misleading to be better be described as being tragic.

References


Becker, H. J., McPortland, J., and Thomas, G. The measurement of segregation: The dissimilarity index and Coleman's segregation index compared. Annual Meetings of the American Statistical Association, Social Science Section, 1978, 349-362.

Cole an, J. S. A response to Page and Keith. Educational Researcher, 1981, 12, August/September, 18-20.

Coleman, J., Hoffer, T., and Kilgore, S. Public and private schools: A report to the national center for education statistics by the National Opinion Research Center. Chicago: University of Chicago, 1981.

Coleman, J. S., Kelly, S., and Moore, J. Trends in school segregation, 1968-73. Washington, D.C.: Urban Institute, 1975.

Cortese, C. F., Falk, R. F., and Cohen, J. K. Further considerations on the methodological analysis of segregation indices. American Sociological Review, 1976, 41, 630-639.

Cox, G. W. Laboratory manual for ecology, Third Edition. Dubuque, Iowa: Wm. C. Brown Co., 1976.

Duncan, O. D. and Duncan, B. A methodological analysis of segregation indexes. American Sociological Review, 1955, 20, 210-217.

Hurlbert, S. H. The nonconcept of species diversity: A critique and alternative parameters. Ecology, 1971, 52, 577-586.

McIntosh, R. P. An index of diversity and the relation of certain concept to diversity. Ecology, 1967, 48, 392-404.

Monk, C. D. Tree species diversity in the eastern deciduous forest with particular reference to north central Florida. American Naturalist, 1967, 101, 173-187.

Page, E. B. and Keith, T. Z. Effects of U.S. private schools: A technical analysis of two recent claims. Educational Researcher, 1981, 12, August/September, 7-17.

Patil, C. P. and Taillie, C. Diversity as a concept and its measurement. Journal of American Statistical Association Invited Papers Section, September, 1982, 77, 548-563.

Peet, R. K. The measurement of species diversity. Annals of the Review of Ecological Systems, 1974, 5, 285-307.

Peet, R. K. Relative diversity of indices. Ecology, 1975, 56, 496-498.

Simpson, E. H. Measurements of diversity. Nature, 1949, 163, 288.

Shannon, C. W. and Weaver, W. *The mathematical theory of communication*. Urbana: University of Illinois Press, 1949.

Taeuben, K. E. and Taeuben, A. F. *Negroes in cities: Residential segregation and neighborhood change*. New York: Atheneum, 1969.

Theil, H., and Finizza, A. A note on the measurements of racial integration of schools by mean of informational concepts. *Journal of Mathematical Sociology*, 1971, 1, 187-194.

Whittaker, R. H. Evolution and measurement of species diversity. *Taxon*, 1972, 21, 213-251.

Zuloth, B. S. Alternative measures of school segregation. *Land Economics*, 1976, 278-298.

Table 1

Correlation Among 14 Measures of Socioethnic Diversity
Ethnicity Correlations Above Main Diagonal, Racial
Correlations Below Main Diagonal (N=1015)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $r_{ij}$ | .086 | .228 | -.251 | -.243 | -.248 | -.243 | -.256 | -.293 | -.268 | -.227 | .191 | .208 | -.208 |
| .086 | E[S] | -.158 | .105 | .160 | .126 | .160 | .191 | .071 | -.075 | -.087 | -.248 | -.079 | .079 |
| -.375 | .179 | $D_1$ | -.676 | -.975 | -.971 | -.975 | -.963 | -.922 | -.676 | -.567 | .944 | .911 | -.911 |
| .385 | -.181 | -.951 | $D_2$ | .672 | .672 | .678 | .768 | .761 | .615 | .393 | -.657 | -.544 | .544 |
| .375 | -.179 | -1.00 | .951 | $D_3$ | .996 | 1.00 | .980 | .939 | .687 | .668 | -.923 | -.888 | .888 |
| .374 | -.183 | -1.00 | .950 | 1.00 | $D_4$ | .996 | .968 | .952 | .717 | .696 | -.904 | -.899 | .899 |
| .375 | -.179 | -1.00 | .951 | 1.00 | 1.00 | $D_5$ | .978 | .939 | .687 | .668 | -.923 | -.888 | .888 |
| .383 | -.172 | -.996 | .971 | .996 | .994 | .996 | $D_6$ | .942 | .681 | .590 | -.938 | -.867 | .867 |
| .362 | -.185 | -.985 | .942 | .985 | .986 | .985 | .980 | $D_7$ | .868 | .712 | -.832 | -.834 | .834 |
| .174 | -.187 | -.656 | .659 | .656 | .659 | .656 | .637 | .754 | $D_8$ | .713 | -.503 | -.572 | .572 |
| .153 | -.177 | -.597 | .489 | .597 | .600 | .597 | .569 | .669 | .883 | $D_9$ | -.331 | -.475 | .475 |
| -.223 | -.014 | .373 | -.446 | -.373 | -.370 | -.373 | -.401 | -.275 | .323 | .521 | $D_{10}$ | .881 | -.881 |
| -.370 | .174 | .956 | .898 | .956 | -.957 | -.956 | -.950 | -.903 | -.453 | -.448 | .500 | $D_{11}$ | -1.000 |
| .370 | -.174 | .956 | .898 | .956 | .957 | .956 | .950 | .903 | .453 | .448 | -.500 | -1.000 | $D_{12}$ |

$r_{ij}$ = Coleman's Index;
E[S] = The Expected Value of Coleman's Index
$D_1$ = Simpson's $\ell$;
$D_2$ = Simpson Index of Diversity=$1/D_1$;
$D_3$ = Hurlbert's PIE=$D_5$;
$D_4$ = Simpson's $1-\Sigma\pi^2$;
$D_5$ = Simpson's $1-\ell$;
$D_6$ = McIntosh's Index;
$D_7$ = Shannon-Weiner Index;
$D_8$ = S (Number of Groups);
$D_9$ = 1-1/S;
$D_{10}$ = $\ell$-1/S;
$D_{11}$ = unrelative importance
$D_{12}$ = $1-D_{11}$.

Table 2

Varimax Rotated Factor Matrix for Racial Diversity

| Indices | Factor I | Factor II | Factor III |
|---|---|---|---|
| $r_{ij}$ | .39655 | -.00707 | .69287 |
| E[S] | .21943 | -.06304 | .85079 |
| $D_1$ | -.98150 | -.17912 | -.03114 |
| $D_2$ | .95823 | .08507 | .08177 |
| $D_3$ | .98150 | .17911 | .93114 |
| $D_4$ | .98092 | .18240 | .02722 |
| $D_5$ | .98150 | .17911 | .03114 |
| $D_6$ | .98417 | .14956 | .03933 |
| $D_7$ | .94748 | .29345 | .02703 |
| $D_8$ | .52641 | .78915 | -.03241 |
| $D_9$ | .44751 | .88018 | -.02865 |
| $D_{10}$ | -.52671 | .82756 | -.06629 |
| $D_{11}$ | -.97507 | .01636 | -.02113 |
| $D_{12}$ | .97508 | -.01637 | .02113 |

Table 3

Varimax Rotated Factor Matrix for Ethnic Diversity

| Indices | Factor I | Factor II |
|---|---|---|
| $r_{ij}$ | -.17845 | -.49602 |
| E[S] | .30477 | -.71969 |
| $D_1$ | -.97228 | -.12170 |
| $D_2$ | .70983 | .19624 |
| $D_3$ | .97486 | .17223 |
| $D_4$ | .96747 | .21368 |
| $D_5$ | .97486 | .17223 |
| $D_6$ | .97765 | .13540 |
| $D_7$ | .91792 | .34848 |
| $D_8$ | .64466 | .56886 |
| $D_9$ | .54719 | .60002 |
| $D_{10}$ | -.95862 | .09097 |
| $D_{11}$ | -.91045 | -.09480 |
| $D_{12}$ | .91045 | .09480 |

Table 4

Summary of Oneway ANOVA's, Racial Diversity by Sector[1]

| Indices | $df_b$ | $df_w$ | $SS_A$ | $SS_W$ | $MS_A$ | $MS_W$ | F |
|---|---|---|---|---|---|---|---|
| $r_{ij}$ | 2 | 1012 | .036 | 138.810 | .018 | .137 | .134 |
| E[S] | 2 | 1012 | 13566.00 | 52185.699 | 6783.066 | 51.566 | 131.539 |
| $D_1$ | 2 | 1012 | .315 | 46.317 | .157 | .045 | 3.448 |
| $D_2$ | 2 | 1012 | 1.949 | 317.225 | .974 | .313 | 3.110 |
| $D_3$ | 2 | 1012 | .315 | 46.316 | .517 | .045 | 3.444 |
| $D_4$ | 2 | 1012 | .336 | 44.129 | .168 | .043 | 3.859 |
| $D_5$ | 2 | 1012 | .315 | 46.310 | .157 | .045 | 3.444 |
| $D_6$ | 2 | 1012 | .128 | 22.720 | .064 | .022 | 2.861 |
| $D_7$ | 2 | 1012 | .194 | 23.327 | .096 | .023 | 4.196 |
| $D_8$ | 2 | 1012 | 15.975 | 1205.002 | 7.987 | 1.190 | 6.708 |
| $D_9$ | 2 | 1012 | .328 | 54.799 | .164 | .054 | 3.030 |
| $D_{10}$ | 2 | 1012 | .118 | 41.059 | .059 | .040 | 1.460 |
| $D_{11}$ | 2 | 1012 | .778 | 97.714 | .389 | .096 | 4.030 |
| $D_{12}$ | 2 | 1012 | .778 | 97.714 | .389 | .096 | 4.030 |

[1] sectors-public schools, catholic schools, private schools

Table 5

Summary of Oneway ANOVA's, Ethnic Diversity by Sector[1]

| Indices | $df_b$ | $df_w$ | $SS_A$ | $SS_w$ | $MS_A$ | $MS_w$ | F |
|---|---|---|---|---|---|---|---|
| $r_{ij}$ | 2 | 1012 | .036 | 138.810 | .018 | .137 | .134 |
| E[S] | 2 | 1012 | 13566.136 | 52185.699 | 6783.06 | 51.566 | 131.566 |
| $D_1$ | 2 | 1012 | .046 | 19.506 | .023 | .019 | 1.203 |
| $D_2$ | 2 | 1012 | 18.602 | 13664.901 | 9.301 | 13.502 | .689 |
| $D_3$ | 2 | 1012 | .007 | 20.118 | .003 | .019 | .193 |
| $D_4$ | 2 | 1012 | .001 | 19.266 | .004 | .019 | .047 |
| $D_5$ | 2 | 1012 | .007 | 20.118 | .003 | .019 | .193 |
| $D_6$ | 2 | 1012 | .038 | 21.472 | .109 | .021 | .900 |
| $D_7$ | 2 | 1012 | .033 | 36.967 | .0168 | .036 | .461 |
| $D_8$ | 2 | 1012 | 85.917 | 9638.228 | 42.958 | 9.523 | 4.511 |
| $D_9$ | 2 | 1012 | .058 | 3.279 | .029 | .003 | 8.900 |
| $D_{10}$ | 2 | 1012 | .096 | 12.414 | .048 | .012 | 3.946 |
| $D_{11}$ | 2 | 1012 | .007 | 32.810 | .003 | .032 | .114 |
| $D_{12}$ | 2 | 1012 | .007 | 32.810 | .003 | .032 | .114 |

[1]sectors-public schools, catholic schools, private schools

Table 6

Means of Sectors for Racial Diversity Measures

| Indices | Public(N=893) | Catholic(N=84) | Private(N=38) | F |
|---|---|---|---|---|
| $r_{ij}$ | .019 | -.002 | .026 | .134 |
| E[S] | 11.878 | .561 | .802 | 131.539** |
| $D_1$ | .749 | .739 | .840 | 3.448* |
| $D_2$ | 1.487 | 1.521 | 1.265 | 3.110* |
| $D_3$ | .251 | .261 | .160 | 3.444* |
| $D_4$ | .245 | .257 | .152 | 3.859* |
| $D_5$ | .251 | .261 | .160 | 3.444* |
| $D_6$ | .164 | .169 | .106 | 2.861 |
| $D_7$ | .192 | .210 | .126 | 4.196* |
| $D_8$ | 2.798 | 3.143 | 2.395 | 6.708** |
| $D_9$ | .563 | .609 | .499 | 3.030* |
| $D_{10}$ | .312 | .348 | .339 | 1.460 |
| $D_{11}$ | .692 | .698 | .839 | 4.030* |
| $D_{12}$ | .308 | .302 | .161 | 4.030 |

*$p<.05$
**$p<.01$

Table 7

Means of Sectors for Ethnic Diversity Measures

| Indices | Public(N=483) | Catholic(N=84) | Private(N=38) | F |
|---|---|---|---|---|
| $r_{ij}$ | .019 | -.002 | .026 | .134 |
| E[S] | 11.878 | .561 | .802 | 131.566** |
| $D_1$ | .214 | .222 | .181 | 1.203 |
| $D_2$ | 6.342 | 5.858 | 6.176 | .689 |
| $D_3$ | .786 | .777 | .792 | .193 |
| $D_4$ | .768 | .764 | .764 | .047 |
| $D_5$ | .786 | .777 | .792 | .193 |
| $D_6$ | .629 | .611 | .647 | .900 |
| $D_7$ | .820 | .822 | .790 | .461 |
| $D_8$ | 11.222 | 11.789 | 9.974 | 4.511* |
| $D_9$ | .900 | .909 | .863 | 8.900** |
| $D_{10}$ | .114 | .131 | .070 | 3.946* |
| $D_{11}$ | .251 | .247 | .238 | .114 |
| $D_{12}$ | .749 | .753 | .762 | .114 |

*p<.05
**p<.01

Table 8

Social Status Distribution by Sector of the Entire High School and Beyond Students (percent by sector)

| Social Status | Public | Catholic | Private |
|---|---|---|---|
| High | 9988<br>20.45 | 1799<br>33.53 | 1194<br>65.97 |
| Middle | 23362<br>47.83 | 2540<br>47.34 | 490<br>27.07 |
| Low | 15491<br>31.72 | 1027<br>19.14 | 126<br>6.96 |