Measuring Ethnic Diversity in Schools

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OBJECTIVES

A continuous variable, by its nature, provides more information than a dichotomous variable. Take for example, a variable commonly used to represent diversity in the field of Educational Psychology, percent nonwhite. Because the achievement gap is typified by one group performing better than another, and these groups are usually defined by using a frequency count of a dichotomous variable which we know results in a loss of information, then the use of a continuous variable might provide more information to the achievement gap. Using *Shannon's entropy index* (Shannon, 2001), a racial diversity index can be computed from the five main ethnic groups commonly collected from public schools: Native American, Asian, Hispanic, African American, and White. This paper explores the research question: How do the two variables, percent nonwhite and Shannon's entropy index, compare when using the same model to predict achievement? The paper then moves on to explore how the two measures of diversity can be used to predict social factors of education such as school climate and teacher community support.

PERSPECTIVES

Measuring Diversity

With diversity typically being a measure of percent non-white in the schools, this may or may not be an appropriate measure to describe the ethnic diversity of a school. As a suggestion for improvement of better measurement practice, more precise measures would minimize our errors in predicting the significance of diversity within the schools.

White (1986) defines diversity "as the relative heterogeneity of the population" (p. 199). The Shannon entropy index is based off of information theory to measure the uncertainty of a random

variable. This was in turn used as biological indices, but also has implications for human populations (White, 1986). Pielou's (1977) addresses several desirable characteristics of a diversity index: population diversity being maximized when all groups are present and equal, the population with more groups having a higher diversity, and the decomposition property holding when there are multiple classifications of diversity that are independent. A diversity index that meets Pielou's guidelines would be able to measure the unevenness in the population distribution, and handle multiple groups or just two groups.

Peet (1975) argues that heterogeneity indices are based on the combination of the amount of species and the evenness of each species, what he calls the richness and equitability. The Shannon index, meeting the guidelines of both Peet (1975) and Pielou (White, 1986), is what is most frequently encountered signifying its potential as a valuable measure of diversity. The index has been mainly used in ecology to index the diversity of different species. The Shannon index is calculated as follows:

$$H' = -\sum_{k=1}^{K} p_k log p_k$$

Where $p_k = N_k/N$

N_k= number of persons in K ethnic groups

N= total number of persons

As the index increases, it becomes more uncertain that a random individual is from a particular ethnic group (Lou Jost, 2006). For instance, if the index is a larger number, it would be more difficult to predict which ethnic group a random student would belong to, showing the richness of the k groups and the sample can be said to be more diverse.

In the case of racial demographics, there are the five common groups used in studies of education across the United States: Native American, Asian, Hispanic, African American, and

White. When the data come from a sample, as opposed to a census, Pielou (1966) states that our interpretation is different than if the data were the actual population values. We would need to estimate the proportions and our diversity variable using a slightly modified calculation:

$$H'' = -\sum_{k} \frac{N_k}{N} log \frac{N_k}{N}$$

This is only an estimation of H' because H' is defined for an infinite population. H'' is actually a maximum likelihood estimator of the unknown population diversity, H', where we use N_i/N to estimate the unknown p_k (Pielou, 1966). Since this is only an estimate, we cannot say that H'' is equal to H' unless we were sampling from an infinite population and that H'' was an exact representative sample.

Academic Success

Academic achievement in schools is commonly measured by test scores and percent graduation. Along with academic achievement, school is also meant to develop students socially. Social supports within the school are often overlooked, but, as Haynes, Emmons, and Ben-Avie (1997) state, these factors have an influence in the academic success of students as well. School environment is critical for learning and development (Bronfenbrenner, 1994; Hopson & Lee, 2011; Haynes et al., 1997; Cohen & Geier, 2010; Benson, Scales, Hamilton, & Sesma, 2006). In fact, Samdal, Wold, and Bronis (1999) found that from a study of 11, 13, and 15 year old students in Finland, Latvia, Norway and Slovakia, students' satisfaction with school had the strongest association with academic achievement in all these countries. Although this is not from the US, it can speak to the general perspectives of students.

This study of school safety/climate (SSC) examines the associations between what Haynes et al. (1997) call the interpersonal interactions and the interpersonal relations

between school community, staff, parents and students. Family, teacher, and community support are forms of developmental measures that have been associated with school climate (e.g., Cabrera & Rodriguez, 2011). The Entropy index from Shannon's work on information theory (White, 1986) is used to calculate a measure of diversity at the school level to try to explain additional variation, which Nassar-McMillan, Karvonen, Perez, and Abrams (2009) believe represents a critical element in school climate.

Search Institute identifies supports as 6 of their 40 assets that are a part of the positive developmental outcomes of adolescents (Scales, Benson, Leffert, & Blythe, 2000). All of the support assets involve a relationship that has a positive effect on students' lives. School climate involves a supportive school culture where students from diverse backgrounds feel welcomed and are welcomed (Nassar-McMillan et al., 2009). This feeling of being welcomed can create a comfortable environment for students and have a positive influence on them. Pink (1982) found that when students have positive school perceptions of their climate, their behavior has a strong association. Teacher expectations and relationships with students were strongly associated with student performance, especially at predominantly Black schools.

Adults must create a climate within the educational community that can help support students to think of themselves as learners (Bryk, 2010). This allows for a safe and orderly environment for students to learn. Bryk proposes that a safe and orderly environment is one ofthe five essential supports for school improvement. Another essential support mentioned by Bryk is to have strong parent-community-school ties. These ties help students to become motivated and participate in the school community. Haynes et al. (1997) summarize in their study that these social interactions and experiences students have in school impact their academic success, as well as their psychosocial adjustment later on in life. Nassar-McMillan et

al. (2009) performed a focus group with students, teachers/counselors, parents and principals. All groups agreed that school-community collaboration can improve school climate in terms of multicultural diversity to promote learning and students' cultural identity.

Ethnicity is a part of a students' identity and can aid in adolescent development (Phinney, 1992). Phinney found that self-esteem was related to ethnic identity for high school students. When a student feels a sense of belonging to a group and has self-esteem due to their ethnic identity, this should allow them to be comfortable in their environment.

With the changing demographics of the US, it is important to understand how diversity is affecting our schools and the educational growth of our students. This study is meant to be a step in obtaining a measure that will provide the most information that can guide researchers and educators to obtaining the knowledge to plan for academic and developmental success.

METHODS

The non-cognitive factors were Rasch-scaled with Winsteps 3.74 (Linacre, 2012). Rasch scaling is used to create scale scores, providing scale (statistical) properties that make them stronger variables in general linear model based analyses. Rasch analysis also provides a strong tool to evaluate the rating scale structure of survey rating scale items and to estimate reliability of each measure. The study uses hierarchical linear model (HLM) analysis as the primary analysis. HLM can help produce the appropriate error terms that can take into account the within-school dependencies (Raudenbush and Bryk, 2002). For example, this can investigate the extent to which school characteristics may be able to explain variation in students' perceived School Safety and Climate. The statistical software HLM6 is utilized to conduct the hierarchical linear model analysis.

DATA SOURCES

The Minnesota Student Survey (MSS) was designed by an interagency team from the MN Departments of Education, Health and Human Services, Public Safety, and Corrections to monitor important trends and support planning efforts of local public school districts and the four collaborating state agencies. The MSS in 2010 was administered to students in 6th, 9th, and 12th grades. During the administration, all operating public school districts were invited to participate, including correctional facilities housing youths.

This study involved a secondary data analysis of the MSS. The study was a correlational research design that treated the data as cross-sectional data. The school level data were calculated using averages across grades within year of the MSS, the National Center for Educational Statistics Common Core Database for 2010, and the Minnesota Department of Education for 2010.

RESULTS

Table 1
HLM results

Variable	Standardized effect	Intra Class Correlation
	SSC	
Percent non-white	-1.83	6%
Diversity Index	-.51	6%
	GPA	
Percent non-white	-.112	2.5%
Diversity Index	-.025	3%

Table 1 shows some preliminary results. The variables, controlled for gender, free/reduced lunch, grade, and location of the school appears to explain more variation for the non-cognitive factor. Within the separate outcome variables, SSC and GPA, these variables appear to have larger effect sizes.

DISCUSSION

The research question was intended to assess the difference between the two different diversity variables, ethnic diversity and percent non-white. Another intention of the study was to compare whether these types of diversity variable would be directly related to academic outcomes or non-cognitive outcomes. As research shows (Bronfenbrenner, 1994; Hopson & Lee, 2011; Haynes et al., 1997; Cohen & Geier, 2010; Benson, Scales, Hamilton, & Sesma, 2006), these non-cognitive outcomes are indirectly related to the success to students. The preliminary results seem to indicate that these types of diversity variables explain more variation with the non-cognitive outcomes. This may suggest a more appropriate use of this type of variable in these scenarios. While the ethnic diversity index really meets all of the strict criteria outlined by Pielou (White, 1986) and Peet (1975), it only performs marginally better (if that) than percent nonwhite. So researchers are faced with a dilemma; do they want to use a pragmatic variable that is easily accessible such as percent nonwhite, or do they want to use something that is theoretically sound, such as Shannon's diversity index, but more research is needed to really explore the utility of these two variables within education because we don't want to fall into the trap of letting our choice of how we measure diversity dictate how we define diversity, absent of any real theory as in the case with measuring socio-economic status (Harwell & LeBeau, 2010).

The correlational design allowed for the variables of interest to correspond to examining variation in the outcome variable but the design itself does not permit causal inferences. The analysis used the data from students in Minnesota who took the survey in 2010 so generalizations will only be made to this population.

References

Benson, P.L., Scales, P.C., Hamilton, S.F., & Sesma, A. (2006). Positive youth development: Theory, research, and applications. In W. Damon & R.M. Lerner (Eds.), *Handbook of Child Psychology: Vol. 1* (6th ed., pp. 894-941). New York: John Wiley & Sons.

Bronfenbrenner, U. (1994). Ecological models of human development. In *International Encyclopedia of Education, Vol. 3, 2nd. Ed.* Oxford: Elsevier. Reprinted in : Gauvain, M. & Cole, M. (Eds.), *Readings on the development of children, 2nd Ed.* (1993, pp.37-43). NY: Freeman.

Bryk, A. S. (2010). Organizing schools for improvement. *Phi Delta Kappan,91*(7), 23-30.

Cabrera, J., & Rodriguez, M.C. (2011, April). *Latino youth's beliefs and attitudes and their influence on after-school activity participation*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Cohen, J. & Geier, V. K. (2010). *School Climate Research Summary: January 2010.* Retrieved from http://www.schoolclimate.org/climate/research.php.

Harwell, M., & LeBeau, B. (2010). Student eligibility for a free lunch as an SES measure in education research. *Educational Researcher, 39*(2), 120-131.

Haynes, Norris M., Emmons, Christine, & Ben-Avie, Michael (1997). School climate as a factor in student adjustment and achievement. *The Consultant's Corner.* 8(3), 321-329.

Hopson, L. M., & Lee, E. (2011). Mitigating the effect of family poverty on academic and behavioral outcomes: The role of school climate in middle and high school. *Children and Youth Services Review,* 2221-2229.

Nassar-McMillan, S. C., Karvonen, M., Perez, T. R., & Abrams, L. P. (2009). Identity

Development and School Climate: The Role of the School Counselor. *Journal of Humanistic Counseling, Education and Development,* 195-214.

Phinney, J. S. (1992). The multigroup ethnic identity measure a new scale for use with diverse groups. *Journal of adolescent research, 7*(2), 156-176.

Pielou, E. C. (1966). Shannon's formula as a measure of specific diversity: its use and misuse. *The American Naturalist*, *100*(914), 463-465.

Pink, W. T. (1982). School Effects, Academic Performance, and School Crime: Some Inescapable Realities of Viewing Schools from the Inside. *Urban Education, 17*(1), 51-72.

Peet, R. K. (1975). Relative diversity indices. *Ecology*, 496-498.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Sage.

Samdal, O., Wold, B., & Bronis, M. (1999). Relationship between students' perceptions of school environment, their satisfaction with school and perceived academic achievement: an international study. *School Effectiveness and School Improvement*, *10*(3), 296-320.

Scales, P. C., Benson, P. L., Leffert, N., & Blyth, D. A. (2000). Contribution of developmental assets to the prediction of thriving among adolescents. *Applied developmental science*, *4*(1), 27-46.

Scales, P. C., Benson, P. L., Roehlkepartain, E. C., Sesma, A. Jr., & Dulmen V. D. (2006). The role of developmental assets in predicting academic achievement: a longitudinal study. *Journal of Adolescence.* 29, 691-708.

Sesma, A., Jr., & Roehlkepartain, E. C. (2003). Unique strengths, shared strengths: developmental assets among youth of color. *Search Institute Insights & Evidence,* 1(2). Retrieved from http://www.search-institute.org/research/insights-evidence/november-

2003

Shannon, C. E. (2001). A mathematical theory of communication. *ACM SIGMOBILE Mobile Computing and Communications Review*, *5*(1), 3-55.

White, M. J. (1986). Segregation and diversity measures in population distribution. *Population index*, 198-221.