Race and Friendship Choice:
A Test of Contact and Group Threat Theories

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Introduction

According to contact theory, exposure to individuals of different racial/ethnic backgrounds changes attitudes and opinions in positive ways, leading to more interracial friendships and a stronger preference for other-race friends (Allport 1954). As a result, as schools integrate racially, so should friendships. Group threat theory predicts the opposite; as diversity increases within a school, group competition increases and friendships become more rather than less segregated (Blalock 1967). A small body of research focuses on distinguishing the role of school racial composition and diversity on the friendship choices of individuals and generally supports group threat theory (Moody 2001; Quillian and Campbell 2003; Zeng 2004). Although this result may be correct, it could also be the consequence of two important but overlooked methodological features of past research: the use of choice models without accounting for important independence assumptions, and the modeling of *individual* friend choice rather than choices of *groups* of friends.

In this paper I model the effect of race and school racial composition on friend choice using data from the National Longitudinal Study of Adolescent Health (Add Health) in order to distinguish between contact theory and group threat theory. To account for the methodological shortcomings of past research, I first demonstrate the bias created by choice models when applied to friendship choice using a hypothetical dataset. I then show two strategies for correcting this bias. I apply these models with and without corrections to the Add Health data, comparing models of individual friend choice with models of friendship group choice. Through these steps, this paper improves on past research by 1) showing that bias is introduced into models of friend choice when "identical" friend alternatives are included in the choice-set and non-chosen friend alternatives are sampled in small numbers, 2) correcting models for "identical alternatives" and sampling a sufficiently large set of non-chosen alternatives, and 3) modeling friendship *group* choices rather than choices for individual friends.

I show, consistent with past research, that the relationship between school racial diversity and inter-racial friendships is negative when estimated using a traditional discrete choice model. After correcting this model for violations of key model assumptions, this relationship becomes positive, providing support for contact theory. I then compare corrected models of individual friend choice with corrected models of friendship group choice. Although both models support contact theory, models of individual friend choice tend to overstate same-race preferences. Models of friendship group preferences allow individuals to choose racially heterogeneous groups and as a result are able to capture important friend preferences ignored by past research.

Background

Contact theory and group threat theory developed as competing explanations for racial attitudes and race relations in the US. Although generally studied in isolation, they provide an interesting contrast to one another. Both are concerned with how contact between individuals of different races affects attitudes and prejudice, but they come to dramatically different conclusions. According to contact theory, prejudice against minorities is based on negative and faulty stereotypes. As contact between racial groups increases, these negative stereotypes are countered by direct information about the values and lifestyles of the other group. Through sustained and positive interactions, racial attitudes change, resulting in more positive race relations (Allport 1954). In contrast, group threat theory predicts that more contact between minority and majority groups will lead to greater competition for resources and power, creating more rather than less antagonistic feelings between groups (Blalock 1967; Olzak 1992).

A significant body of research attempts to test these theories to determine whether contact between racial groups increases or decreases animosity and prejudice between groups. Evidence is largely mixed. On the one hand, several studies show that interracial contact is associated with fewer negative stereotypes of racial groups; individuals who experience more self-reported integrated neighborhoods, schools, churches, and other social institutions are less likely to express prejudice against another racial group (Dixon and Rosenbaum 2004; Pettigrew and Tropp 2006; Powers and Ellison 1995; Sigelman and Welch 1993). On the other hand, other research shows a strong and positive relationship between interracial contact and prejudice. Increases in the percentage black in a city, for example, are associated with increases in anti-black prejudice among whites (Glaser 1994; Quillian 1996; Taylor 1998).

In all of this work, it is unclear whether actual contact or perceived contact is being measured. One way to deal with this ambiguity is to look at actual behaviors rather than stated attitudes. Friends provide an interesting case. If individuals have positive attitudes towards other races, their friendship choices should presumably reflect these attitudes. Of course, friendship choices are dependent on opportunities. No matter how much a white individual wants a black friend, if she does not come into contact with a black person, there is no way that she can choose a black friend. The contexts of these choices are therefore important to account for. Among adolescents, schools provide the primary social environment in which adolescents choose friends and therefore these peers can be thought of as adolescents' potential friends. According to both contact and group threat theories, adolescents' friendship preferences should change depending on the composition of their school environments, net of their opportunities to make cross-race friends. By looking at individuals' local school environments, I am able to capture adolescents' contact with individuals of other races.

A small body of research looks at the effect of race on adolescent friendship choice. This research all confirms that adolescent friendships are organized by race. (Hallinan and Williams 1989; Quillian and Campbell 2001; Moody 2001; Mouw and Entwisle 2006; Zeng 2004; Kao and Joyner 2006). Black adolescents are more likely to be friends with other black students; white adolescents are more likely to be friends with other white students (Joyner and Kao 2000; Quillian and Campbell 2001; Tuma and Hallinan 1979; Hallinan and Williams 1989).

Importantly, the school context matters for adolescents' racial preferences for friends. The likelihood of forming interracial friendships varies dramatically by school racial composition. Some research shows that the probability of forming an interracial friendship increases with school racial diversity (Joyner and Kao 2000). Joyner and Kao (2000) use logistic regression to predict the likelihood that a student with given individual and school characteristics has a cross-race friend. They show that as school racial diversity increases, so does a student's likelihood of having a cross-race friend. These models though do not account for students' opportunities to have cross-race friends. It is therefore impossible to separate the effect of school racial diversity on preferences from the effect of school racial diversity on opportunities for cross-race friends.

Quillian and Campbell (2003) use p* models to separate out these effects. p* models use logistic regression to predict the probability that a tie exists between two actors. These models compare an individual's actual friendship choices to the set of possible choices an individual could have chosen. Dyadic pairs are the unit of analysis and characteristics of those pairs as well as individual and school characteristics are used to predict the likelihood that the pair of students are friends (see Wasserman and Pattison 1996 for a formal discussion of p* models). Although Quillian and Campbell show a clear propinquity effect such that friendships are more likely to cross race as school diversity increases, once in-school opportunities are accounted for, preferences for cross-race friendships *increase* as diversity declines. For example, white students prefer white friends when white students make up a minority of the school. As white students make up larger proportions of schools, whites prefer cross rather than same-race friends. These results are supported by similar research by Moody (2001), who shows, also using p* models, that the odds of having a same-race friend *increase* as school racial heterogeneity increases. Both of these papers provide support for group threat theory.

Although p* models account for students' opportunities to choose cross-race friends in the school, they do not condition on the individual respondent. They imply that students make independent decisions about each friend alternative without comparing the friend alternative to the other alternatives available (Zeng and Xie Forthcoming). In response, Zeng (draft) uses a conditional logit model to account both for students' opportunities for cross-race friendships and the dependence of students' friendship choices. Consistent with both Moody (2001) and Quillian and Campbell (2003), Zeng finds that as a racial group increases their proportion in a school, members of other races are less likely to nominate them as friends.

All of this research supports group threat theory; the size of the population of any given racial group in a school is negatively related to that group's probability of being nominated as a friend. This work, though, is limited in two respects. First, all of the current research on friendship choices focuses on preferences for individual friends (Quillian and Campbell 2001; Mouw and Entwisle 2006; Zeng 2004). However, adolescents choose many friends and these choices are interdependent (Moody 2001). Whom an individual chooses as her second friend is dependent in part on whom that individual chose as her first friend. Additionally, adolescents' preferences for friends may differ depending on the friend. For example, an individual may prefer certain characteristics for her best friend but different characteristics for other friends. Studying preferences for individual friends rather than preferences for a group of friends treats friendship choices as independent events and treats preferences for characteristics in friends as uniform.

Second, all of the research focused on variations in friendship preferences across school types uses choice models (or some relation) to compare each individual's friend choices to her set of possible friend alternatives within the school. These models require several, normally plausible, assumptions that, if violated, could misrepresent adolescents' preferences for same and cross-race friends (McFadden 1978; Powers and Ellison 1995).

Choice models are traditionally used in economics to understand consumer choice, transportation choice, and housing choice. These models compare an individual's choice with her possible but non-chosen choice alternatives, allowing a calculation of the probabilities that different choices are made given the attributes of the choices and the individual. Validity of these models rests on the assumption that choices are independent of irrelevant alternatives[1]. The relative choice probabilities of a set of choice alternatives are assumed to be unchanged when other choice alternatives are added or removed from the set of choice possibilities. This assumption is known as the IIA assumption. In order to estimate unbiased choice models, this assumption must be met. (Ben-Akiva and Lerman 1985; McFadden 1978). Traditional choice

[1] Choice models also assume that the chooser is knowledgeable and aware of her choice possibilities. This assumption presents complications for models of friend choice because these choices are made by two people; the chooser must choose the chosen and the chosen must also choose the chooser. As a result, determining who is part of an individual's choice-set is difficult for both the respondent and the researcher. The respondent limits her set of possible friends to those who she *believes* would also choose her and likely does not consider all possible choices. The researcher, not knowing the interpersonal details of respondents, is unable to identify a respondent's actual choice-set or even her perceived choice-set. The consequence is that the researcher generally overstates a respondent's choice-set, while the actor understates her choice-set. If a choice alternative is included in the choice-set that is both unknown to the respondent *and* a high probability choice if the respondent were to know about that alternative, estimates could be significantly biased. Because this paper uses relatively simple models, friend alternatives are generally not unique in their characteristics. As a result, it is unlikely that a friend alternative with given characteristics would be included in the researcher defined choice-set but not the respondent defined choice-set.

problems generally satisfy this assumption. Although friend choice shares some features with these more traditional choice problems, friend choice is more complicated.

Although each friend alternative is unique, each friend alternative is not necessarily unique in its characteristics. Two different friends in a choice-set, whose racial identification is the same, are technically identical alternatives (when race is the only characteristic included in a model) but treated in the model as distinct options. According to Ben-Akiva and Lerman (1985), "the validity of the choice axiom is restricted to choice sets with distinct alternatives" (p. 51). As a result, models including identical alternatives violate the IIA assumption and lead to biased estimates of friend preferences.

With this limitation in mind, the next section formally describes the methods and data used in this analysis. I demonstrate the bias created by including "identical" friend alternatives in models of friend choice using a simulated sample of adolescents and schools. I then show how corrections for identical alternatives make models more sensitive to sampling of the non-chosen friend alternatives. This work provides the basis for my improved choice model, correcting for IIA violations and sampling. These models are then used to correct past research on school racial composition and its effect on racial preferences for friends.

Data

This analysis uses two data sources. In order to test group threat and contact theories, I use data from the National Longitudinal Study of Adolescent Health (Add Health). Add Health surveyed seventh- through twelfth-grade students in 144 sampled schools in 80 U.S. communities between September of 1994 and April of 1995 (N=89,940). Nearly all students in participating schools completed the in-school survey, containing basic socio-demographic information as well as friendship nominations. Each student was asked to nominate his/her five closest male friends and five closest female friends. Nominations were allowed to include any friend, whether or not that friend attended the respondent's school. All students participating in the in-school survey were linked to their nominated in-school friends, providing a unique opportunity to consider the relationship between race, and friendships. Because data are only collected for in-school friends, my analysis is limited to adolescents' in-school friendships and their preferences for in-school friends. (Bearman et al 1997)

Although, I believe that previous models of friendship choice using choice models are biased, it is impossible to show this bias using the Add Health data because adolescents' actual preferences are unknown. In order to test models of friendship choice, I construct a series of hypothetical samples. These samples are constructed so that preferences are known. An unbiased model predicting friend choice should reflect these known preferences. Although these samples are meant to emulate the structure of the Add Health data, respondents' characteristics are limited to race.

I construct two simple hypothetical samples. Each sample contains 1000 respondents, 500 black and 500 white. These respondents attend one of two schools. School 1 is 80% black and 20% white, and school 2 is 20% black and 80% white. To emulate the Add Health data, each respondent is allowed to choose up to 10 friends. In the first sample, each respondent is randomly assigned a number of chosen friends between 1 and 10. Friend choices are assigned based on race with the following probabilities. Black respondents have a .7 probability of choosing a black friend and a .3 probability of choosing a white friend. White respondents have a .8 probability of choosing a white friend and a .2 probability of choosing a black friend. These probabilities represent respondents' race preferences for friends. Regardless of the school attended, all white students have the same race preference and all black students have the same race preference. The set of possible but non-chosen friends is sampled randomly within the school without replacement. No two chosen friends or sampled possible friends are the same. For each respondent, I sample 90 non-chosen friend alternatives and flag non-chosen friends in order to run models with varying numbers of sampled non-chosen friend alternatives. The resulting sample contains between 91 and 100 observations per individual, including their chosen friends and a sample of their possible in-school friends.

Sample 1 focuses on respondents' individual friends and non-chosen friend alternatives. Sample 2 changes the unit of analysis from the individual friend to the friendship group. I select adolescents' chosen friendship groups with the following probability distributions: black students experienced a .1 probability of choosing a friendship group that is 0% black, .3 probability of choosing a friendship group that is 1-50% black, and a .6 probability of choosing a friendship group that is 51-100% black, white students experienced .8, .1, and .1 probabilities of choosing friendship groups that are 0, 1-50, and 51-100% black respectively. All black students have the same preferences while all white students have the same preferences regardless of the school they attend. I then sample non-chosen friendship group alternatives using a two-step sampling procedure where I first randomly sample the size of the friendship group and then sample individuals in the school without replacement to correspond to each person in the friendship group. No two friendship groups may contain the same set of individuals but the same individuals may appear in multiple chosen and non-chosen friendship groups. Each individual has one chosen friendship group and 99 sampled possible but non-chosen friendship groups. The resulting sample contains 100 observations per individual.

After formally describing the methods in the next section, I use these two hypothetical samples to test the methods for bias. Once the bias is demonstrated and corrected, I finalize the models that are used with the Add Health data.

Methods

I model adolescents' friendship preferences using a discrete-choice analysis. This method of analysis allows me to compare an adolescent's chosen friends to the friends that the adolescent could have chosen but did not choose through a series of paired comparisons. For individual *i*, the observed utility *V* of friend alternative *n* is a function of the individual's characteristics *X*, their school characteristics *S* and the friend alternative's characteristics *Y*, or:

$$V_{in} = a_n + X_{in} b_n + S_{in} l_n + Z_i Y_n \tag{1}$$

The probability p of choosing friend alternative *n* by individual *i* is:

$$p_i(n|\mathbf{D}) = \frac{\exp[V_{in}]}{\sum_{m \in \mathbf{D}} \exp[V_{im}]}, \qquad n \in \mathbf{D} \tag{2}$$

where **D** is the set of friend choices, including the chosen alternatives (McFadden 1978; Ben-Akiva and Lerman 1985). The friend (or friendship group) is the unit of analysis and all models condition on the respondent. The model therefore includes multiple observations for each respondent and the additive effects of all individual characteristics on friend (or friendship group) choice are netted out of the model.

The first part of my analysis models adolescents' preferences for individual friends, the second part of my analysis models adolescents' preferences for friendship groups. Although both use the same methods, the choice-sets are defined differently and different assumptions are made about the process of friend choice.

In the first part of this analysis, each friend choice is treated as independent of all other friend choices. In other words, each friend is chosen one at a time, without recognition of the previous friends chosen or the future chosen friends. The set of *possible* individual friends is defined as all adolescents who attend the respondent's school[2]. The size of each individual's choice-set is therefore one minus the number of students in the school. If n is the number of students within a school, the number of observations for each school is $n(n-1)$. A small school that contains 100 students will include 9,900 observations. A large school with 2,000 students will include 3,998,000 observations. Given the size and number of schools in the dataset, it is computationally prohibitive to use the full choice-set of each individual in the analysis.

The second part of this analysis models adolescents' preferences for friendship *groups* rather than individual friends. This analysis allows each individual friend choice to be dependent on other friend choices by modeling the effects of group characteristics rather than individual characteristics. The set of possible friendship group choices is defined as all possible combinations of up to five male friends and five female friends within each student's school. Because the size of the choice-set increases more than exponentially with the school size, including each individual's complete choice-set in the model is intractable.[3]

When modeling both individual friend preferences and friendship group preferences, I am forced to sample a set of the choice-set to represent each individual's full choice-set. Because creating the set of all possible friendship groups for each school and then randomly selecting

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[2] Throughout this paper I treat the entire school as the set of possible friends. In many schools there are likely boundaries within the school that affect adolescents' opportunities for friendships, for example across grade levels or tracks. These boundaries make contact with some students more probable than with other students. In future work I hope to complicate these models by incorporating these different opportunities within schools into models of friendship choice as Zeng and Xie (Forthcoming) demonstrate.

[3] Schools in Add Health vary in size from 25 students to 2,551 students. In the smallest school there are 3,774,680 possible friendship groups of up to 10 students (five girls, five boys). In the largest school there are 7.85×10^{26} possible friendship groups.

some number of groups from that set is computationally prohibitive, I develop an alternative method for sampling friendship group alternatives.

Given the gender and size constraints of friendship groups in the data, there are 36 possible types of friendship groups.[4] I go through a two-step sampling procedure where I first randomly sample the type of the group and then sample individuals in the school without replacement to correspond to the individuals in the group. While no two choices can be the same, the same student can appear in more than one friendship group alternative.[5]

The validity of the estimates estimated by choice models rest on the claim that the relative odds of choosing any two alternatives are independent of the attributes and availability of any other alternative (the IIA assumption) (Ben-Akiva and Lerman 1985; McFadden 1978). McFadden (1978) famously illustrates how the IIA assumption can dramatically affect estimations of individuals' preferences using an example of transportation choice. An individual needs to decide how to get to work; he can either drive his car or take a red bus. He is indifferent to the choices and will therefore choose to drive his own car 50% of the time and choose to ride

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[4] For example a group containing 1 female friend and 2 male friends is different than a group containing 2 female friends and 1 male friend. In other words, an individual can choose anywhere from 0 to 5 female friends and 0 to 5 male friends. The number of possible combinations of 0 to 5 male friends and 0 to 5 female friends represents the number of friendship group types. This number is $\binom{6}{1}\cdot\binom{6}{1} = 36$

[5] When this process is complete, the resulting probabilities of choosing each friendship group vary within schools depending on the type of group chosen. For example, in a hypothetical school of 20 students, the probability of choosing a group of 0 friends is $\frac{1}{36}$ while the probability of choosing a group of 4 female students and 1 male student is: $p = \frac{1}{36}\cdot\left(\binom{10}{1}\cdot\binom{10}{4}\right)^{-1}$ or $\frac{1}{75{,}600}$. In standard choice models with sampling, if the probability of sampling choice alternatives is unequal, model estimation requires a correction for sampling: $\ln p_i(\mathbf{D}|n)$. This correction calculates of the joint probability of choosing each element of a set of alternatives **D** given that the probability of choosing alternative *n* in **D** is 1 (McFadden 1978; Ben-Akiva and Lerman 1985). In this particular model, because friendship group composition is correlated with the size of the friendship group and the size of the friendship group is used to sample friendship groups, this offset term works to bias results further rather than correct for sampling bias. I therefore estimate models of friendship group choice without a sampling correction. Models without a correction are not biased when sampled in large numbers.

the bus 50% of the time. Now we add another possibility to his set of choices: a blue bus. He now has to make a choice between driving, riding a red bus, or riding a blue bus. If we assume IIA, he will choose the car, the red bus, and the blue bus each 33% of the time, leading him to ride the bus 66% of the time. Assuming IIA, it now appears that he has a strong preference for riding the bus when in fact, his preferences have not changed at all.

If we approach this problem from the opposite direction, we might ask how this individual would act if IIA were not true. Rather than spread out his preference equally among all choice alternatives, this individual would maintain his .5 preference for the car and split his .5 preference for the bus between the red bus and the blue bus. Through paired comparisons between car and blue bus, and car and red bus, we would estimate his odds of choosing a bus compared to a car at .5 (.25/.5). Because of the inclusion of this essentially identical alternative, we have now understated this man's preference for riding a bus because the model treats each alternative in the choice-set as a unique alternative. Increasing the number of essentially identical options in the choice-set will necessarily decrease the estimated preference for that option because the preference is distributed across identical alternatives.

As discussed earlier, although individual friends are unique (and each friendship group is unique), friends often have the same characteristics. As with the red bus and the blue bus, friends with the same characteristics are treated as unique options by the model proposed above. When identical alternatives are treated as unique options, I dilute the preference for alternatives that are very prevalent in the choice set. In this case, if a school contains a large proportion of (observationally identical) black students, the preference that individuals have for black friends will be distributed across the black friend alternatives. As the distributed preferences for specific black friend alternatives are compared to preferences for specific white friend alternatives, the estimated preference for black friends will be dramatically smaller than the actual preference for black friends. The opposite result should occur in schools with a large proportion of (observationally identical) white students. Preferences for white friends will be understated for all students.

I demonstrate this bias using the hypothetical samples described above. I estimate friend preferences using the model described above. These models *do not* correct for bias introduced by duplicates in the choice-set. Table 1 shows the predicted probabilities of friend choice along with expected racial preferences for friends across the two samples and separated by school.

Comparing the estimated preferences to the expected preferences, I observe large discrepancies across both samples[6]. Looking first at models of preferences for individual friends, differences between expected and estimated preferences are smallest when schools are combined. Among white respondents, estimated preferences for white friends are smaller than actual preferences (compare .711 and.807) and larger for black friends (compare .193 and .289). Among black students, estimated preferences for white friends are larger than expected and estimated preferences for black friends are smaller than expected. When models are separated by school, the predicted probabilities are dramatically different from the expected preferences of respondents. In black schools, both white and black preferences for white friends are overstated, particularly among black students (compare .625 estimated to .292 actual). In white schools, both white and black preferences for black friends are overstated. Models of friendship group choice exhibit similar bias.

[6] Estimated preferences for both individual friends and friendship groups using traditional conditional logit models are not sensitive to the number of sampled non-chosen friendship groups included in the choice-set. Estimates are consistent whether the choice-set includes 10 non-chosen friends (friendship groups) or 100 non-chosen friends (friendship groups).

This exercise shows that the standard conditional logit model overstates both black and white preferences for friends belonging to the minority racial group in the school, a result consistent with group threat theory. Models of friend preferences that do not account for duplicates in the choice-set will therefore misstate racial preferences, particularly when schools are separated by racial composition, and be more likely to incorrectly support group threat theory.

One way to correct for this bias is to reweight duplicate observations so that each identical alternative *appears* to be the only alternative of that type. The result of this action is that paired comparisons should reflect actual preferences. To correct models, I weight up each duplicated observation by including in an offset term the inversed log of the number of duplicates *d* with the same characteristics (composition) as friend (friendship group) *n* in the sampled choice-set, resulting in equation 3.

$$p_i\left(n \middle| \mathbf{D}\right) = \frac{\exp\left[\left(V_{in}\right) + \ln\left(\frac{1}{d_n}\right)\right]}{\sum_{m \in \mathbf{D}} \exp\left[\left(V_{im}\right) + \ln\left(\frac{1}{d_m}\right)\right]}, \qquad n \in \mathbf{D} \tag{3}$$

When the focus of the models and predicted probabilities is race and the racial composition of friends, all friends of the same race and all friendship groups with the same racial composition are treated as duplicate choice alternatives. The effect of this correction on estimates of friend preferences is demonstrated below using the hypothetical samples described above.

Table 2 shows the predicted probabilities of individual friend and friendship group choice estimated from a model that corrects for duplicates of friend characteristics in the choice-set. Again, using the hypothetical data described above, the predicted probabilities can be compared to the actual, expected preferences of respondents in the sample to determine whether models are in fact correcting for the bias introduced by duplicates in the choice-set. Predicted probabilities are shown for varying choice-set sizes. This allows me to determine whether estimates are valid regardless of the size of the sampled choice-set.

Looking first at the columns that include all schools, predicted probabilities are relatively close to expected preferences when duplicates are accounted for. The inclusion of the duplicates correction however, makes models sensitive to the size of the sampled non-chosen choice alternatives. As the sample size of the non-chosen alternatives increases, predicted probabilities converge towards expected results. Running models separately by school introduces significantly more bias. When sample sizes are small and models are separated by school but adjusted for duplicates, all students still show stronger preferences for the minority racial group in the school than expected. Again, as I increase the sample size of the non-chosen alternatives included in the model, results converge to the expected results.

Although these models correct for duplicates in the characteristics of friends in each respondent's choice-set, this correction makes models more sensitive to the *size* of the sampled choice-set. When all schools are pooled, bias is reduced. When models are separated by school racial composition results are biased if the sample size is less than 30 but similar to expected results at larger sample sizes.

This work shows 1) that duplicates in a respondents' choice-set dramatically misrepresent preferences for friends, and 2) that model corrections are sensitive to the number of sampled non-chosen friend alternatives. These two patterns exist whether considering individual friend choices or friendship group choices. The potential consequence of these observations is that past research using the standard discrete choice model described in equation 2 are biased and may misstate the relationship between school racial composition and racial preferences for friends.

In response to these results, I first run models with the Add Health data predicting individual friend preferences without a correction for duplicates, in order to replicate past research. I then include a correction to account for duplicates in the choice-set and sample 100 non-chosen friend alternatives to ensure unbiased results. I compare these estimates to determine first how biased past research is and second the true relationship between school racial composition and racial preferences for friends. Finally, I change the unit of the analysis from the individual friend to the friendship group and compare individual friend preferences to preferences for friendship groups. The next section describes the measures used in these models.

Measures

This paper studies individuals and their chosen and sampled in-school friends and friendship groups. I focus on how preferences for the race of friends and the racial composition of friendship groups depend on the racial composition of schools. By modeling this relationship, I determine whether preferences for black friends increase as the percent black in a school increases, or whether these preferences decrease.

Each respondent has three characteristics: her race, her academic achievement, and her parents' level of education. This analysis focuses on race. Academic achievement and parental education are controls to account for the important correlations between race on the one hand, and academic achievement and socioeconomic status on the other. I dichotomize racial categories into black and non-black. Although a number of studies show variation in preferences across more detailed racial and ethnic categories, the most extreme preferences were always for black adolescents. Although the non-white category is dominated by whites, there is significant variation within this category. Setting up race in this manner will, I believe, create more conservative estimates of adolescents' racial preferences for individual friends and friendship groups. In a sample of 70,377 adolescents[7], 85% are non-black and 15% are black. Academic achievement comes from students' self-reported grade point average (GPA)[8]. The average GPA of respondents is 2.81. Parental education comes from student reports of their father and mother's highest level of education. From these reports I create two measures of parental education: whether at least one parent attended college, and whether at least one parent completed college. Approximately 58% of the sample reported at least one parent attending college and 40% reported at least one parent completing college.

Individuals may nominate up to ten friends, five male friends and five female friends. Students who nominate zero friends are included in the analysis[9] and their choice of zero friends is compared to the other possible friend choices in the school. On average respondents nominate 4.3 in-school friends. Both nominated and possible friends each have three characteristics, their race, academic achievement, and parental education. Friend and possible friend characteristics

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[7] I exclude respondents who are missing information on individual race, gender, age, grade, parental education and achievement. I also exclude all respondents who attend schools with fewer than 100 students. My total choice-set for the individual friend analysis includes 100 chosen and non-chosen friend alternatives, and no friend can be included twice in the choice-set. This requirement cannot be met in these small schools and I therefore exclude them from the analysis. To test whether results are sensitive to the inclusion of these respondents, I sample a smaller set of non-chosen alternatives and run models with and without these schools. Results are not sensitive to the inclusion of these schools in the sample.

[8] Respondents report their average grade in English, math, science, and social science. I calculate a GPA from these self-reported grades by assigning grade points to each average grade and dividing by four. A=4, B=3, C=2, D=1, and F=0. Actual grades taken from respondents' high school transcripts are available for a subset of the in-school survey respondents. Because these transcript data exist only for a subset of the survey sample these cannot be used in this analysis to describe adolescents' level of academic achievement.

[9] In-school survey participants nominated three types of friends: friends who attended their school and participated in the in-school survey, friends who attended their school but did not participate in the in-school survey, and friends who did not attend the school. Approximately 15% of in-school survey respondents nominated zero friends, while 36% nominated ten friends. If I limit nominated friends to students in the school, the number of students nominating zero friends increases to almost 22%, while the number of students nominating ten friends falls to just over 12%. Because I only have data on in-school friends who also participated in the in-school survey, the description of friendship groups is limited to in-school friendship groups. A small number of students appear on the school roster but did not participate in the in-school survey. Limiting friends to students who attend the same school and also participated in the in-school survey increases the percent of students nominating zero friends to 24% and decreasing the number of students nominating ten friends to just fewer than 3%. This analysis treats un-matched in-school friends as friends who did not attend the school.

are based on friends' (and possible friends') self-reported race, grades, and parental education. These characteristics mirror the respondent characteristics described above. 15% of chosen friends are black, 85% of chosen friends are non-black.

When the friendship group is the unit of analysis, individual friend characteristics need to be transformed to describe the composition of the nominated friendship group and the randomly sampled friendship group alternatives. I calculate the percent black, the average GPA, and the proportion of students with at least one parent who attended college[10] in the friendship group from friends' (and possible friends') self-reported race, grades, and parental education. Friendship group racial composition is divided into three categories[11]: 0% black, 1-50% black, and 51-100% black[12]. Approximately 80% of chosen friendship groups are 0% black, 8% are 1-50% black, and 11% are 51-100% black.

I measure school racial composition using the percent black in the school. I split the percent black into 3 categories: less than 20% black, 20 to 50% black, and greater than 50% black. Although some work looks at finer categories of racial composition, there are too few schools in Add Health to support smaller categories, particularly at the high end of the percent black distribution. Approximately 74% of the sample attends a school that is less than 20% black, 20% of the sample attends a school that is between 20 and 50% black, and 6% of the sample attends a school that is more than 50% black.

[10] I also ran models substituting the proportion of friends with at least one parent who attended college with the proportion of friends with at least one parent who completed college. Although the effect of these variables differs, the inclusion of one over the other does not affect the effect of race on friendship group choice.

[11] All proceeding analysis was run using continuous measures of friendship group academic achievement and racial composition. These models provided worse fits to the data than did the categorical measures of these variables according to likelihood ratio tests and BIC.

[12] I ran this analysis dividing racial composition into four rather than three categories: 0% black, 1-20% black, 21-50% black, and 51-100% black. The general story was the same regardless of whether I measured racial composition using four or three categories. Although results were clearer in the four category models, I present the three category models in this analysis because the data were stretched too thin across the two middle categories.

This analysis assumes that nominated friends are students' preferred friends. Friendship is complicated and requires both parties to agree to the friendship. If Ben's preferred friend, Michael, does not want to be friends with Ben, Ben must choose another friend, Martin. This paper treats Martin as Ben's preference when in fact Michael is Ben's preference. One way to deal with this problem is to exploit the fact that respondents' friendship nominations are not required to be reciprocated. Approximately 60% of friend nominations in the data are not reciprocated. Reciprocated friendships may be different than unreciprocated friendships. Reciprocated friendships may represent students' actual friends, whereas unreciprocated friendships may represent students' desired friends. In order to better capture adolescents' actual preferences, I model preferences based on all nominated friends, then on only their reciprocated friendships, and finally only on their unreciprocated friendships. Overall, results are strongest in models that include only unreciprocated friendships but all models generate substantively consistent results. I show models that include all friendship nominations.[13]

Results

Individual Friends

The first part of this analysis looks exclusively at adolescents' race preferences for individual friends. Table 3 shows the descriptive characteristics of adolescents and their chosen and sampled friends. On average, 4% of non-black adolescents' nominated friends are black compared to 75% of black adolescents' nominated friends. These percentages vary by school racial composition. For both black and non-black students, the proportion of nominated friends who are black increases as the percent black in the school increases. Comparing these distributions to those created when friends are randomly selected from the school population,

[13] Estimates from models including only reciprocated friends, and only unreciprocated friends are available from the author upon request.

adolescents have strong race preferences for their friends. A greater percentage of non-black students' sampled friends are black compared to their chosen friends (compare .045 to .104). A similar pattern is observed among black adolescents; 45% of sampled friends are black compared to 75% of chosen friends. The discrepancy between sampled and chosen friends holds across school racial compositions. In general, black students attend schools with larger proportions of black students even within categories of school racial composition, leading their randomly sampled friends to be more black than those of non-black students.

Comparing sampled and nominated friend characteristics, I observe clear preferences for same-race friends but these preferences change with school racial composition. When one race represents the majority in a school, both black and non-black adolescents are more likely to nominate friends of that race. This pattern is consistent with contact theory. Contact between individuals of different races changes their preferences for friends. These observations however, do not account for the opportunities that different students have to nominate friends of different racial backgrounds. Do we observe the same patterns when these opportunities are accounted for in a conditional logit model?

Table 4 shows the log odds of individual friend choice by school racial composition. I provide estimates from standard conditional logit models (top half of the table) and conditional logit models including an offset correcting for duplicates in the choice-set (the bottom half of the table). The top half of table 4 confirms the findings of past research. Racial preferences are stronger than preferences based on academic achievement and socioeconomic status. Overall, adolescents prefer same-race friends and these preferences vary by school racial composition. In table 5, I compare predicted probabilities[14] of friend choice across school racial compositions[15].

[14] Predicted probabilities are calculated for individuals with GPA equal to 3.0 and at least one parent who attended college, and for friends with GPA equal to 3.0 and with at least one parent who attended college.

Focusing on the uncorrected models, in schools with small black populations, black students show a strong preference for black friends (.92 probability of choosing a black friend). This strong preference for same-race friends among black adolescents declines as the proportion black in the school increases. I observe a similar pattern among non-black students. These results are consistent with the group threat hypothesis. When an individual is a member of the minority group in the school, she holds strong preferences for same-race friends, when that individual is a member of the majority group in the school, her strong preferences for same-race friends decline. Although these models confirm the results of past research, these models do not account for important bias introduced when duplicates are included in the choice-set, as demonstrated earlier.

I compare coefficients from corrected models and uncorrected models in table 4 to demonstrate how bias is introduced into models of friend choice when duplicates are ignored. In schools with small black populations, when models are not corrected, non-black students are 49% less likely to choose a black friend than a non-black friend. In contrast, when models are corrected for duplicates, non-black adolescents are 97% less likely to choose a black friend. A similar pattern occurs among black adolescents in schools with small black populations. After models are corrected for duplicates, black adolescents are less likely to choose a black friend. In schools with large black populations, this pattern reverses. In corrected models, both black and non-black adolescents are more likely to choose black friends. Including an offset to correct for duplicates in the choice-set dramatically changes coefficients predicting friend choice, specifically coefficients related to racial preferences.

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[15] Coefficients from table 4 cannot be compared across school racial compositions because models were run separately rather than pooled. A consequence of using a large number of non-chosen friend alternatives is that a significant amount of my computing power is used to accommodate the large number of observations in the dataset. Pooled models use more computing power than is available to me at this time. I am currently upgrading my computing system and will run pooled models when this is complete. For now I compare predicted probabilities implied by the coefficients.

I compare the predicted probabilities calculated from corrected models of friend choice in table 5 to reassess the relationship between school racial composition and racial preferences for friends. Non-black students in schools with small black populations show a strong preference for non-black friends. As the proportion black in a school increases, so do non-black preferences for black friends. In schools that are less than 20% black non-black students experience a .03 probability of choosing a black friend. In schools between 20 and 50% black, this probability increases to .102 and in schools that are more than 50% black this probability increases to .468. Black students show the opposite pattern; in schools with small black populations they experience a .39 probability of choosing a non-black friend and in schools with large black populations they experience a .15 probability. In contrast to uncorrected models, as the size of the minority population in the school increases, preferences for friends belonging to that group also increase. These results suggest that contact is playing an important role in friend preferences. As contact between racial groups increase, preferences for different-race friends increases, providing support for the contact hypothesis.

In summary, once duplicates in the choice-set are correctly accounted for, estimated preferences for different and same-race friends shift dramatically. Although past work provides evidence to support group threat theory, I show that these models ignore important complications introduced by modeling friend choice. After dealing with these complications that lead to violations of key model assumptions, my results support contact theory. Increased contact between racial groups *increases* rather than decreases friendships between members of different racial groups.

Friendship Groups

The preceding discussion focuses on adolescents' preferences for individual friends. However, adolescents choose many friends and these friendship choices are interdependent. Who an adolescent chooses as a friend depends on her other friend choices. The previous analysis treats these friend decisions as separate and independent events. Friendship preferences may also vary for different friends. For example, an adolescent may prefer a similar best friend but have less defined preferences for other friends. Models of preferences for individual friends assume that preferences are uniform across friends. The interdependence of friend decisions and heterogeneity in preferences across friends may lead models of preferences for individual friends to misstate and simplify adolescents' friend preferences. One way to deal with these characteristics of friendship choice is to model friendship *group* choices rather than choices for individual friends.

Table 6 shows predicted probabilities of friendship group choice by individual race, friendship group racial composition, and school racial composition. Table 6 also includes predicted probabilities of individual friend choice in order to compare friendship group estimates with individual friend estimates.

Focusing first on friendship group preferences, with all schools combined, black adolescents prefer friendship groups with a majority of blacks while non-black adolescents prefer friendship groups with no black students. These preferences though differ significantly across school racial compositions. In schools with small black populations, non-black students show a strong preference for friendship groups with no black students; these adolescents have a .90 probability of choosing a friendship group that is 0% black. Non-black students in schools with larger black populations show much weaker preferences for friendship groups that are 0% black. In schools that are 20-50% black they choose 0% black friendship groups with a probability of

.74 and in schools that are more than 50% black they choose 0% black friendship groups with a probability of .31. Clearly, as the size of the black population in a school increases, non-black students' preferences for black friends also increase. Among black students, I observe a similar pattern. In schools with small black populations, black students are more likely to choose friendship groups with a majority of non-black students. As the black population in a school increases, their probability of choosing a friendship group with many non-black students decreases while the probability of choosing a friendship group with many black students increases. However, non-black responses to school racial composition are more extreme than black responses, particularly in schools with large black populations. Figures 1 and 2 provide graphical representations of these results.

How do friendship *group* preferences differ from preferences for *individual* friends? Again, table 6 includes predicted probabilities of individual friend choice as well as friendship group choice by school racial composition. Overall, models of individual friend choice tend to overstate individuals' preferences for same-race friendships. Adolescents have significant preferences for heterogeneous friendship groups with respect to race and this preference cannot be observed in models of individual friend choice. Nonetheless, whether the friendship group or the individual friend is the unit of analysis, the conclusion remains. Increased contact between individuals of different races increases their likelihood of choosing different-race friends, net of their opportunities to choose different and same-race friends.

Discussion

Using data from Add Health, this paper reconsiders the relationship between school racial composition and racial preferences for friends among US adolescents. Estimates from a standard conditional logit model provides support for group threat theory. Increased contact with different racial groups decreases the probability of forming a cross-race friendship. These results are consistent with past work on variations in race preferences for friends across school racial compositions. However using hypothetical samples of adolescents and schools, I show that conditional logit models that do not correct for violations of the IIA assumption are biased towards this result. After correcting models of individual friend preferences for identical alternatives, the relationship between school racial composition and racial preferences for friends reverses. Increased contact between racial groups within schools *increases* the probability of forming a cross-race friendship. Finally, I compare corrected models of individual friend choice with corrected models of friendship group choice. These models show important nuance in adolescent friend preferences. Models of individual friend preferences overstate preferences for same-race friends. Considering all friend choices simultaneously, I show that racial heterogeneity in friendship groups is an important aspect of adolescents' racial preferences for friends.

This analysis provides support for the contact hypothesis. Contact between adolescents of different races increases the likelihood that individuals will develop cross-race friendships, net of their opportunities. As a consequence, school racial integration should lead to more cross-race friendships. These friendships change the attitudes and stereotypes towards minority racial groups, restructuring future race relations in the US. This result however, is dependent on racial integration across schools *and* within schools. Evidence here suggests that integration should have strong positive effects on adolescents' racial preferences for friends.

Race is correlated with other important socioeconomic and achievement characteristics including grade point average, test scores, parental education, parental occupation, and general academic resources. Social scientists believe that friends play an important role in adolescents' outcomes, both positive and negative. Increased cross-race friendships may lead to more heterogeneity between friends with respect to these important and predictive socioeconomic and academic characteristics. If friends share resources and help enforce norms of behavior, increased cross-race friendships may lead to important gains in academic achievement among less advantaged individuals.

Figure 1

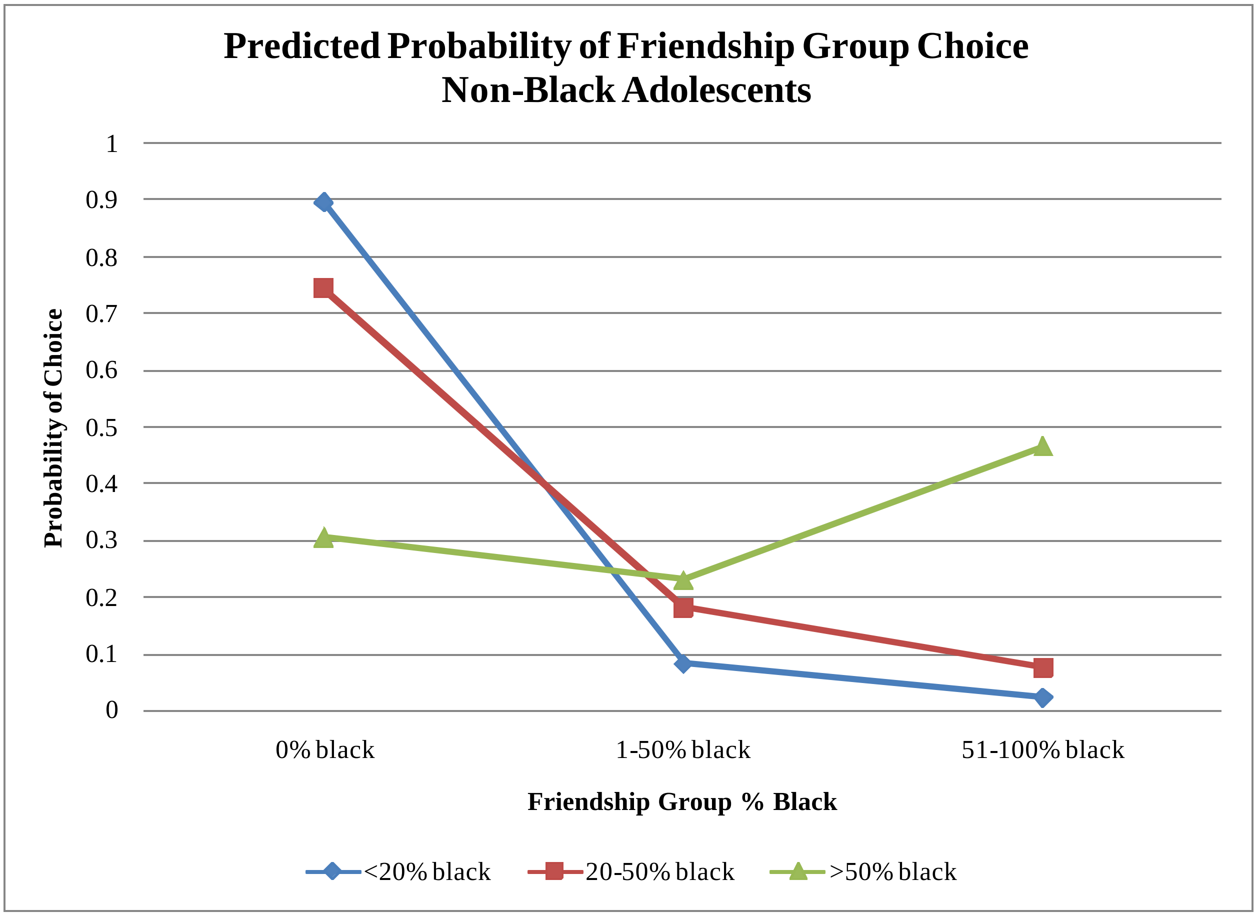
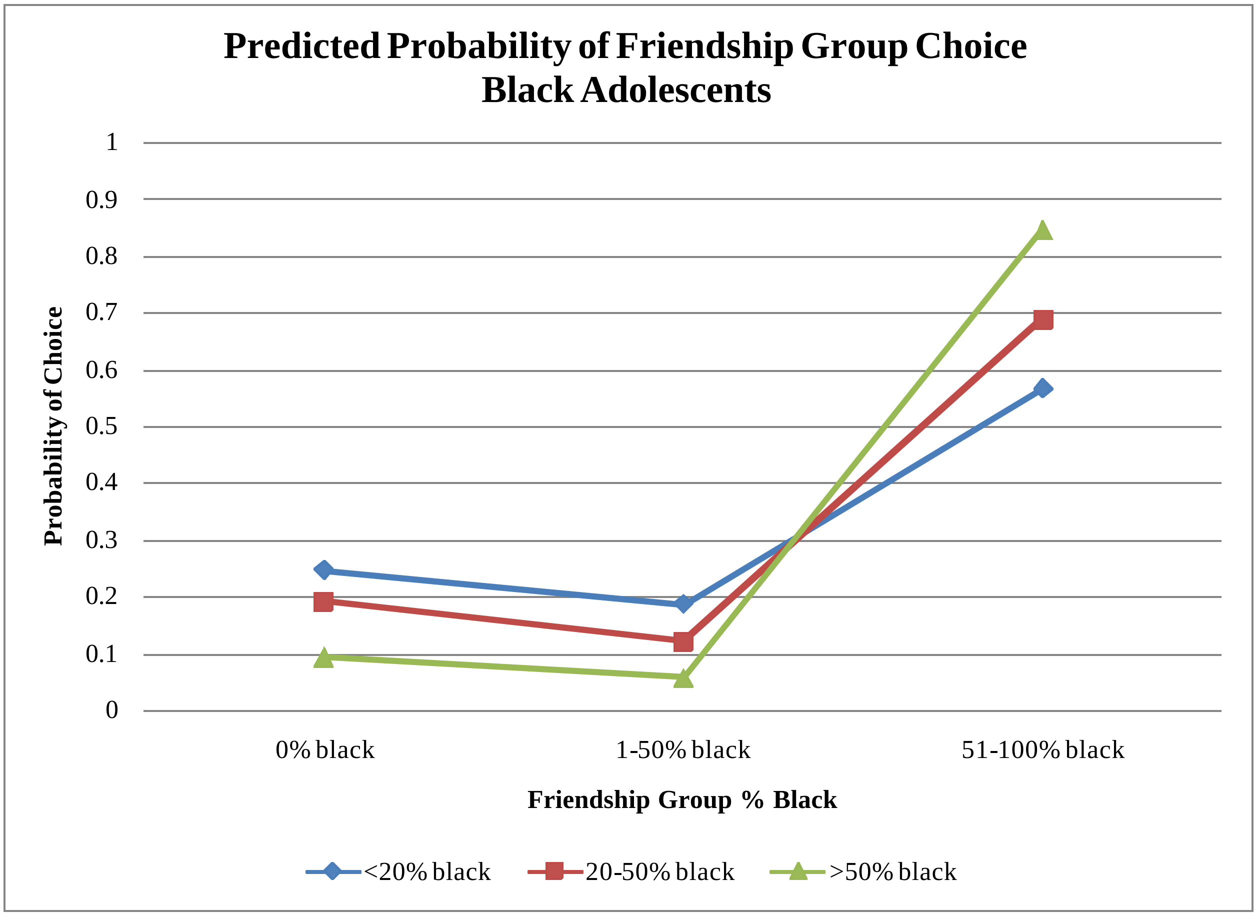

Predicted Probability of Friendship Group Choice
Non-Black Adolescents
Probability of Choice
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0% black
1-50% black
51-100% black
Friendship Group % Black
<20% black
20-50% black
>50% black

Figure 2



Predicted Probability of Friendship Group Choice
Black Adolescents
Probability of Choice
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0.9
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0
0% black
1-50% black
51-100% black
Friendship Group % Black
<20% black
20-50% black
>50% black

Table 1 Predicted probabilities of friend and friendship group choice and actual preferences, conditional logit model, hypothetical samples 1 and 2.

	All Schools		Black school		White school	
	white	black	white	black	white	Black
Individual Friends						
Expected						
white	0.807	0.295	0.830	0.292	0.801	0.306
black	0.193	0.705	0.170	0.708	0.199	0.694
Estimated						
white	0.711	0.466	0.954	0.625	0.502	0.096
black	0.289	0.534	0.046	0.375	0.498	0.904
Friendship Groups						
Expected						
0% black	0.800	0.082	0.750	0.080	0.812	0.090
1-50% black	0.092	0.302	0.110	0.313	0.088	0.260
51-100% black	0.108	0.616	0.140	0.608	0.100	0.650
Estimated						
0% black	0.902	0.304	0.952	0.422	0.521	0.017
1-50% black	0.058	0.502	0.043	0.484	0.034	0.031
51-100% black	0.040	0.193	0.005	0.094	0.446	0.951

Table 2 Predicted probabilities of friend and friendship group choice by choice-set size and actual preferences, conditional logit model with correction for duplicates, hypothetical samples 1 and 2.

	All Schools		Black school		White school	
	white	black	white	black	white	black
Individual Friends						
Expected						
white	0.807	0.295	0.830	0.292	0.801	0.306
black	0.193	0.705	0.170	0.708	0.199	0.694
Choice-set=20						
white	0.834	0.303	0.943	0.359	0.787	0.146
black	0.166	0.697	0.057	0.641	0.213	0.854
Choice-set=60						
white	0.819	0.294	0.879	0.307	0.800	0.248
black	0.181	0.706	0.121	0.693	0.200	0.752
Choice-set=100						
white	0.814	0.294	0.862	0.300	0.801	0.269
black	0.186	0.706	0.138	0.700	0.199	0.731
Friendship Groups						
Expected						
0% black	0.800	0.082	0.750	0.080	0.813	0.090
1-50% black	0.092	0.302	0.110	0.313	0.088	0.260
51-100% black	0.108	0.616	0.140	0.608	0.100	0.650
Choice-set=20						
0% black	0.789	0.132	0.851	0.169	0.769	0.058
1-50% black	0.085	0.295	0.075	0.312	0.083	0.168
51-100% black	0.127	0.573	0.075	0.519	0.148	0.774
Choice-set=60						
0% black	0.801	0.095	0.773	0.097	0.808	0.088
1-50% black	0.089	0.298	0.100	0.309	0.087	0.255
51-100% black	0.109	0.606	0.127	0.594	0.105	0.657
Choice-set=100						
0% black	0.803	0.087	0.765	0.086	0.812	0.090
1-50% black	0.090	0.301	0.103	0.311	0.087	0.260
51-100% black	0.107	0.612	0.131	0.603	0.101	0.650

Table 3 Means and standard deviations of friend characteristics by race, Add Health 1995

	All Schools		<20% black		20-50% black		>50% black	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Chosen Friends and Friendship Groups								
Non-black								
Number of friends	5.279	3.449	5.329	3.438	5.219	3.451	4.057	3.573
Proportion of black friends	.045	.208	.021	.142	.108	.311	.503	.500
Friendship group % black								
0%	0.898	0.302	0.935	0.247	0.777	0.416	0.503	0.500
1-50%	0.078	0.268	0.060	0.237	0.160	0.366	0.147	0.354
51-100%	0.024	0.152	0.005	0.074	0.063	0.244	0.350	0.477
N	59,994		49,463		9,384		1,147	
Black								
Number of friends	4.703	3.568	4.411	3.519	4.602	3.525	4.938	3.618
Proportion of black friends	.746	.435	.490	.500	.750	.433	.844	.363
Friendship group % black								
0%	0.277	0.448	0.408	0.492	0.265	0.441	0.231	0.421
1-50%	0.108	0.310	0.219	0.414	0.113	0.317	0.052	0.223
51-100%	0.615	0.487	0.373	0.484	0.622	0.485	0.717	0.451
N	10,383		2,543		4,608		3,232	
Sampled Friends and Friendship Groups								
Non-black								
Number of friends	5.066	2.363	5.066	2.362	5.067	2.371	5.055	2.344
Proportion of black friends	.104	.305	.040	.197	.326	.469	.660	.474
Friendship group % black								
0%	0.717	0.451	0.834	0.372	0.219	0.413	0.053	0.224
1-50%	0.234	0.423	0.161	0.367	0.611	0.488	0.241	0.428
51-100%	0.050	0.218	0.006	0.075	0.170	0.376	0.705	0.456
N	1,799,820		1,483,890		281,520		34,410	
Black								
Number of friends	5.062	2.356	5.060	2.347	5.065	2.360	5.061	2.355
Proportion of black friends	.452	.498	.098	.297	.349	.477	.729	.445
Friendship group % black								
0%	0.211	0.408	0.624	0.484	0.196	0.397	0.041	0.198
1-50%	0.376	0.484	0.359	0.480	0.599	0.490	0.158	0.365
51-100%	0.413	0.492	0.017	0.130	0.205	0.404	0.801	0.399
N	311,490		76,290		138,240		96,960	

Table 4 Log odds of friend choice by school racial composition, Add Health 1995

	All Schools		<20% black		20-50% black		>50% black	
	Coef.	S.D.	Coef.	S.D.	Coef.	S.D.	Coef.	S.D.
No Correction								
Race								
black friend	-1.059	0.022	-0.660	0.027	-1.412	0.036	-0.894	0.072
black respondentXblack friend	2.707	0.034	3.099	0.055	3.226	0.048	1.539	0.078
Academic Achievement								
GPA friend	-0.481	0.012	-0.538	0.014	-0.395	0.021	-0.252	0.041
GPA respondentXGPA friend	0.216	0.004	0.235	0.005	0.185	0.007	0.146	0.014
Parental Education								
attended college friend	-0.090	0.010	-0.097	0.012	-0.082	0.021	-0.032	0.033
college respondentXcollege friend	0.396	0.012	0.381	0.015	0.478	0.026	0.331	0.044
Correction for duplicates								
Race								
black friend	-2.702	0.025	-3.400	0.028	-2.180	0.037	-0.130	0.080
black respondentXblack friend	3.971	0.033	3.850	0.057	3.421	0.047	1.867	0.086
Academic Achievement								
GPA friend	-0.481	0.012	-0.317	0.015	-0.390	0.021	-0.259	0.041
GPA respondentXGPA friend	0.217	0.004	0.263	0.005	0.185	0.007	0.149	0.015
Parental Education								
attended college friend	-0.088	0.010	-0.197	0.012	-0.076	0.021	-0.044	0.033
college respondentXcollege friend	0.401	0.012	0.667	0.015	0.485	0.026	0.352	0.044
N	4,547,933		3,361,722		941,512		244,699	

Table 5 Predicted probability of friend choice by school racial composition, Add Health 1995

	All Schools		<20% black		20-50% black		>50% black	
	non-black	black	non-black	black	non-black	black	non-black	black
No correction								
non-black	0.742	0.161	0.659	0.080	0.804	0.140	0.710	0.344
black	0.258	0.839	0.341	0.920	0.196	0.860	0.290	0.656
Correction for duplicates								
non-black	0.937	0.219	0.968	0.389	0.898	0.224	0.532	0.150
black	0.063	0.781	0.032	0.611	0.102	0.776	0.468	0.850

Table 6 Predicted probability of friend and friendship group choice by school racial composition, Add Health 1995

	All Schools		<20% black		20-50% black		>50% black	
	non-black	black	non-black	black	non-black	black	non-black	black
Individual friends								
non-black	0.937	0.219	0.968	0.389	0.898	0.224	0.532	0.150
black	0.063	0.781	0.032	0.611	0.102	0.776	0.468	0.850
Friendship groups								
0% black	0.825	0.096	0.895	0.247	0.743	0.191	0.305	0.094
1-50% black	0.099	0.108	0.082	0.187	0.182	0.121	0.230	0.058
51-100% black	0.076	0.797	0.023	0.567	0.076	0.689	0.465	0.848

Works Cited

Allport, Gordon. 1954. *The Nature of Prejudice*. Reading, MA: Addison Wesley.

Ben-Akiva, Moshe, and Steven Lerman. 1985. *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge: The MIT Press.

Blalock, Hubert M., Jr. 1967. *Toward a Theory of Minority-Group Relations*. New York: Capricorn Books.

Dixon, J. C., and M. S. Rosenbaum. 2004. "Nice to know you? Testing contact, cultural, and group threat theories of anti-black and anti-hispanic stereotypes." *Social Science Quarterly* 85:257-280.

Glaser, James. 1994. "Back to the Black Belt: Racial Environment and White Racial Attitudes in the South." *Journal of Politics* 56:21-41.

Joyner, K., and G. Kao. 2000. "School racial composition and adolescent racial homophily." *Social Science Quarterly* 81:810-825.

McFadden, Daniel. 1978. "Modeling the Choice of Residential Location." in *Spatial Interaction Theory and Planning Models*, edited by Anders Karlqvist. Amsterdam: North-Holland Publishing.

Moody, J. 2001. "Race, school integration, and friendship segregation in America." *American Journal of Sociology* 107:679-716.

Olzak, Susan. 1992. *The Dynamics of Ethnic Competition and Conflict*. Stanford, CA: Stanford University Press.

Pettigrew, T. F., and L. R. Tropp. 2006. "A Meta-Analytic Test of Intergroup Contact Theory." *Journal of Personality and Social Psychology* 90:751-783.

Powers, Daniel, and Christopher Ellison. 1995. "Interracial Contact and Black Racial Attitudes: The Contact Hypothesis and Selectivity Bias." *Social Forces* 74:205-226.

Quillian, L., and M. E. Campbell. 2003. "Beyond black and white: The present and future of multiracial friendship segregation." *American Sociological Review* 68:540-566.

Quillian, Lincoln. 1996. "Group Threat and Regional Change in Attitudes Toward African Americans." *American Journal of Sociology* 102:816-860.

Sigelman, Lee, and Susan Welch. 1993. "The Contact Hypothesis Revisited: Black-White Interaction and Positive Racial Attitudes." *Social Forces* 71:781-795.

Taylor, Marylee. 1998. "How White Attitudes Vary with the Racial Composition of Local Populations: Numbers Count." *American Sociological Review* 63:512-535.

Wasserman, S., and P. Pattison. 1996. "Logit models and logistic regressions for social networks .1. An introduction to Markov graphs and p." *Psychometrika* 61:401-425.

Zeng, Zhen. 2004. "The Contextual Determinants of Interracial Preferences in Adolescent Friendship." draft.

—. draft. "The Contextual Determinants of Interracial Preferences in Adolescent Friendship."

Zeng, Zhen, and Yu Xie. Forthcoming. "A Preference-Opportunity-Choice Framework with Applications to Intergroup Friendship." *American Journal of Sociology*.