Structural and Individual Covariates of English Language Proficiency

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This study evaluates the empirical merits of a multilevel model of English language proficiency among immigrants. The model represents a synthesis of Blau's theory of intergroup relations and the human capital model. Hypotheses derived from the model were tested using multilevel ordinal logistic analysis with individual and aggregate data from the 2000 U.S. Census for members of 20 non-English language groups. The results lent strong support to predictions derived from Blau's theory. As expected, immigrants' English proficiency was affected negatively by group size and segregation, and positively by linguistic heterogeneity and inequality between fluent and poor English speakers of foreign origin. In addition, individual factors also exerted significant effects on English fluency as predicted by the human capital model.

Among the extant perspectives employed to explain intergroup relationships, Blau's macrostructural theory (Blau 1977; Blau and Schwartz 1984) is undoubtedly one of the most influential views. The theory has proven useful in studies examining intermarriages and interracial crimes (e.g., Blau, Beeker and Fitzpatrick 1984; Blau, Blum and Schwartz 1982; South and Messner 1986). Most of these studies have demonstrated that intergroup relations are affected by structural attributes of communities within which intergroup relations are embedded.

Despite its enormous success in the realm of intergroup relations, the applicability of Blau's theory to other research topics closely related to intergroup relations has so far been largely overlooked. Because intergroup relations and the ability to speak a common language by members of different groups mutually reinforce each other (Lazear 1999; Lieberson 1981), the structural factors that affect intergroup relations should also affect the ability for members of different groups to communicate using a common language. In addition, just as intermarriages are enabled by opportunities for intergroup contacts and deterred by structural constraints (Blau 1977); immigrants' abilities to speak the host society's languages are

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expected to be affected by the same factors (Lieberson 1981). Systematic testing of such propositions, however, is largely lacking.

Previous studies of bilingualism, English language proficiency, and mother-tongue shift among immigrants in the United States, Canada and Australia have been dominated by individualistic perspectives with little recognition of Blau's theory. Although a few researchers have independently arrived at arguments similar to those explicated by Blau, there is no *direct* and *systematic* evaluation of the theory. These studies have focused mainly on the effect of group size (Chiswick and Miller 1995, 2002; Jasso and Rosenzweig 1990; Linton 2004; McManus 1990; Stevens 1992). Other structural variables such as residential segregation, heterogeneity, and inequality are rarely included in those studies. As a result, previous findings pertaining to the effects of structural variables on language use are not only *incomplete* but also may be *biased* by specification errors (Lieberson 1985).

The purpose of this study is to conduct a systematic testing of four structural hypotheses derived from Blau's (1977) theory. While the primary interest of the study is the empirical applicability of the structural theory for a different outcome variable, we also include several *individual*-level variables derived from the human-capital paradigm. Thus, it represents a synthesis of the two theoretical perspectives.

While there are obvious theoretical gains to combine a macro-level theory with a micro-level one, doing so incurs new methodological issues. Testing multilevel theory requires grouping micro-level units (i.e., individual immigrants) by macro-level units (i.e., the language group to which individual immigrants belong and the MSA in which they live). Because members of the same group or the same MSA are expected to share some common characteristics left out of the analysis, statistical techniques which rest on the assumption that individuals are independently selected are inappropriate. The study will use HLM to analyze the nested data (Raudenbush and Bryk 2002).

Although the inappropriateness of OLS analysis for nested data has been known for sometime, past studies of language use continued to rely on OLS-type analyses. The implication of such violations is that some of the claims about the significant effects of structural factors might have been based on *false positives* resulting from underestimated standard errors. Our results based on multilevel analyses allow us to verify the validity of past claims.

A Multilevel Model for English Language Fluency

The large volume of research focusing on English language fluency among immigrants testifies to the importance of the research topic. Previous research, however, has been dominated by individualistic explanations of English language fluency (Carliner 1981; Chiswick 1991; Chiswick and Miller 1995, 2002; McManus 1990; McManus, Gould and Welch 1983). Structural factors which constitute the English learning environment, and therefore should affect immigrants' *opportunities* as well as their *motives* to speak English (Lazear 1999; van Tubergen and Kalmijn 2005), have largely been overlooked. Blau (Blau 1977; Blau, Blum and Schwartz 1982; Blau and Schwartz 1984) is undoubtedly the most imaginative scholar in advancing this line of reasoning, arguing that interactions between groups are affected by such factors as group size, heterogeneity, segregation and inequality.

Group Size

Blau (1977) argues that despite the prevailing preferences for people to associate with others sharing the same traits, population compositions of the community determine the availability of individuals with these traits and thus impose structural constraints on choices one can make. Members of a larger group, however, are more likely to fulfill this preference because of the large pool from which choices can be made. Thus, large group size suppresses intergroup relationships. Intergroup associations become more necessary and therefore more common for a smaller than for a larger group. As intergroup associations require a common language, members of the smaller group face greater pressure to learn the host society's language because of their limited opportunities for ingroup associations.

The necessity for intergroup interactions and the pressure to learn the language of the majority is expected to reduce with increased group size (Breton 1964; Lazear 1999). In communities with a large minority group, a self-sufficient ethnic community replete with key institutions is likely to develop. Interactions between co-ethnics are most likely to be conducted with native language. English should be spoken less and the pressure to learn it reduced. Blau's theory helps explain past findings indicating a negative association between the size of non-English-speakers and their English proficiency (Chiswick and Miller 1995; Jasso and Rosenzweig 1990; McManus 1990; Stevens 1992).

Heterogeneity

In addition, Blau (1977) suggests that the potential for members of different groups to meet and interact depends on the heterogeneity of the community in which they live. He defined heterogeneity as "the chance expectation that two randomly chosen persons do not belong to the same group." (Blau, Blum and Schwartz 1982:46) Linguistic heterogeneity can be indicated by the number and the composition of language groups in the community. The chance that two randomly chosen persons who do not speak the same language is maximized as the number of language groups is large and their sizes are equal (Greenberg 1956).

Contrary to conventional wisdom, Blau (1977) theorizes that heterogeneity *promotes* intergoup relations by increasing fortuitous encounters between individuals with dissimilar characteristics. Accordingly, the need for English as a *lingua franca* is increased in communities where linguistic heterogeneity is high, as indicated by the co-existence of multiple language groups of relatively large sizes.

The heterogeneity hypothesis makes clear that increases in minority group size do not necessarily reduce the use of English among the group's members. While unilateral increases in the size of the sole minority group are likely to reduce the overall usage of English in a community, simultaneous increases in the size of multiple minority groups necessitate the adoption of English as a *lingua franca.*

This prediction casts doubts on the validity of explanations based solely on group size. Thus, an increase in Spanish speakers, for example, in a community is expected to boost the importance of Spanish and lower that of English only when there are no other minority language groups with significant size in the community. In communities where there are multiple language groups with approximately the same size, chance encounters between members of diverse groups are likely to be high, thus necessitating the use of English as a *lingua franca* by these non-English speakers.

This reasoning makes clear that it is necessary to separate group size from heterogeneity and both variables are required in the model. Unfortunately, we are aware of no study which has done so. Although Lieberson and Curry (1971) have examined the effects of group size and heterogeneity independently, they were unable to disentangle the effects of the two variables because they had relied on bivariate analyses.

Segregation

Another aspect of community that can affect interactions between members of different groups is segregation. Blau (1977) maintains that interactions depend on opportunities for social contacts and physical propinquity increases the opportunities for such contacts. Segregation between groups, therefore, counters the positive influences of heterogeneity. Segregation has been found to affect interracial marriages (Hwang, Saenz and Aguirre 1997), the viability of ethnic enterprises (Aldrich et al. 1985; Portes and Bach 1985), and minority languages retention (Stevens 1992). The clustering of a large number of immigrants who speak a common non-English language is bound to suppress the use of English and weaken their ability to speak English (Massey and Denton 1988).

Although the potential of segregation as a predictor of English proficiency is apparent, there is surprisingly little empirical evidence to demonstrate it. While a few studies by labor economists have examined the effects of minority "concentration" (e.g., Chiswick and Miller 1995, 2002), the word "concentration" was often used loosely to equate with the size of a minority group in the community. Such use is inappropriate because segregation and group size are two distinct concepts and there are no necessary relationships between the two (Massey and Denton 1988).

A few studies have examined the relationship between segregation and language use but the findings were inconclusive. McManus (1990) showed that Hispanics with a deficiency in English are three times as concentrated as their counterparts who speak English fluently. Lieberson (1963) examined between-group variations in segregation within a city. Although he found that members of more segregated groups tended to speak English less fluently, it is unclear whether his findings based on within-city comparisons can be generalized to between-city comparisons. Stevens (1992) also found that more segregated groups showed greater tendency to speak their native language than English. But the validity of her conclusion was hampered by the use of a segregation measure which does not reflect regional variations. Linton (2004) examined the effects of between-community variations in segregation on bilingualism for U.S.-born Hispanics but was unable to detect any significant effects.

Inequality

Of the four single-parameter concepts considered by Blau, inequality is perhaps the most troublesome one, often exerting effects on intergroup relations contradicting common senses. Inequality is the differentiation of the population along a graduated parameter commonly indexed by average status differences between all possible pairs of individuals in the population. Based on the widely accepted assumption that people prefer to associate with others sharing traits similar to their own, associations involving persons of dissimilar statuses are expected to be rare. Surprisingly, empirical studies have demonstrated that intermarriage rates increase with inequality (Rytina et al. 1988).

To make sense of the paradoxical association between inequality and intermarriage, Rytina et al. (1988) demonstrated that although inequality decreases intermarriages *indirectly* by making people more status-conscious when choosing a spouse (i.e., *motives*), this negative indirect effect was unable to counterbalance the overwhelming positive *direct* effect of inequality (i.e., *opportunities*).[1]

Although Blau's theory does not provide a clear prediction, Rytina et al.'s (1988) empirical work supports the hypothesis that inequality promotes intergroup relations. The latter is consistent with the human-capital arguments that higher earnings received by fluent English speakers motives poor English speakers to learn English (Chiswick and Miller 1995; Lazear 1999). Immigrants are most motivated to learn English when they see a large disparity in average earnings between good and poor English speakers in the same community.[2]

Human Capital Model

English language proficiency among immigrants as a topic of research has received wide attention from sociologists as well as labor economists. For sociologists, English proficiency is an indicator of cultural assimilation (Gordon 1964; Hwang, Seanz and Aguirre 1997). For immigrants from non-English speaking countries resettling in an English-speaking host society, being able to speak the language of the host society portends successful acculturation and a smooth social transition (Espenshade and Fu 1997; Espinosa and Massey 1997; Linton 2004; Stevens 1992; van Tubergen and Kalmijn 2005).

Labor economists, on the other hand, tended to focus on English language fluency as a means toward other ends instead of an end in itself (Carliner 1981; Chiswick 1991; Chiswick and Miller 1995, 2002; Grenier 1984; Lazear 1999; McManus 1990; McManus, Gould and Welch 1983; Tainer 1988). As such, proficiency in English is often seen as a human capital by which immigrants can earn higher economic returns (Chiswick and Miller 1995). Learning English is considered a worthwhile investment because it often translates into improved employment opportunities and higher wage rates (Chiswick 1991; Grenier 1984).

Despite a preoccupation with English ability as a predictor of economic outcomes, a concern with endogeneity between the two have led some labor economists to model English language proficiency (Chiswick and Miller 1995, 2002; McManus 1990). Among the numerous efforts made to explain English language fluency, Chiswick and Miller (1995) provided perhaps the most general and useful model.

According to Chiswick and Miller (1995), English language proficiency among immigrants can be seen as a function of *economic incentives, exposure* and *efficiency*. *Economic incentives* are said to exist if an improvement in English-speaking ability made by the immigrant is awarded with improved employment opportunities and higher wages. *Exposure* to English is related to such factors as employment status, the length of time the immigrant has spent living in the United States, and the language environment in which the immigrant lives. Aside from incentives and exposure, English language fluency is also affected by *efficiency*, or the extent to which an effort to learn English actually translates into

English fluency. According to Chiswick and Miller (1995), efficiency in learning English is determined by factors such as age at migration and educational attainment of immigrants. Immigrants who are more educated and who came to the United States at a younger age are expected to be more efficient in acquiring the host society's language than their older and less educated counterparts.

We find this model very helpful because it supplements Blau's theory by identifying a set of individual-level variables that are outside of the structural theory's domain. Individual-level variables such as age at migration, educational attainment and the length of time an immigrant has lived in the United States augment Blau's conceptual framework and enhance our understanding of English language fluency among immigrants.

To summarize, immigrants' English language proficiency is expected to be affected not only by individual factors associated with the immigrants but also by the characteristics of the group of which immigrants are members and the characteristics of the communities in which immigrants reside. Specifically, we hypothesize that the English language fluency of the immigrant is negatively affected by group size and segregation and positively affected by heterogeneity and inequality. We also include linguistic distance (Snow 1998) between a foreign language and English as a control variable. Following the human-capital model, we hypothesize that an immigrant's level of English proficiency is affected by characteristics such as the immigrant's educational attainment, the number of years he or she has lived in the United States, and the age at which s/he entered the country. In addition, an immigrant's English proficiency is expected to be affected by the presence of school-age children in the household, which affects opportunities to speak English (Chiswick and Miller 1995), and gender of the immigrant.

Data and Methods

The data for this study come from two sources: the 5% Public-Use Microdata Samples of the 2000 U.S. Census, which supplies data for our outcome and individual-level independent variables; and Summary File 3, which gives us the group- and MSA-specific structural variables. From the PUMS dataset, we identified all foreign-born individuals as potential subjects for the analysis. Because MSA-level measures for each language group are needed as predictors, we restricted our sample to foreign-born individuals who are members of one of the 20 largest non-English speaking groups and who reside in a MSA (U.S. Bureau of the Census 2003). As a result, 334,620 cases were excluded. The exclusion of members of small language groups that have been combined with other language speakers from the same region is necessary because the appropriateness of group-specific measures as predictors depends on homogeneous groupings. We also restricted our sample to persons 22 years or older because structural determinants of English proficiency for those who are still in school are likely to be different from those for adults.[3]

English language fluency in the 2000 U.S. Census is measured only for those who reported speaking a language other than English at home; foreign-born individuals who speak only English are not assigned an English fluency value (U.S. Bureau of the Census 2003). Excluding the latter from a study of English fluency is problematic because these people are presumably the most fluent in English. To remedy the shortcoming in the census measure, we conducted a systematic analysis of the subsample of foreign-born individuals who speak only English. The purpose is to identify those cases that can be assigned to one of the 20 language groups based on information about the dominant language spoken in their countries of birth. To determine the dominant language spoken in a country, we relied on the CIA's (2004) *The World Factbook* and a detailed cross-tabulation analysis of country of birth by language spoken at home. Both approaches led to the same answer for a majority of cases. When conflicting designations occurred, we relied on the CIA's designation because immigrants from a country are not necessarily a representative sample of all individuals in the country in terms of language spoken.[4]

Measurement

The outcome variable, English language fluency, is an ordinal variable that consists of five categories (i.e., English only, very well, well, not well and not at all). While most studies in the past have recoded the ordinal variable into a dichotomy (e.g., Chiswick and Miller 1995; Dustmann and Van Soest 2002), the fact that there are multiple ways of doing so renders any particular recoding arbitrary (Winship and Mare 1984). We will therefore analyze the outcome variable in its original scale.

The PUMS dataset is used to measure the outcome and individual-level variables used in human-capital tradition. Following Chiswick and Miller (1995), *educational attainment* is measured as an interval variable. Because the initial measure was ordinal, we converted it into an interval variable by assigning a value equal to the midpoint of each educational category. The number of years an immigrant has lived in the United States, or *years since migration*, is measured by (2000 – year of entry). *Age at immigration* is equal to (age – (2000 – year of entry)) or 0, whichever is bigger. Two dummy variables are used as controls to indicate whether the respondent is a *female* and lives in a household with at least one *school-age child*.

To test hypotheses derived from Blau's research, we used two measures of group characteristics (i.e., group size and segregation) and two measures of MSA characteristics (i.e., heterogeneity and inequality). Because the same language group may have very different characteristics in different MSAs, our group-specific measures are also MSA-specific. Heterogeneity and inequality are characteristics of the metropolitan area. They are shared by all groups in the same MSA.

The Summary File 3 of census 2000 was used to measure these macro-level variables whenever feasible. Although it is possible to measure macro-level variables by aggregating individual records from the PUMS dataset, measures based on a sample are less stable. In addition, macro-level variables, by definition, are contextual measures and therefore should include additional information not captured by the 5% sample.

Another consideration we must address in measuring macro-level variables is the operational definition of community, or the choice of macro-level units. According to Hawley (1950:257), community can be defined from a spatial standpoint as comprising an area where "the resident population of which is interrelated and integrated with reference to its daily requirements." In order to conduct a multilevel analysis using the PUMS dataset, our choices of macro-level units are limited to those available in the PUMS dataset. Of the two reasonable candidates, public-use microdata areas and metropolitan statistical areas, we choose MSA because PUMAs are arbitrary and smaller units which tend to under-bound community (Siegel and Swanson 2004). In addition, the use of PUMA as an operational definition of community would force us to measure structural variables by aggregating individual records. Such measures are likely to be less reliable due to sparsity of data. Furthermore, it is impossible to measure segregation using the microdata because information on census tract IDs needed for the measure is suppressed. On the other hand, MSA is defined by taking into considerations the functional integration of the population and thus comes closest to the classic concept of community defined by Hawley (1950). As such, MSA is more appropriate than PUMA as a demarcation of a person's realm of activities and interactions. Measures of group size, heterogeneity, segregation and inequality are thus more relevant when MSAs rather than PUMAs are used for grouping persons.

For each of the language groups in each MSA, a measure of group size and a measure of segregation are obtained.[5] *Group size* is measured by the number of persons 5 years or older in a particular language group in the MSA based on language spoken at home. Because the distribution of group size is rather skew, our analyses were based on the log transformed measures of group size to minimize the influences of extreme values. Segregation is measured by White's (1983) *average proximity index* (P_{xx}):

$$P_{xx} = \sum_{i=1}^{N} \sum_{j=1}^{N} \frac{x_i x_j c_{ij}}{X^2}$$

The index measures average proximity between members of the same group *x* in different census tracts *i* and *j* given the total number of X members in the MSA. The c_{ij} in the numerator is equal to $exp\ (- d_{ij})$, the negative exponential function of distance between census tracts *i* and *j*.[6] Of the many possible measures of segregation (Massey and Denton 1988), we considered spatial proximity index most appropriate because it not only captures the degree of concentration of a group in a few census tracts, but also takes into consideration the extent to which these census tracts are spatially clustered (White 1983). Because of the latter attribute, the measure has been touted as a proxy for ethnic enclave (Siegel and Swanson 2004) and was recommended as an indicator of potentials for intergroup associations (Massey and Denton 1988). The average proximity index will be measured for each available language group in each MSA.

Linguistic heterogeneity is measured by heterogeneity index: $H = 1-\Sigma P_i^2$. While P_i is the proportion of the MSA's population 5 years old or older in language group *i* for up to 40 language groups (including English speakers as one group) used in the SF3. This measure has been used (Blau, Blum and Schwartz 1982) to measure heterogeneity based on a wide variety of parameters including race, place of birth, language spoken at home, occupation, and industry. It is identical to the A index Greenberg (1956) proposed to measure linguistic diversity.[7]

Finally, we used a MSA-wide measure of inequality. Specifically, *inequality* is measured by the ratio of the median earnings for immigrants 15 years old or older who speak only English or speak English very well vs. the median for immigrants with inferior English abilities, a division justified by Chiswick and Miller (1995). Because the SF3 does not provide income data by English proficiency groups, we computed the two medians based on the PUMS dataset. While group-specific measures of inequality seem to make better sense, the 5% data do not permit reliable measures for small groups. The ratio is log transformed to reduce the skewness of the variable in its initial form. In addition to the four structural variables, we also control for *linguistic distance* (Snow 1997; van Tubergen and Kalmijn 2005) using a scale developed by Snow (1997).[8]

Analytical Strategy

Because our hypotheses involve individual- as well as group- and MSA-level independent variables, individual records are sorted by MSAs and by groups. Doing so resulted in a three-level hierarchical data structure in which individuals are nested within groups and groups are, in turn, nested within MSAs. The nesting of lower-level units under upper-level units makes it clear that those lower units in the same upper-level units are not independent. Thus, we use an analytical procedure, hierarchical linear modeling, which takes into consideration the *intraclass correlation* between units and adjusts for its effects accordingly (Raudenbush and Bryk 2002).

Because we have an ordinal-level outcome variable, a logical statistical method of choice is the cumulative logit model (Allison 1991). The cumulative logit model is analogous to logistic analysis of a binary variable except that it includes additional intercepts to differentiate k-1 contrasts for a variable with k response categories. The cumulative logit model rests on the assumption that the ordinal-level variable being analyzed is the observed form of a latent variable that is actually continuous. As such, the independent variables' effects on the ordinal outcome in the cumulative logit model can be interpreted in ways similar to those of a continuous outcome variable (Allison 1991).

Our hierachical model consists of one level-1 equation, a set of level-2 and level-3 equations used to explain variations in intercepts observed in previous level. Variables and coefficients for different levels are distinguished by different symbols for clarity. Our level-1 model takes the following form:

$$\eta_{mijk} = \alpha_{0jk} + \alpha_{1jk} X_{1ijk} + \alpha_{2jk} X_{2ijk} + \alpha_{3jk} X_{3ijk} + \alpha_{4jk} X_{4ijk} + \alpha_{5jk} X_{5ijk} + \alpha_{6jk}$$

$$\left(X_{4ijk}\right)^2 + \alpha_{7jk}\left(X_{5ijk}\right)^2 + \Sigma D_{mijk}\delta_m$$

The η_{mijk} in the equation is the expected log odds for individual *i* in group *j* and MSA *k* to take on a response value of *m* or lower for the ordinal outcome variable with *m* categories. For our outcome variable, ability to speak English, *m* can take a discrete value of 1 to 5; with 1= "English only", 2 = "very well", 3 = "well", 4 = "not so well", and 5 = "not at all." The α_{0jk} is the intercept, or the average log odds for $m = 1$ (i.e.,speak English only) for the sample. This interpretation of intercept is justified when all independent variables are grand mean-centered, as recommended when higher-level variables are used in an "incremental" manner to supplement first-level predictors (Hofmann and Gavin 1998). The five human-capital variables (i.e., educational attainment, gender, school-age child, years since migration, and age at migration) are represented by X_{1ijk} through X_{5ijk}. The squared terms of the last two variables are also included because the effects of years since migration and age at migration have been founded to be curvilinear in past studies (Espenshade and Fu 1997). The corresponding coefficients of these variables are indicated by α_{1jk} through α_{7jk}. The last term in the equation, $\Sigma D_{mijk}\delta_m$, represents a set of thresholds (δ_m) which indicate the difference between the intercepts for the first and each of the other contrasts.[9]

At level-2, we model the level-1 intercept[10] using three group-specific variables: group size, segregation, and linguistic distance. Because we are primarily interested in the main effects of these variables on English fluency, no attempt is made to model level-1 slopes. Our level-2 model is a *random intercept model* (Raudenbush and Bryk 2002) which can be expressed in the following equations:

$$\alpha_{0jk} = \beta_{00k} + \beta_{01k}Y_{1jk} + \beta_{02k}Y_{2jk} + \beta_{03k}Y_{3jk} + r_{0jk}$$

$$\alpha_{qjk} = \beta_{q0k}, \; for \; q = 1, 2, ...7$$

The equations make clear that the level-1 intercept, or the average log odds of being able to speak English fluently, is determined by group size (Y_{1jk}), segregation (Y_{2jk}), and linguistic distance (Y_{3jk}), plus a random error r_{0jk}. The seven level-1 slopes are assumed to be fixed,[11] and can be estimated from the weighted average of the j group-specific slopes within each MSA k.

At level-3, we model the level-2 intercept with two MSA-level predictors, i.e., heterogeneity (Z_{1k}) and inequality (Z_{2k}), also using a *random intercept model*:

$$\beta_{00k} = \gamma_{000} + \gamma_{001}Z_{1k} + \gamma_{002}Z_{2k} + u_{00k}$$

$$\beta_{0rk} = \gamma_{0r0}, \; while \; r = 1, 2, \; and \; 3, which \; indicates \; the \; three \; level - 2 \; variables; \; and$$

$$\beta_{q0k} = \gamma_{q00}, \; while \; q = 1, 2, ...7, which \; indicates \; the \; seven \; level - 1 \; variables.$$

When the α coefficients in the level-1 model are replaced by β coefficients in the level-2 model, and the β coefficients in the level-2 model are, in turn, replaced by γ coefficients in the level-3 model, a mixed model incorporating independent variables of all three levels is obtained:

$$\eta_{mijk} = \gamma_{000} + \gamma_{001}Z_{1k} + \gamma_{002}Z_{2k} + \gamma_{010}Y_{1jk} + \gamma_{020}Y_{2jk} + \gamma_{030}Y_{3jk} + \gamma_{100}X_{1ijk} + \gamma_{200}X_{2ijk} + \gamma_{300}X_{3ijk}$$
$$+ \gamma_{400}X_{4ijk} + \gamma_{500}X_{5ijk} + \gamma_{600}\left(X_{4ijk}\right)^2 + \gamma_{700}\left(X_{5ijk}\right)^2 + \Sigma D_{mijk}\delta_m + r_{0jk} + u_{00k}.$$

The mixed model looks similar to a one-level model with the exception that it contains two error components r_{0jk} and u_{00k}, with the first indicating between-group variations, and the second between-MSA variations. We conducted the multilevel analyses using the HLM version 6 program.

Findings

Table 1 presents the percentage distributions of the outcome variable for the 20 language groups used in the analysis. The number of persons who speak only English was estimated for each language group based on the dominant language spoken in the country of origin as discussed in the Data and Methods section. The frequency counts for other categories are based on the original responses to the English fluency question recorded in the 5% PUMS dataset. The table clearly shows that there are large variations in ability to speak English among the 20 groups. For example, while a very high percentage of German and Hindi either speak only English or can speak English "very well," the percentage of people with the same level of English ability is much smaller for Vietnamese

(29 percent), Spanish (31 percent), Russian (34 percent) and Chinese (37 perent). Although it is rare for members of any group to be "not at all" able to speak English, Spanish is an exception, with nearly 2 out of every 10 persons falling into this category. This probably reflects the transient nature of migration for many immigrants from Mexico and the newness of many Spanish speakers in the United States. It is also noteworthy that the combined percentages of people who can speak English "well" or better tend to be higher for people originated from countries where English was and remains one of the dominant languages (e.g., Hindi, Tagalog, Urdu and Gujarathi).

We present some descriptive statistics for the three sets of independent variables in tables 2A-2C. Statistics for first-level variables are given in Table 2A, those for level-2 and level-3 variables are presented in tables 2B and 2C respectively. For the sample as a whole, the average respondent has attained 11.9 years of education, immigrated to the United States at the age of 24.9, and has lived in the United States for 18.6 years. Of all the respondents, 51 percent are female and 25 percent live in a household with at least one school-age child.

The statistics for two group-specific variables, logged group size and segregation, averaged across all applicable MSAs are given in Table 2B. Also shown is the linguistic distance score assigned to each group (see endnote 8 for proper interpretation of these scores) based on a scale developed by Snow (1998). It is a global measure with no between-MSA variations. The wide variations in group size across the 20 groups are clearly evident. Spanish speakers are not only the largest group, they are also found in all 297 MSAs that can be uniquely identified. In contrast, Armenian speakers have a much smaller size and are found only in 112 MSAs according to the 5% PUMS dataset. Aside from the large between-group variations, there are also large within-group variations across MSAs, as indicated by the group-specific standard deviations.

The between- and within-group variations in segregation, as measured by average proximity, are also noticeable. While the average proximity between members of the same group tends to be rather low for German, Polish, Persian and Gujarathi; the extent of clustering is much more intensive for Spanish, Vietnamese, and French Creole. The 20 groups also differ in terms of the linguistic distance between their native language and English (Snow 1998).

Table 2C presents the descriptive information for the two MSA-level variables, linguistic heterogeneity and inequality, or the ratio of median earnings for better and worse English speakers of foreign origin. The mean for linguistic heterogeneity suggests that in an average MSA, the probability that two randomly selected individuals would speak two different languages is .22. In other words, one out of every five random

Table1: Level of English Fluency by Foreign Language Groups

Fluency Level	Spanish	French	Creole	Italian	Portuguese	German	Greek	Russian	Polish	Armenian
English only	6.65	13.13	7.10	22.75	10.28	52.85	11.88	5.70	15.77	1.48
Very well	23.91	60.21	38.17	38.62	36.84	37.61	45.55	28.41	31.81	38.77
Well	22.17	19.88	29.90	24.18	25.24	8.24	26.27	32.03	30.16	28.00
Not well	28.21	6.02	20.08	12.25	20.51	1.17	14.41	25.58	18.39	21.61
Not at all	19.07	.77	4.75	2.20	7.13	.12	1.90	8.28	3.87	10.15
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
n	503,315	21,001	13,231	23,250	17,395	42,323	8,117	22,876	17,396	6,572

Fluency Level	Persian	Gujarathi	Hindi	Urdu	Chinese	Japanese	Korean	Vietnamese	Tagalog	Arabic
English only	9.32	15.99	16.00	6.19	6.11	34.73	11.41	5.94	13.27	12.70
Very well	51.76	49.75	64.45	59.43	30.46	24.61	24.85	22.71	56.72	50.66
Well	23.44	20.64	14.01	22.81	29.71	25.45	29.78	32.67	23.87	24.04
Not well	11.59	9.81	4.50	8.89	23.32	14.32	28.97	31.35	5.71	10.13
Not at all	3.90	3.81	1.04	2.68	10.40	.89	4.99	7.32	.43	2.48
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
n	11,388	8,444	12,324	7,803	69,464	16,573	31,046	33,821	50,472	18,057

Table 2.A: Descriptive Statistics for the First-level Variables

	Mean	SD
Education Attainment	11.91	5.41
Female	.51	.50
School Age Child	.25	.43
Years since Migration	18.64	14.02
Age at Migration	24.92	13.84

encounters would involve speakers of different languages. Such a level of diversity is expected to favor the adoption of English as a *lingua franca* by two speakers of different languages. Inequality is log transformed because the original variable has a skew distribution. The transformed inequality has a mean of .49 and a standard deviation of .34. Because the mean of the transformed inequality does not make intuitive sense and there is no easy way to revert it to the mean of untransformed inequality, we also reported the statistics for inequality in its original form. Our results indicate that in an average MSA, the median earnings of those immigrants who can speak English very well or speak only English is 1.73

Table 2B: Descriptive Statistics for the Second-level Variables

	Ln(Size)		Segregation		Lingustic	
Language Groups[a]	Mean	SD	Mean	SD	Distance [b]	n
Spanish	9.84	1.61	3.51	3.29	4	297
German	7.48	1.15	1.76	1.64	2	297
French	7.46	1.31	2.27	1.96	4	290
Chinese	6.83	1.73	3.13	2.75	7	288
Vietnamese	6.47	1.77	3.64	3.75	7	273
Italian	6.46	1.78	2.14	1.96	4	272
Tagalog	6.19	1.80	2.29	2.37	7	295
Korean	6.19	1.67	2.48	2.42	7	290
Russian	6.16	1.70	2.69	2.24	5	241
Arabic	6.15	1.69	3.15	3.22	7	274
Polish	5.87	1.80	2.01	2.32	5	253
Greek	5.87	1.58	2.46	2.58	6	234
Japanese	5.86	1.49	2.66	2.84	7	288
Portuguese	5.77	1.88	2.50	3.21	4	239
Hindi	5.56	1.66	2.71	3.57	6	259
Urdu	5.45	1.66	2.35	3.13	6	210
French Creole	5.40	2.03	3.47	4.22	4	151
Gujarathi	5.38	1.54	1.98	2.84	6	243
Persian	5.28	1.79	1.93	2.37	6	229
Armenian	4.95	1.84	2.25	3.61	6	112
Total	6.35	1.98	2.57	2.87	—	5,035

[a] Sorted by the average size of groups. [b] Based on Snow (1998).

Table 2C: Descriptive Statistics for the Third-level Variables

Variables	Mean	SD
Linguistic Heterogeniety	.22	.14
Ln(Inequality)	.49	.34
Inequality	1.73	.62

times as high as the corresponding measure for those in the remaining English ability categories.

The results from our multilevel analyses are presented in Table 3. Model 1 sets the baseline, it is an ANOVA model used to estimate the total variance in the data that can be explained and to estimate the intercept and the three thresholds for the baseline model. The results indicate that for the sample as a whole, the odds of being a foreign-born person who speaks English only is .26 (= $e^{-1.351}$). All thresholds are statistically significant, which indicates that there is a distinctive intercept for each English proficiency category. An examination of variance components indicates that variations in English proficiency exist mainly at group level (level-2) instead of MSA level (level-3).

Individual Covariates

Individual-level or level-1 predictors are introduced in Model 2. The results clearly indicate that all but one level-1 variables are statistically significant predictors of English language fluency. In addition, the effects of these predictors are all in the predicted direction. Our findings indicate that a foreign-born person's ability to speak English is affected positively by the person's educational attainment and the number of years the person has been in the United States, and negatively by gender (= female) and age at migration. In order to make meaningful comparisons of the relative importance of independent variables measured in different units, we reported the marginal changes in Y associated with one standard deviation increase in X for each independent variable. Thus, one SD increase in year of education increases the foreign-born person's odds of being a fluent English speaker by 110 percent. One SD increase in year spent in the U.S. improves the odds by 96 percent on average, but the improvement get smaller as time goes by. On the other hand, being female reduces the odds by 7 percent. Immigrants who arrived in the United States at an age one SD older than the average immigrant would see a 74 percent reduction in the odds, but the negative effect of delayed migration is larger for immigrants who arrived at a younger than an older age. Although it has been speculated that having a school-age child in the household increases an adult immigrant's exposure to English, the effect of the variable is not significant; perhaps suggesting that a school-age child can function not only as a teacher, but also as an interpreter, for their parents, thus reducing the latter's urgency to learn English (Chiswick and Miller 1995). Adding the human-capital variables to the baseline model reduces the combined variances at levels 2 and 3 from .91 to .56, or a 39 percent reduction.

Table 3: Multilevel Ordered Logit Analysis of English Language Fluency

	Model 1	Model 2		Model 3		Model 4	
	β	β	$(e^{sd*\beta}-1)*100$	β	$(e^{sd*\beta}-1)*100$	β	$(e^{sd*\beta}-1)*100$
Fixed Effects							
Average Fluency							
Intercept	-1.35*	-2.24*	—	-2.10*	—	-2.11*	—
Threshold 2	2.10*	2.53*	—	2.54*	—	2.54*	—
Threshold 3	3.21*	3.99*	—	4.00*	—	4.00*	—
Threshold 4	4.67*	5.85*	—	5.85*	—	5.85*	—
Level-1 Predictors							
Education Attainment		.15*	110.71	.15*	110.71	.15*	110.71
Female		-.15*	-7.23	-.15*	-7.23	-.15*	-7.23
School Age Child		.02	.86	.02	.86	.02	.86
Years Since Migration		.05*	96.00	.05*	96.00	.05*	96.00
Years Since migration^2/100		-.04*	-26.99	-.04*	-26.99	-.04*	-26.99
Age at Migration		-.10*	-73.52	-.10*	-73.52	-.10*	-73.52
Age at Migration^2/100		.07*	95.22	.07*	95.22	.07*	95.22
Leve-2 Predictors							
Segregation				-.05*	-13.62	-.05*	-14.11
Ln(Group Size)				-.22*	-34.80	-.23*	-36.20
Linguistic Distance				-.20*	-24.78	-.20*	-25.32
Level-3 Predictors							
Linguistic Heterogeneity						.46*	6.62
Ln(Inequality)						.08*	2.90

Structural Covariates

Model 3 tests the structural hypotheses that English fluency is affected by group characteristics such as the size of the non-English language group and the extent to which members of the group are spatially clustered in metropolitan areas. Because group size and segregation are group- and MSA-specific, they capture the effects of both group variations within each MSA as well as between-MSA variations of group size and segregation. The results for the model supported our hypotheses. As was anticipated theoretically, the logistic coefficients (and the marginal changes) indicated that an immigrant's ability to speak English is retarded if s/he lived in a MSA with a large population of co-ethnics and where these co-ethnics are spatially clustered. Because marginal effects have no easy interpretation unless variables are measured in natural and common units, Table 3 reported standardized marginal effects using SD as unit of measurement. These marginal effects show that for an average immigrant, the odds of being able to speak English fluently decreased by 14 percent (or 35 percent) when s/he moves from the average MSA to another whose level of segregation (or log group size) is one SD higher than the average. Because we have group-specific SD's for each of the level-2 variables, it is possible to show group differences in marginal effects, For example, the findings implied that a Chinese moving from Little Rock, AR to Orlando, FL, which approximates a one SD (1.73) increase in log group size from the mean (6.83), will see a 31% (i.e., $(e^{(-.216*1.73)}-1)*100$) reduction in the odds of being able to speak English fluently. The same person moving from Lancaster, PA to San Francisco, who experiences a one SD increase in segregation from its mean, will see a 13 percent reduction in the odds. The corresponding effects of the same two variables for a Spanish speaker

Table 3 *continued*

	Model 1	Model 2		Model 3		Model 4	
	β	β	$(e^{sd*\beta}-1)*100$	β	$(e^{sd*\beta}-1)*100$	β	$(e^{sd*\beta}-1)*100$
Random Effects							
Variance Components							
Level-2	.90*	.55*		.33*		.32*	
Level-3	.02*	.01*		.02*		.01*	
%Reduction in Error from the Previous Model		38.75		38.17		5.64	

Note: *p < .05.

are 29 percent and 15 percent, respectively. These findings clearly indicate that living in a community with a large and spatially clustered population of co-ethnics is unfavorable for the development of English speaking skills for immigrants. In addition, there are large differences between groups in ability to speak English resulting from the linguistic distance between English and foreign languages. Comparing the combined variances for models 2 and 3 indicates a 38 percent reduction in variance when the three group-specific variables are added to the model.[12]

We turn to results from Model 4 to test the two remaining structural hypotheses with regard to the effects of linguistic heterogeneity and inequality on English fluency. As expected, linguistic heterogeneity exerts a positive effect on English fluency among immigrants. As an immigrant moves from Champaign-Urbana to Washington, DC, roughly equivalent to one SD increase in linguistic heterogeneity from the mean, his/her odds of being able to speak English fluently will improve by 6.6 percent. This finding is consistent with our arguments that linguistic heterogeneity increases the chance for speakers of different languages to rub elbows with one another and thus puts pressure on immigrants of diverse origins to find a common language for communication. When the effect of heterogeneity is examined in conjunction with that of group size, it confirms our reasoning that while a unilateral increase in the size of one language group suppresses English fluency, simultaneous increases in the size of multiple language groups, as indicated by linguistic heterogeneity, has the opposite effect.

Our hypothesis that inequality between immigrants with different English-speaking abilities would function as incentives for investing in English is also supported. For example, when an immigrant moves from Philadelphia to Danbury, CT, and sees a one SD increase in inequality, he or she will also experience a 2.9 percent increase in the odds of being able to speak English fluently. This finding suggests that immigrants living in communities where earnings gap between better and worse English speakers is large are more motivated to learn English. A comparison of the combined variances for models 3 and 4 indicates a 5.6 percent reduction in variance.

Compared to the three group-level measures, the standardized marginal effects of the two MSA-level variables are considerably smaller. Although linguistic heterogeneity showed a very large effect on English fluency when evaluated using its original scale, its standardized effect is considerably smaller than other variables. With a standardized marginal effect of only 2.9 percent, inequality has the smallest effect among the five structural variables.

It is noteworthy that the estimated effects of individual covariates in Model 4 are identical to those estimated in Model 2. It is so because in random intercept models, the higher-level variables are used to explain *only* the parts of variations in ability to speak English that could not be explained by lower-level variables, or the residuals. Therefore, it would not be fair to compare the relative importance of variables across different levels (Raudenbush and Bryk 2002).[13]

Conclusions

In countries which have historically depended on immigrants for their population growth and labor demands, the ability to incorporate immigrants into the host society has been one of the utmost important research and policy issues. The immigrants' ability to speak the language of the host society is an important indicator of how successful they are incorporated. As such, researchers from many disciplines have devoted a lot of energy to study English language proficiency among immigrants.

Previous studies of this topic, however, have shown a bias toward individualistic explanations of English fluency among immigrants, with considerably less effort been made to examine the usefulness of structural explanations. Structural explanations have been underrepresented in an area of research where structural theories can be most promising.

Drawing on Blau's macrostructural theory, we argued that English language fluency among immigrants as a phenomenon can be subsumed under the broader conceptual framework of intergroup relations. Because English fluency and intergroup relations influence each other and their possibilities depend on opportunities for intergroup contacts, structural theory which has been proven useful in explanations of intergroup relations can be readily borrowed to study English fluency as well.

Although our primary interest lied with the empirical validity of structural explanations, we also incorporated individual factors from the work of Chiswick and Miller (1995, 2002) to form a more balanced and complete multilevel model. The results of our multilevel cumulative logit analyses lend strong empirical support to Blau's theory. Consistent with his arguments, our findings indicate that English language fluency of foreign-born individuals are affected negatively by the size and residential clustering of immigrants who speak a common native language, and positively affected by the level of linguistic heterogeneity and inequality of the metropolitan area where they live.

Because our analysis included 20 language groups in 296 MSAs, the above findings concerning the effects of structural factors are generalizable to members of all 20 groups and to all MSAs. The testing of these structural hypotheses was done in a forward inclusion manner after individual-level predictors have done their share of explanation. For these reasons, these findings are particularly important because they indicate that structural factors make unique contributions to our understanding of English fluency that cannot be explained by individual factors alone.

Our analysis also reconfirms some of the well-known findings regarding the extent to which English language fluency among foreign-born is affected by such human-capital factors as educational attainment, length of stay in the United States, the age of entry, and gender. Although living with school-age children has been cited as an important asset for adult immigrants to learn English, we were not able to substantiate such effect. As Chiswick and Miller (1995) have argued, a school-age child can function both as an English teacher and a translator for adult immigrants, and the two effects are likely to cancel each other. Together, the results of our multilevel analysis clearly indicate that the ability to speak English among the country's immigrants is affected not only by the individual characteristics of these immigrants, but also by the characteristics of the groups of which they were members and the characteristics of the metropolitan areas in which they lived. Thus, previous studies which ignored these important group and community characteristics were not only incomplete, but the results based on such incomplete models could also be biased for failing to acknowledge the role played by structural factors.

Notes

1. Rytina et al. (1988) used a sampling analogy to explicate the positive association. According to them, average status difference between married couples, which reflects the extent of intermarriage, can be seen as a sample estimate of the population parameter, i.e., inequality. If only chance is allowed to operate, there should be a positive correlation between the parameter and its estimate.

2. Blau's multi-parameter concept, consolidation, is similar to group differences in earnings. But earnings differences between good and poor English speakers resulted from a consolidation of English ability and earnings, which, according to Blau (1977), would impede instead of encourage intergroup associations.

3. One reviewer maintains that an alternative strategy to control for the effect of U.S. schooling is to restrict the sample to immigrants who arrived in the United States as adults. While we believe that the inclusion of age at migration serves a similar purpose, future studies should consider other restriction alternatives.

4. While immigrants from most countries can be assigned to one language group; those from India can be assigned to either Hindi or Gujarathi, both are official languages of India. Assigning all Indian immigrants to either is obviously inappropriate. As a solution, we randomly assign Indian immigrants who speak only English to Hindi and Gujarathi using probabilities proportionate to the size of the two groups.

5. Although there are a total of 331 MSA/PMSAs (Primary Metropolitan Statistical Area) in the SF3, we were only able to uniquely identify 297 units because many small metropolitan areas have been combined. In addition, not all 20 groups are found in all MSAs. Therefore, the numbers of MSAs and MSA-specific groups used are 297 and 5,052, respectively. Although aggregate studies typically excluded smaller units from analyses to minimize their undue influences (Hwang and Murdock 1998), the HLM program uses empirical Bayes estimator to address the problem by weighting each unit according to its size and the reliability of unit-specific estimates (Raudenbush and Bryk 2002).

6. Following White (1983), the distance between two persons living in the same census tract i is not 0 but is a value approximated by $.6\sqrt{A}$, with A stands for the land area of census tract i.

7. We have computed an alternative index of heterogeneity based on place of birth to verify the construct validity of our measure. The measure based on all 40 language groups used in the SF3 (including English speakers) is correlated positively with the index based on place of birth ($r = .89$).

8. According to Snow (1997), the distance between English and a non-English language increases in the following order: Dutch (1), German (2), Scandinavian (3), Romance (4), Slavic (5), other Indoeuropean (6), and non-Indoeuropean (7).

9. Because the ordinal outcome variable has five responses, four cumulative log odds can be computed (i.e., p_1 vs. $p_2 + p_3 + p_4 + p_5$; $p_1 + p_2$ vs. $p_3 + p_4 + p_5$; $p_1 + p_2 + p_3$ vs. $p_4 + p_5$, and $p_1 + p_2 + p_3 + p_4$ vs. p_5). With α_{0jk} representing the intercept for the first contrast; and the intercepts for second, third, and last contrasts are indicated by $\alpha_{0jk} + \delta_2$, $\alpha_{0jk} + \delta_3$, and $\alpha_{0jk} + \delta_4$, respectively.

10. The inclusion of a set of thresholds in the Level-1 and the mixed model equations implies that there are multiple intercepts but that all intercepts are affected in the same manner by higher-level variables.

11. This assumption is appropriate because the focus of this study is to test the four hypotheses derived from Blau's instead of explaining variations of level-1 slopes. The effects of higher level variables resulted from this specification are consistent with results when no level-1 independent variables are included in the model (see Appendix A).

12. It is inappropriate to compare the percent reduction in variance associated with different models and to draw conclusion that one set of variables are more important than others. Because some of the explainable variance in the outcome variable is shared by variables at different levels due to cross-level correlations, the variables that entered the model first are expected to reap a lion's share of the credit. While one can include only higher-level variables in HLM, there is no way to enter higher-level variables and then the lower-level ones. Thus, it is impossible to test the hypothesis that if group-level variables could have explained more variances than the individual-level ones.

13. Because the main purpose of our hierarchical modeling is to explain variations in intercepts observed at lower-levels using higher-level explanators, the estimated effects of lower-level variables (i.e., slopes) are unaffected by higher-level variables that enter the model later. Given this unique feature, it would not be appropriate to attempt a comparison of explanatory power of predictors measured at different levels because the built-in disadvantage for the higher-level variables.

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Appendix A: Structural Determinants of English Language Fluency

	β	$(e^{sd^*\beta}-1)^*100$
Fixed Effects		
Average Fluency		
Intercept	.24*	—
Threshold 2	2.10*	—
Threshold 3	3.21*	—
Threshold 4	4.67*	—
Level-1 Predictors		
Education Attainment	—	—
Female	—	—
School Age Child	—	—
Years Since Migration	—	—
Years Since Migration^2/100	—	—
Age at Migration	—	—
Age at Migration^2/100	—	—
Level-2 Predictors		
Segregation	-.07*	-18.44
Ln(Group Size)	-.27*	-41.64
Linguistic Distance	-.26*	-31.59
Level-3 Predictors		
Linguistic Heterogeneity	.48*	6.89
Ln(Inequality)	.16*	5.66
Random Effects		
Variance Components		
Level-2	.54*	
Level-3	.02*	

Note: $^*p < .05$.