

Birds of a Feather Fight Together: Status-Enhancing Violence, Social Distance and the Emergence of Homogenous Gangs

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Abstract

Objectives This study proposes a theoretical framework for understanding two empirical findings from gang research: (1) gangs are generally racially homogenous, even in heterogeneous environments, and (2) gang violence tends to be intra-racial. We draw from the extensive literature on street gangs as well as from research on group formation and status-enhancing behavior to develop a theoretical model of gang formation.

Methods Using game theory, we model the simultaneous decisions of individuals to commit status-enhancing acts of violence and to seek protection by joining a gang. We then conduct computer simulations to examine the resulting patterns of violence and gang composition.

Results We demonstrate that as long as some social distance exists between racial groups in a community, gang violence will be intra-racial and gangs will be homogenous. We find that our results are robust to a number of simple variations of the model and allow us to generate several hypotheses about the nature of gang formation and patterns of violence.

Conclusions When violence is motivated by socially constructed rewards, socially closer targets are likely to yield greater rewards. In such a system, individuals must reduce their likelihood of victimization by entering a social contract of non-violence (i.e. gang membership) with individuals who might view them as status-enhancing targets (i.e. socially close individuals). The result is that gangs are made up of socially close individuals interested in attacking other socially close individuals. Therefore, gangs tend to be racially homogenous and violence is overwhelmingly intra-racial.

Keywords Gangs · Violence · Group formation · Status · Game theory

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Introduction

A recurrent finding in the social sciences is that individuals tend to associate with similar others. Lazarsfeld and Merton (1954) refer to this sorting process as homophily with race and ethnicity serving as two of the most important associated with homophily (McPherson et al. 2001). While most research has examined homophily in positive relationships such as friendship (e.g. Kandel 1978; McPherson and Smith-Lovin 1987), marriage (e.g. Schwartz 2013) and work team formation (e.g. Ibarra 1992), criminal relationships exhibit similar homogeneity, especially among participants in violence. Violence overwhelmingly tends to occur between individuals similar in age, sex and race/ethnicity (Hipp et al. 2009; Messner and South 1992; O'Brien 1987; Wadsworth and Kubrin 2004). To extend upon the well-known adage that “birds of a feather flock together”, it seems fair to say that birds of a feather also fight together.

Our research examines the emergence of homogeneity both in terms of group formation and patterns of violence of urban street gangs. Notwithstanding some notable exceptions (e.g. Klein 1995; Starbuck et al. 2001; Spergel 1995; Grund and Densley 2015), researchers reports that gangs are more likely to form among individuals of the same racial and ethnic groups¹ (e.g. Cohen 1955; Esbensen et al. 2008; Klein and Maxson 2006; Thrasher 1927; Short and Strodbeck 1965; Vigil 2002). Gang violence is also more likely to occur within, rather than across, racial groups, even in diverse communities (e.g. Los Angeles; Hipp et al. 2010). Black gangs tend to fight with other black gangs, Latino gangs tend to fight with other Latino gangs, and so forth (Maxson and Klein 1996; Maxson et al. 1985; Papachristos 2009; Hipp et al. 2010).

The current paper uses game theory and develops a simple model for the emergence of racially homogenous gangs. In the real world, the formation of street gangs is difficult to study. Researchers rarely capture the initial formation process but instead begin their observations once individuals have coalesced into a gang. The use of modeling techniques such as game-theoretic models and other simulation are valuable tools to generate theoretical insights on phenomena difficult to observe (Birks et al. 2012). The primary contribution of this paper is to use such techniques to propose a theory about potential mechanisms driving gang formation.

A game-theoretic model builds from prior empirical and theoretical work to establish the most advantageous outcomes for actors in a system of self-interested actors and examine choices actors can reasonably make to maximize their outcomes (Fudenberg and Tirole 1996). In the following sections, we first review research on the empirical facts we aim to reproduce in our model. Second, we examine possible mechanisms that might reproduce these facts and develop the underlying logic of our model. Third, we outline our methodology and formal mathematical model. Fourth, we report on the results of our analyses and simulations. Finally, we discuss our findings and suggest avenues for future research.

¹ For the sake of simplicity and clarity, we will refer only to racial groups for the remainder of the paper, but our argument applies both to racial and ethnic groups.

Literature Review

Racial Homogeneity and Intra-Racial Gang Violence

Since the work of early gang scholars, there have been substantial changes in the racial composition of U.S. cities (e.g. Alba et al. 2000; Hipp and Boessen 2012). Whereas gangs studied at the turn of the century flourished in mostly segregated neighborhoods (Howell 2015), the development of public transportation, the proliferation of private vehicle ownership, as well as such policies as the desegregation of public schools have increased opportunities for between-group interactions (e.g. Hagedorn 1988). Furthermore, the influx of new immigrant groups—Central Americans, South Americans, Asians—also dramatically changed the composition of large cities (e.g. Coughlin and Venkatesh 2003), most prominently, Los Angeles (Moore 1978; Vigil 1988, 2002). Yet, gangs continue to form along racial lines and gang violence remains intra-racial.

This is not to suggest that all gangs are homogeneous. Indeed, the changes noted above may have led to the emergence of some heterogeneous gangs (Block and Block 1993; Fleisher 1998; Papachristos et al. 2013; Starbuck et al. 2001). However, the preponderance of evidence from cities across North America highlight the homogeneous nature of gangs in Chicago, IL (Papachristos 2009), Boston, MA (e.g. Papachristos et al. 2013), Columbus, OH (Miller 2001), St. Louis, MO (Decker and Van Winkle 1996), Pittsburgh, PA (Cohen and Tita 1999), Milwaukee, WI (Hagedorn 1991), Los Angeles, CA (Hipp et al. 2010), and Montreal, Canada (Tremblay et al. 2016). Other reviews have suggested that gang homogeneity is a pattern observed across the United States more generally (Esbensen et al. 2008; Klein and Maxson 2006; Spergel 1995). Even with ethnically heterogeneous (but racially homogenous) gangs, research has shown that members tend to gravitate towards similar others when it comes to co-offending (Grund and Densley 2012, 2015), a finding consistent with the racial and ethnic homophily found in delinquent peer groups and co-offending networks more generally (Malm et al. 2011; Sarnecki 2001; Schaefer et al. 2014; Tayebi et al. 2014). These findings suggest that residential segregation alone cannot explain the homophilous nature of gangs. Racial homophily may be facilitated by geographical proximity. However, the robustness of the findings regarding gang composition is likely the result of a mechanism more complex than simple propinquity—the idea that the probability of social interaction is a function of spatial proximity.

Likewise, despite increased opportunities for interaction and conflict, violence has generally been found to be intra-racial (Becker 2007; Block 1985; Cancino et al. 2009; Hipp et al. 2009; Messner and South 1992; Wadsworth and Kubrin 2004), a fact especially true for gang-related homicide (Hutson et al. 1995; Maxson and Klein 1996; Maxson et al. 1985; Block and Block 1993; Papachristos 2009; Rosenfeld et al. 1999; Hipp et al. 2010; Hughes 2005).

Again, geographical proximity does not seem to be sufficient to explain intra-racial patterns of violence. Though “defended communities” theories (e.g. Green et al. 1998) have predicted increases in inter-group violence associated with racial mixing in communities, there is little evidence that such violence ever materializes. A study of homicide in South Los Angeles—a historically African American community turned into a mostly Latino community—highlights this point. Motivated by concerns that the area was a “powder keg” or “on the verge of a race war”, Hipp et al. (2010) conducted a careful analysis of homicide reports to better understand the nature of inter-racial homicide. Inter-racial homicides made up 14.5% of all homicide and only 11.3% of gang homicides.

Furthermore, most events involving rival gang members of different races were not motivated by racial antagonism or even their gang member identities. Rather, the motives were often related to love-triangles or jealousy.

It is interesting to note that Pyrooz et al. (2010) found that levels of racial and ethnic heterogeneity of a city were a significant predictor of the number of gang members in that city. That said, a subsequent analysis found that heterogeneity did not predict gang homicide rates (Pyrooz 2012). These results taken together suggest that while racial diversity may be associated with more individuals joining gangs, it does not follow that gang violence is any more intense in heterogeneous cities.

As Hipp et al. (2009) found, intra-racial violence is generally more likely than inter-racial violence even when accounting for propinquity. In fact, the authors showed that rates of intra-racial violence were actually higher in mixed areas compared to homogenous areas. Hipp et al. (2009) conclude that the explanation for these results may lie in the notion of “Blau space” (Blau 1977; McPherson and Ranger-Moore 1991), that is, the tendency of individuals to interact socially with individuals who are similar to them on important dimensions (McPherson et al. 2001).

Explaining Both Gang Homogeneity and Intra-Racial Violence

Most explanations for why gangs tend to be racially homogenous are inconsistent with the fact that violence tends to be intra-racial. For example, many have argued that gangs form as a response to racial antagonism and the necessity for protection of the neighborhood from intrusions of new racial groups (Adamson 2000; Alonso 2004; Decker et al. 2009; Hagedorn 2006). However, while racial conflict may serve to explain the initial formation of gangs, such motivations have generally been short-lived and certainly do not account for the resilience of gangs since the 1970s in these communities (Adamson 2000, Alonso 2004, Brown et al. 2012).² As Decker et al. (2009) argued, many immigrant youths experience culture shocks, which may lead them to form gangs of “similarly situated, as well as similarly cultured ethnic others” (p. 400). In a context where many cultures are suddenly brought together in the same communities, prior research on racial threats would predict increased conflicts between these groups (Decker et al. 2009). Yet, we find little evidence of such conflicts.

Another explanation for gang homogeneity is homophily. Research finds that human groups tend to be racially homogenous, above and beyond what would be expected by chance given the distribution of members of different groups (e.g. Blau 1977; Marsden 1987; McPherson et al. 2001). Inbreeding homophily, or the process by which the proportion of in-group ties exceeds what would be expected by chance, is said to account for the robustness of racial homophily in social relationships (McPherson et al. 2001). Macro-structural factors may limit the pool of potential contacts but individuals choose within this pool others who are likely to share their attitudes, language, cultural background, and other shared experiences that promote identity. Inbreeding homophily could potentially explain why gangs tend to be homogenous, even when other association opportunities are available to them. However, this explanation at first seems contradictory in light of the intra-racial

² As Brown et al. (2012) explain, the initial spirit of mobilization of Black youths to protect themselves and their communities against violence and racism of whites was short-lived as the rise of the Crips—led by a 15-year old high school student in the 1970s—was soon met with the formation of rival groups in the same communities, and “Crippin’” came to represent an escalation of intra-ghetto violence to Clockwork Orange levels (murder as a status symbol, and so on) that was [...] anathema to everything that the [Black] Panthers had stood for” (Brown et al. 2012, p. 221).

nature of gang violence. If gangs arise from preferences to associate with similar others, what principle explains that violence between gang members *also* occurs between similar others?

Current Study

As Vigil (2002, p. 6) puts it, “Ethnicity plays an important role when cultural groups live in close contact and their physical or cultural characteristics are used to create social boundaries”. We propose in this paper is that these social boundaries are in part responsible for homogeneity and intra-racial gang violence. The model we propose in this paper is meant to reproduce racial homophily in gangs, while simultaneously taking into account that gang violence tends to be intra-racial. Our proposed mechanism hinges on three testable assumptions derived from prior research.

First, we argue that despite being geographically proximate, racial groups co-existing in a community will be socially distant, that is, individuals from each group will interact more frequently with members of their own racial group. Second, we argue that given the status-enhancing value of much gang violence, violence directed at socially close individuals would yield greater status returns than violence directed at distant individuals. This argument relies on the fact that status is a socially defined commodity and thus requires that others recognize actions as status enhancing. Individuals seeking status through violence are thereby better off choosing socially close targets to maximize the chances that relevant others will interpret the violence committed as status enhancing. Third, we argue that the same mechanism promoting violence also incentivizes individuals to seek protection from violence.

In a system where socially close targets yield the greatest status benefits, forward-looking actors will secure the most protection by ensuring that socially close others will not attack them. The outcome of such a model is that choices for status-enhancing targets of violence and for candidates to join with in a protective coalition are governed by a single parameter: social closeness.

In the following sections, we draw from existing literature to support our model’s assumptions. We then present the formal mathematical model followed by the results of our simulations. Finally, we discuss our findings and how they might be used to generate new research on gang violence and formation.

Status-Enhancing Targets and Social Distance

The macro-level forces that led to racial and socio-economic segregation of African-American and eventually Latino and Asian immigrant groups in many US cities also affected the quality of education, the availability of community services, employment prospects, and the collective efficacy of these communities (Vigil 1988, 2002). Many gang theorists have argued that such socioeconomic conditions constrain one’s ability to attain status within society. Constraints posed on youths in impoverished areas lead to what Cohen (1955: 65) termed “status problems” that prompt youth to turn to gangs as a means to achieve status. As a result, a subculture that promotes the use of violence as one way to gain status emerges. Similarly, Anderson (1999) termed the informal laws and mores that guide interpersonal behavior, particularly within inner-city communities, as the “Code of

the Street.” Respect and honor are at the heart of this code, with violence often used as a mechanism to obtain and preserve these coveted commodities.

The instrumentality of gang violence for status attainment is a recurrent theme in gang research. Decker and Van Winkle (1996: 185), for example, observed that gang violence is most often expressive: “Gang members [prove] their manhood, their toughness, their hardness through initiations, [by] trespassing on rival territories, and beating or shooting the opposition’s colors.” The relational feature of status-enhancing behaviors has important implications not often discussed in subcultural explanations of gang violence even though these theories place status, honor and reputation as the primary motivation for violent behavior. In order to produce symbolic benefits, violence must be “translated” into its symbolic resource. As Gould (2003) explains, honor is as important a resource as wealth to their possessors, but “the key difference is that honor is entirely symbolic: its possession consists in the recognition by others of its possession” (p. 7). This logic implies that not all violent events will yield an equal benefit, a key idea at the center of our formal analysis below.

While other factors such as the number of actors present during the event may influence the reputational return of an “investment” in violence (Hughes 2005; Hughes and Short 2005), social closeness between the attacker and the victim is likely to yield a greater reputational return. Logically, choosing targets that are socially closer may result in a greater exposure of the event to one’s own social network, thereby facilitating the reputational gain associated with these events. As an extreme example, a young male would receive a very low pay off from attacking an elderly woman or a very young child. In fact, when the social closeness is so distant (in this case we use age rather than race), carrying out an attack meant to enhance one’s status may actually result in the accrual of negative benefits.

Social networks play an important role in our conceptualization of social distance. In theory, there exists a social network that connects most members of a given community. Within this network the social closeness between any two individuals would increase as the number of interactions between each individual increases. Such a measure could be aggregated for each racial group in the network/community and create a measure of social closeness as the frequency in which ties form between members of different racial groups. Though we measure closeness, such a measure of social distance is merely the inverse of social closeness are merely inverses of one another. Specifically, we define the social closeness of two groups as the frequency of non-violent interaction between individuals of each group.

Our definition of social distance is conceptually similar to Simmel’s (1955) intersecting social circles, which was elaborated by Blau and Schwartz (1984). Any two groups in a community—in our present case, racial groups—are socially close to the extent that their members share similar membership in other social circles. Simmel (1955) argued that people who share many of these social dimensions (e.g. neighborhood of residence, school, gender, age group, social class, gang membership, criminal involvement, street corners, etc.) are more likely to interact with one another. Blau and Schwartz (1984) extend his ideas to a macrosociological focus by arguing that social groups are more or less close to the extent that members of these groups have a tendency to have crosscutting social circles.³

Hipp (2010) built on the work of Simmel and Blau to empirically measure social distance between households in a community. Hipp’s approach includes constructing a

³ This idea is also consistent with Breiger’s (1974) notion of the duality of persons and groups.

matrix from the differences between households on a variety of indicators (e.g. income, education level, homeownership, age, marital status, and presence of children at home, region of origin). From this matrix, a variety of measures can be created. For example, the row average represents a household's average distance from its neighbors. Hipp and Boessen (2012) used the distance matrix to compute the average distance between racial and ethnic groups in the neighborhood.

A Note on Geographic Versus Social Distance

We chose to focus on social distance rather than geographical space mostly because our model assumes that different racial groups co-exist in a given community. In other words, we assume that there is no geographical distance between groups and that any differentiation between groups is related to social interactions. We recognize the important role that geography plays in the formation and activities of urban street gangs (Tita et al. 2005). Indeed prior research has shown that gang violence tends to occur near the shared boundaries of gang turfs (Brantingham et al. 2012; Cohen and Tita 1999; Papachristos et al. 2013). Papachristos et al. (2013) also show that a prior history of violence between gangs, even when their turfs are not adjacent, significantly predicts violent relationships.

This result is consistent with the notion that gang violence, although it might be strongly influenced by spatial proximity, is embedded in social networks and shaped by social processes that can overcome geographical distance. For example, work by Papachristos et al. (2013), Tita and Radill (2011) conclude that networks play an important role in explaining observed patterns of violence, especially gang violence. Researchers examining violence at the individual level also provide compelling evidence that social networks facilitate susceptibility of violence (Papachristos et al. 2012; Papachristos and Wildeman 2014; Papachristos et al. 2015). The process we are modeling in this paper is similar to a contagion process in that status can only be obtained if others in the network are made aware of the status-enhancing violence one commits. Physical distance is likely to play an important role in contagion processes. However, when social processes are concerned, as we argue they are in the case of status-enhancing behavior, examining social distance is likely to yield a more complete explanation, whereas physical distance would provide merely a proxy for the actual theoretical construct.

Gangs as Social Contracts of Non-violence: The Protective Role of Gangs

Gang members participate in a dynamic system where they understand that public displays of violence have reputational benefits but that others are also likely to seek these rewards, thereby necessitating protection from others also seeking such benefits. As is true for other populations (Jennings et al. 2012) especially in neighborhoods where violent norms are prevalent (Berg et al. 2012), gang members are often found at both ends of the violent dyad as victims and offenders. In fact, Pyrooz et al. (2014) found that gang members are over two times more likely than non-gang members to be both victims and offenders. In another study, researchers found that 85% of all gunshot injuries were located within a social network that comprised less than 2% a community's population, with gang members accounting for a third of the individuals in the network (Papachristos et al. 2012). Clearly, individuals involved in gang violence are in need for protection from others in their networks and, in fact, protection is one of the most common reasons to join gangs cited (Curry et al. 2014; Decker and Van Winkle 1996; Klein 1995; Melde et al. 2009; Klein and Maxson 2006). Decker (1996) notes that threats simultaneously generate both a need for

protection and justify the necessity of coordinated action (e.g. violence). Given this paradox, it is useful to conceive of gang membership as a form of social contract in which members make concessions in order to receive benefits that come from banding together. Gang members, by joining a gang, benefit from the protection of other members. We argue that one way to minimize victimization is for an individual to associate with others who, absent the social contract of gang membership, would be more likely to see this individual as an attractive target for status enhancement. Therefore, the determinant of gang composition resides in the identification of the most attractive status-enhancing targets.

Prior research has argued that gang members are able to recognize opportunities to improve their social standing by, for example, identifying optimal strategies to retain or gain more leadership in the gang (Short and Strodtbeck 1965). Short and Strodtbeck (1965) argued that while the importance of cultural expectations, status problems, and delinquent values in explaining the formation of gangs is undeniable, the decision of whether or not to engage in violence is an individual choice driven mostly by hedonistic principles. Thus while subcultures may provide the rules of the game, gang members can decide which card they will play.

Methodology

Game Theory, Gangs and Generative Explanations

Game theory is the mathematical study of decision making in multi-person, interactive settings. A “game” is a mathematically defined scenario comprised of (1) actors, (2) the possible actions available to those actors, including a specific order under which actions are selected, and (3) rules that determine the well-being of each actor for each combination of possible actions taken, with well-being measured by a generic term “utility.” A game-theoretic model is a game constructed by a researcher to represent a real-life setting. The researcher then solves for a profile of actions, one for each actor, which comprises a solution (i.e. equilibrium) of the game such that no actor would prefer to change her action. A solution, of which there might be more than one, is obtained by mathematical analysis or, for more complex games, by numerical simulations. The solution serves as a prediction for the type of behavior that may emerge in the real-world counterpart.

Game theory has rarely been used in criminological studies despite the fact that it offers many opportunities to examine the importance of theoretical mechanisms difficult to observe (McCarthy 2002). The formation of gangs provides a mechanism that has garnered much theoretical attention but given the inherent difficulties of observing the emergence of gangs, there has been little empirical observation. Game theory and other types of simulations models can be powerful theory testing tools when empirical observations are difficult to obtain (Birks, et al. 2012). Although they use agent-based modeling,⁴ Birks et al. (2012, p. 225) argue that simulations can be helpful in “identifying *generative explanations* as those hypothesized individual-level behaviors that produce macro-level output patterns consistent with the observed regularity of the target”. The goal of generative

⁴ An important distinction between agent-based models such as those simulated by Birks et al, and game theory is that agent based models assume as a primitive a mode of behavior, which may be supported by some hypothesis or theory, and then allow the researcher to observe the outcome of that behavior. Game theory, on the other hand, assumes as a primitive the payoffs of all possible outcomes, often much easier to predict or justify than actions, and then allows the researcher to examine the choices that would be made by a self-interested agent in the setting.

explanations is to examine mechanisms that are sufficient (though not always necessary) to produce the observed outcomes. Ultimately, game-theoretic models, agent-based models, and other generative approaches produce hypotheses that are falsifiable, and can be tested empirically (Birks et al. 2012; McCarthy 2002).

A well-known example of the use of game theory to produce generative explanations—and one that has many similarities with our own model—is Schelling’s (1978) seminal work on racial segregation in neighborhoods. At the time of his study, respondents of self-report surveys overwhelmingly reported that they preferred to live in integrated communities. However, there was one caveat—if the typical household had five immediate neighbors (two next-door neighbors, three neighbors facing from across the street), the preference was that at least three of those neighbors were of the same group. Schelling demonstrated that even this slight preference to reside in neighborhoods with a slight majority of same-group members is enough to lead to the perfect sorting of residents into segregated neighborhoods. Schelling’s point was not to discount the pernicious forces of racism, redlining practices of banks or other discriminatory factors. Instead, he simply demonstrated that simple choices at the individual level could create complex patterns at more macro scales.

The Model

Set-Up

Consider a community N consisting of n individual actors. Actors are identical except for racial identity (identified as X or Y , n_X and n_Y being the number of members of each racial group, respectively) so two actors of the same race are interchangeable. The actors engage in a two-stage interaction: first, they form gangs, and second, they engage in violent attacks

Drawing from the literature discussed in the previous sections, we assume that there are three main effects of the actors’ engaging in violence:

- (1) The principal reason for engaging in violence is that it enhances the status of attackers. Formally, we assume that the status benefit to an individual i from utilizing a quantity of violence v_{ij} against actor j is $(v_{ij})^{1/2}$ if j and i are from the same racial group and instead is $\alpha(v_{ij})^{1/2}$ if j and i are from different racial groups. The parameter α reflects the combined social distance between any two individuals of different racial groups in the community, with a higher value of α corresponding to a lower social distance. Our model assumes that social distance between racial groups is constant for every member of these groups. This assumption simplifies the model by defining the decision of gang members as a binary choice between directing their violence within or outside one’s racial group. We acknowledge that a binary choice between targets within or outside one’s racial groups oversimplifies a much more complex process. In fact, gang members are unlikely to view the violence they commit in terms of a decision making process that involves multiple choices. After all gang violence, like most violence, often occurs in a spur of the moment fashion, leaving the only decision consciously considered to be whether or not to attack a gang member in a given situation. Nevertheless, a decision *does* occur and it is guided more often than not by status considerations (Hughes and Short 2005; Short and Strodbeck 1965). We assume $0 < \alpha < 1$ to capture social closeness so that an individual receives a smaller benefit from violence committed against a member of

the other racial group, with benefits increasing as social closeness increases between racial groups (i.e. as the social distance decreases).

- (2) Actors incur costs of victimization. The damage incurred by actor j from an attack from actor i of a quantity of violence v_{ij} is θv_{ij} where $\theta > 0$ captures the extent of damage caused by the attack. The value of θ is held constant for analytic simplicity but it could potentially vary from one event to another according to, for example, the characteristics of the attack, or the community's perception of the participants.
- (3) The risk and efforts required by attacks make them inherently costly for attackers. We use $v_i = \sum_j v_{ij}$ to denote the sum of all the violence committed by agent i against all other actors j . The cost to actor i of committing a quantity of violence v_i is βv_i , where $\beta > 0$. The value of β depends on many factors. For example, β will be greater in communities exhibiting strong informal social control against the use of violence or with a heavy police presence. At the individual level, some targets for violence may lead to a greater risk of retribution, and therefore leading to a higher β . However, as with the value of θ , the value of β is the same for all attacks since they occur in only one community and all actors are assumed to be identical.

An important assumption of the model is that by joining a gang, members make a commitment to not fight other members of the gang. This commitment is upheld through a social contract between members that entails additional costs. Let G_i and $|G_i|$ denote the members of actor i 's gang and the size of actor i 's gang, respectively. The cost of maintaining peace within the gang is defined as $c|G_i|(|G_i|-1)/2$, where $c > 0$ captures the lack of cohesion or closeness between members within the gang. In our model, we assume that gangs are equally cohesive. The rest of the cost term captures the idea that maintaining peace within the gang is increasingly costly as the size of the group increases (i.e., the cost is convex in group size). Although disputes are known to arise within gangs, Hughes (2005, p. 113) argued that “unless the gang lacked any real cohesion, however, these types of disputes are likely to be resolved without violence”.

Let N_w denote the set of actors in the same group as actor i and N_o the set of actors in the other group. Then the utility function of actor i , using our notation above, is $u_i =$

$$\sqrt{\sum_{j \in N_w - G_i} v_{ij}} + \alpha \sqrt{\sum_{j \in N_o - G_i} v_{ij} - \sum_{j \in N - G_i} \theta v_{ji} - \beta v_i - \frac{c}{2} |G_i| (|G_i| - 1)}.$$

Note that our use of utility is consistent with standard rational choice analysis in that utility reflects all costs and benefits associated with the actions of all individuals. Also note that we have not made assumptions that explicitly suggest gangs should form along racial lines. While there may be other reasons why individuals want to associate with members of their same racial group, we will show below even a small incentive to direct violence towards racially similar others is sufficient to lead to the formation of racially-homogenous gangs. Thus, the tendency in reality for gangs to form along racial lines may even be stronger than in our model if there are other factors that promote homogeneity.

Violence Choices

As our model is a two-stage game, actions have an explicit ordering. The standard way to solve a two-stage game such as ours is to proceed backward.⁵ First, we identify the violence patterns that emerge given different gang formations. Second, given that

⁵ See Fudenberg and Tirole (1996) for a discussion of using backward induction to solve games with sequential decision-making.

individuals correctly anticipate the resulting violence patterns, we identify which gang formations are stable in the sense that no gang benefits from removing one of its members or adding an actor to the gang who would benefit from the switch.

Each actor i can only influence the benefits he gains from violence through his choices of targets. Thus, by taking the gang formation, cost of social contracts, and violence choices of others as fixed, the relevant components of each actor i 's decisions are defined by

$$\sqrt{\sum_{j \in N_w - G_i} v_{ij}} + \alpha \sqrt{\sum_{j \in N_o - G_i} v_{ij}} - \beta v_i$$

Because this function does not depend on the actions of other actors, the optimal total violence actor i commits against other actors within his racial group and outside his racial group (but outside his gang) are independent of both the other actors' decisions and of the gang formation, given by:

$$v_i^w = \frac{1}{4\beta^2}$$

$$v_i^o = \frac{\alpha^2}{4\beta^2}$$

Note that given the presence of any social distance between racial groups ($\alpha < 1$), it is optimal for actors to direct less violence in total at members of the other racial group than at members of their own racial group. Indeed, if $\alpha = 0$, then all violence is intra-racial, while if α is very close to one, then the violence directed at each racial group is nearly identical.⁶

Gang Formation

In order to predict the features of gangs that form, we must first specify the appropriate game-theoretic solution concept that defines a stable gang formation. We use an original concept, which we call *gang stability*. For a gang formation to be stable, we require it to be robust to reasonable deviations that the actors might make as well as minor perturbations that might occur over time. This concept is based on the concept of *individual stability* which was developed by Bogomolnaia and Jackson (2002) to study group formation in settings where individuals have a limited ability to coordinate their decisions. Individual stability reflects the notion that the only feasible changes to a given group formation are the result of individual deviations since it is difficult for groups of people to simultaneously coordinate their actions. For an individual to join a different group, she would require approval from that group's members, while leaving the group can be done without approval. Thus, under individual stability, a group formation is stable if no actor would

⁶ As we have constructed the model, it is in the best interests of the actors to employ the optimal total violence derived above; however, the actual targets of their violence within a given group do not affect their utility. As such, we make a simplifying assumption that each actor divides his total violence directed toward a group equally between all potential targets within that group (not in his gang). This is by no means a strong assumption, as the indeterminacy of the individual targets is an artifact of the simplistic model, and an arbitrarily small perturbation would lead to a prediction of equal splitting as in the assumption.

benefit from leaving her group or joining a different group whose members would be made better off from the switch in group membership.

In our setting, individual actors will join a gang that allows them to maximize the benefits gained from violence, while at the same time securing protection and minimizing the costs associated with being attacked and sustaining cohesion within the gang. These considerations extend to the decisions of actors within gangs to deviate from a system of gangs by adding or removing members from the gang or leaving the gang entirely. The deviations we consider are:

- (1) A non-gang member may join a gang with unanimous approval from the gang.
- (2) A subset of a gang may break away to form a new gang.

Additionally, we consider a perturbation that might occur to the gang formation in a dynamic setting. Over time, individuals will leave the community, such as through physical relocation, imprisonment, or death. Similarly, new individuals will enter the community, such as through physical relocation or coming of age. Thus, we consider the following perturbation as well as the previous deviations.

- (3) When an individual leaves the community, a new individual takes their place and may join a gang with unanimous approval from that gang.⁷

A system of gangs has reached *gang stability* when *no group of actors may benefit from additional deviations from the current system and new members of the community cannot improve upon their predecessors by joining a different gang than that of the individual they replaced*. We will also refer to any system of gangs having reached gang stability as an *equilibrium gang formation*. To be sure, the idea that a system of gang formation can be “stable” is a purely theoretical construct. Given the heavy turnover in gang members and the relatively short length of membership (e.g. Pyrooz 2014; Pyrooz and Sweeten 2015), it is likely that gang composition is constantly in flux.

The deviations considered for this concept of stability vary to some degree in their validity as criteria for a gang to be stable. Certainly, the ability to join a gang with its’ members approval is perfectly reasonable. This idea is consistent with the notion that gang joining is not a unidirectional process. As Densley (2012, 2015) argued, while individuals may want to join a gang, the gang must also consider whether the incoming member is trustworthy (i.e. will uphold the social contract) and whether the addition of this member will serve the interests of the current members of the gang. It is certainly true that gang members sometimes join gangs through the seemingly unilateral decision of a few members. For example, as Descormiers and Corrado (2016) show, gang members are sometime “blessed in” because of their connection to current members. Still, it is doubtful that other members would agree with accepting a member who is “blessed in” that did not serve the interest of others, such as providing protection.

It is within the power of a subset of a gang to leave and form a new gang. While such an action might realistically incur some kind of negative reaction from the remaining members, that is captured to some degree by our model in that the seceding members are added to the victim pools of the remaining members. It is not uncommon for smaller groups

⁷ It is worthwhile to point out that this perturbation is mathematically equivalent to a third deviation whereby a gang member may switch gangs with unanimous approval from the gang he wishes to join, provided that the new gang does not have incentive to immediately remove him from the gang. This equivalent interpretation is valuable for two reasons. First, it allows that stability concept to be considered in an entirely static setting. Second, it allows for the convergence of simulations of gang formation as a dynamic process.

within the gang to form their own gangs. In fact, according to Papachristos (2009), black-on-black gang violence in Chicago was in part the result of the splitting up into factions of a much larger gang.

Finally, the third deviation is related to the heavy turnover noted by many gang researchers (e.g. Pyrooz 2014; Pyrooz and Sweeten 2015). Results from multiple longitudinal surveys suggest that the vast majority of gang members leave the gang after one year of membership (Curry et al. 2014). While some members simply age out of the gang, others decide to leave to avoid the violent and stressful environment of the gang or because of external “pull” factors such as having children or employment opportunities (Pyrooz and Decker 2011). In other cases, gang members simply move away from the neighborhood where the gang operates (e.g. Vigil 1988; 2002).

Results and Simulations

Regularity Condition

We now analyze the gang formation stage taking optimal violence choices described above as given. First, we establish a regularity condition on the payoffs. This regularity condition is used to restrict the parameter values so that the implied predictions are not clearly ruled out by casual observation.

Condition: For each racial group $A = X, Y$,

$$\frac{1}{4\beta} + c(n_A - 1) > \frac{\theta}{4\beta^2(n_A - 1)}$$

Specifically, this condition states that if all members of one racial group were together in one gang and one of those members were removed from the gang, the benefits from having a target for status-enhancing violence within that racial group along with the increased cohesion of the gang would exceed the damage that the removed member would inflict upon each of the remaining members. This regularity condition guarantees that no gang containing all members of a single racial group would form. In large communities where gangs typically emerge, this condition appears reasonable and should hold naturally. An important implication of this regularity condition is that in any gang stable formation, all individuals will have valid targets within each racial group for their violence, so that both intra-racial and inter-racial violence have the potential to emerge.

Equilibrium Gang Formation

We may now characterize the equilibrium gang formations. We shall see that in equilibrium, there is a tendency for gangs to be homogenous regarding the racial identity of their members, though there is a possibility of heterogeneity when groups are sufficiently close. The reason for the tendency to homogeneity is that violence is more frequent within racial groups than between groups, and individuals thus gain relatively more protection when banding together with members of their own racial group. When racial groups are sufficiently distant, individuals from different racial groups do not pose a great enough threat warrant the formation of racially heterogeneous gangs. Figure 1 demonstrates the actions by which an initially diverse gang formation could transition to a racially-sorted equilibrium. If a subset of race X found themselves together in a gang with members of race Y,

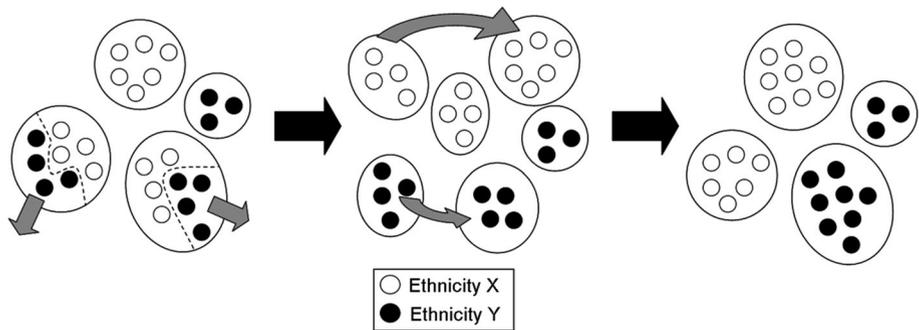


Fig. 1 Sorting from mixed initial condition to homogenous state

they could simply break away and then recruit more members of race X to their now homogenous group.

The equilibrium is characterized in the following theorem given various levels of group distance (see “Appendix” 2 for formal proof).

Theorem *For any level of group distance, a gang stable partition exists in which all but possibly one gang are homogenous. The following are true:*

(1) *Suppose that groups are sufficiently distant (α sufficiently close to zero). Then in any equilibrium, violence is predominantly intra-racial and every gang is homogenous.*

(2) *Suppose that groups are sufficiently close (α sufficiently close to one). Then in any equilibrium, intra-racial violence is as likely to occur than inter-racial violence, and gangs may be mixed in any equilibrium.*

(3) *Suppose that groups are moderately distant (α sufficiently far between zero and one). Then intra-racial violence is more likely to occur than inter-racial violence, and there may or may not exist an equilibrium in which some gangs are racially mixed.*

This theorem generates clear predictions about the types of gang formations that are stable when social distance between racial groups is at both extremes (α close to 0 or 1), but the more realistic and theoretically interesting case falls somewhere in between these values where there is a non-negligible but limited amount of social distance between the racial groups. Given a moderate amount of racial group distance, there can be many types of gang formations, some with mixed gangs, some without mixed gangs. Although our theoretical result shows that mixed gangs can be stable in this intermediate case, it remains to be seen that mixed gangs will actually form under plausible social dynamics of gang formation. We next place the basic model above into a dynamic setting in which gangs form over time, and we will show that homogeneous gangs are overwhelmingly selected to form by the actors, even when mixed gangs can be stable.

Before we proceed to the numerical simulation of the dynamic model, it is worthwhile to highlight the fundamental aspects of the model that lead to our predictions. The Theorem above is robust to drastic changes in the model: it depends very little on the parameters, or even the functional forms. The single fundamental aspect which is necessary for our results is that the marginal benefit of intra-racial violence is higher than that of inter-racial violence given an equal amount of intra- and inter-racial violence. As long as this is true, it will be beneficial for individuals to commit more intra-racial violence than inter-racial violence. Consequently, individuals pose a greater threat to members of their own ethnic group than other ethnic groups, and thus will be more apt to band together for protection from one another than joining with members of other ethnic groups. The

remaining components of the model, the parameters and functional forms, have minimal influence on the outcome. As long as there are diminishing returns to the reputational benefit of violence and the increase in the cost of maintaining cohesion within a gang from inducting a new member increases in the size of the gang, then an equilibrium will exist. The only difference across parameters and functional forms will be the total amount of violence and the size of the gangs, neither of which is important to our results.

Dynamic Process Simulations

Consider the following discrete time dynamic process. In each round, an actor is selected at random to propose a deviation from the current gang formation. The actions proposed are restricted to those an actor might reasonably be able to coordinate (i.e. related to the actor's own membership or members of the actor's current gang). Changes occur only if all involved parties agree to the proposition. We assume that actors always suggest the most beneficial change to the current gang formation. Specifically, the actor may propose:

1. To switch to another gang,
2. That the actor's gang inducts another individual as a new member,
3. That the actor's gang removes one of its members,
4. To exit the gang without joining another gang,
5. To maintain the status quo.⁸

Simulation Results

We conducted simulations using four different parameter sets which correspond to different predicted gang sizes (10, 20, and 40 with equally sized groups, as well as one set with unequal group size).⁹ For each of these parameter sets, the social distance between racial groups in the community (α) is allowed to vary between 0 and 1 by increments of 0.1, as well as from 0.9 to 1 by increments of 0.01. The total population size used for the simulations is 500 for the treatments with equally sized groups,¹⁰ and the system always begins with no gangs. For the treatment with unequal group sizes, which is arguably more reflective of realistic communities, we set $n_X = 250$ and $n_Y = 100$. We performed 1000 simulations for each gang size-social distance combination. To examine the composition of the gangs that emerge, we compute multiple indicators. First, we report the percentage of gangs that are completely homogenous. Second, we report the average within-gang racial homogeneity, computed by dividing the number of members of the majority racial group of the gang by the total number of members for each gang and taking the average of this value for all gangs. Third, we explore the average homogeneity and gang sizes of mixed gangs.

Figure 2 shows the percentage of homogenous gangs at different values of social distance, α where gangs can have a maximum size of 10, 20 and 40 members. The simulations

⁸ Note that this fourth deviation is inherently more restrictive than the deviation allowed in the game-theoretic model whereby multiple members of a gang may simultaneously leave the gang and form a new gang. If anything, this restriction would bias the simulation toward a more mixed outcome, thus lending more strength to the results that homogeneity is the predominate outcome.

⁹ The parameters of the model influence the set of stable gang formations primarily through the maximum number of members that a stable gang may retain. As such, any parameters that yield the same maximum number of members would induce identical or nearly identical predictions.

¹⁰ We also conducted the same simulations with a population size of 100 and found no substantive difference.

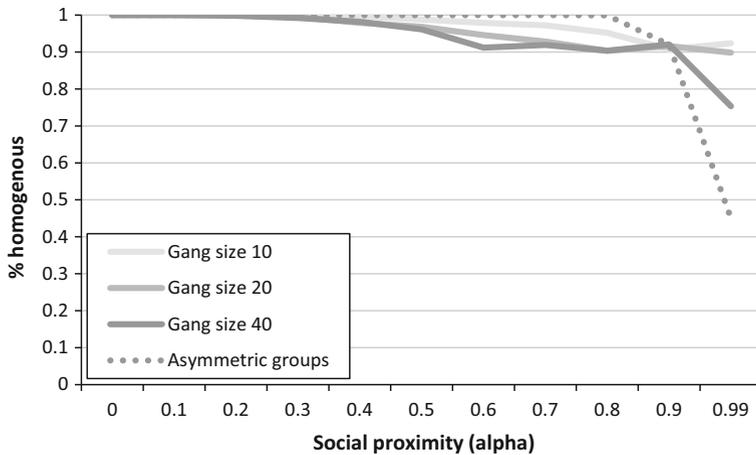


Fig. 2 Percentage of homogenous gangs by social proximity

revealed that most gangs were homogenous as α goes from 0 until about 0.9 regardless of the maximum gang size allowed. Most of the variation occurs when racial groups are not socially distant, i.e., when $0.9 < \alpha < 1$. Figure 3 looks more closely at this narrower range. Overall we see a strong tendency toward homogenous gangs. Moreover, when larger gangs are allowed to form (i.e. when the cost of maintaining the within-gang social contract is low), the trend of homogeneity is more stable. When only smaller gangs are allowed to form, slightly fewer homogeneous gangs are observed as α approaches 1. Still, even under these conditions, an overwhelming majority of gangs are completely homogenous, and the reduction in the percentage of homogenous gangs formed only occurs when social proximity is very high with α very close to 1. Results are qualitatively similar in all treatments.

Figure 4 reveals the composition of mixed gangs. The lines refer to the average homogeneity of mixed gangs that emerge from the simulations and the bars indicate the average size of mixed gangs formed. First, Fig. 4 shows that at large social distance $\alpha < 0.5$, the few mixed gangs formed are very small. However, as α gets larger and mixed gangs increase in size, the mixed gangs that form are fairly heterogeneous, approaching 0.5 (perfect mixing) as α approaches 1. In effect, as social distance drops (α approaches 1), the mixed gangs become larger and more evenly split because violence against a person of either group yields almost the same benefits, and as such, association with either group yields almost equal protection.

The dynamic model above can be interpreted in one of two ways. First, it is a model of gang formation that can provide predictions about the ethnic composition of gangs and the ensuing rates of inter- and intra-racial violence. A second interpretation, however, is that the dynamic model merely provides a way to select one stable gang pattern over another when many stable gang patterns are possible. In game-theoretic settings in which multiple equilibrium patterns exist, the standard tools of classical game theory generally cannot identify which equilibrium is more likely to occur. Placing the static game into a dynamic context via simulations thus provides a way to identify which equilibrium is more likely to emerge. Assumptions made about the dynamic process will necessarily be simplified and abstract, but they do provide a useful benchmark level of results as well as more specific predictions about the properties of gangs in the real world. We emphasize, however, that

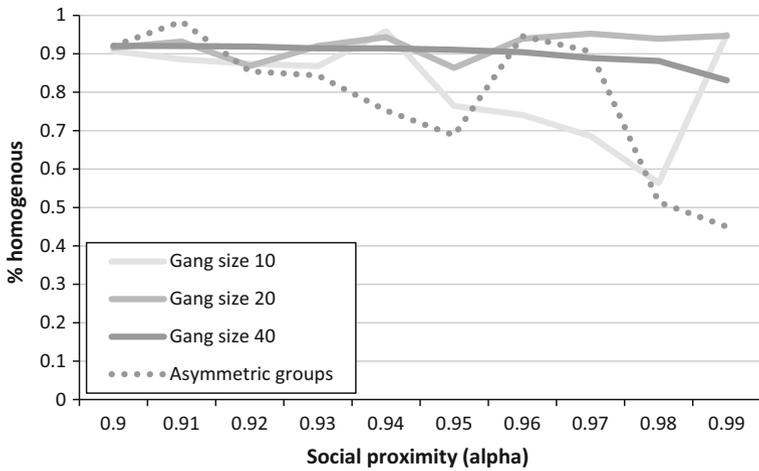


Fig. 3 Percentage of homogenous gangs by social proximity (0.9–0.99)

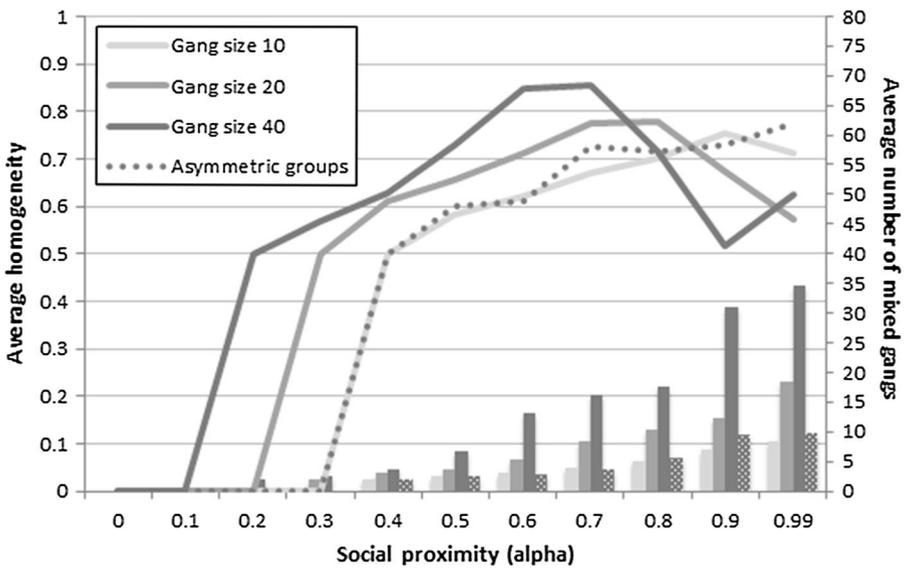


Fig. 4 Average homogeneity and average sizes of mixed gangs by social proximity

the key feature that intra-racial violence provides more benefits than inter-racial violence drives the dynamic process just as it did in the static analysis.

Discussion

In this paper, we set out to develop a model that would replicate two empirical findings in gang research: gangs tend to be racially homogenous, and gang violence tends to be intra-racial. Our theoretical contribution is an attempt to resolve the seemingly contradictory

coexistence of these findings. We propose that in contexts where violence has a status-enhancing property, as is known to be the case in gangs, individuals use two different strategies to maximize their social status: (1) they choose targets that are most likely to increase their status, and (2) they form alliances to ensure that they are not losing status by being victimized.

The resulting alliances (i.e. gangs) are likely to be homogenous under three assumptions: (1) individuals form gangs for protection, (2) socially close individuals are likely to belong to the same racial group, and (3) status benefits of violence are greater when it is perpetrated against socially close others. The formation of homogenous gangs occurs under such conditions because individuals make decisions about gang membership by considering which targets others may find attractive to enhance their own statuses. In an effort to minimize their victimization, individuals enter social contracts of non-violence with socially close others. The balancing act between individuals' need for protection and for status-enhancement leads to groups that are likely to be racially homogenous, to the extent that status benefits decrease with increasing social distance and that there exist at least *some* distance between racial groups in a community.

The Dual Role of Homophily

Our analyses suggest that, consistent with prior research, racially homogenous gangs are highly stable social units even in settings when another racial group is present. This finding occurs when we assume that status-enhancing targets are likely to be those that are socially close. In such a system, homophily operates in two different ways to create intra-racial violence and homogenous groups.

First, gang formation occurs in a community where social distance between racial groups is influenced by homophily. There are many reasons why individuals of a particular racial group tend to be closer to other members of their group. Chiefly among these reasons is the notion that individuals are likely to associate with similar others because it is easier to connect with individuals who have similar cultural referents therefore facilitating communication, enabling parties in the relationship to better predict the actions and reactions of the other, and fostering trust (Festinger 1957, Kandel 1978; McPherson and Smith-Lovin 1987). Much like they do for many other types of human activities, these advantages facilitate criminal collaboration as well: Greater trust between parties, which is extremely valuable in the absence of enforceable formal agreements such as in cooperation in crime (Tremblay 1993) and research has consistently found that co-offending relationships are often homophilous (Grund and Densley 2012; Samecki 2001; Reiss and Farrington 1991; Warr 2002).

This type of homophily, we argue, is not sufficient to explain racial homogeneity in gangs. It is difficult to simultaneously argue that gangs tend to be made of individuals who prefer the company of socially similar others, and that gang violence tends to occur between socially similar individuals. Homophily, in a traditional sense, occurs at the community level to create a system where interactions within racial groups are more frequent and therefore, over time, carries with them a richer history than interactions between racial groups. Thrasher (1927) argued long ago that “the gang has its beginning in acquaintanceship and intimate relations which have already developed on the basis of some common interest” (p. 27). There is a life before the gang and the quarrels and rivalries that emerge over time between playgroups of school-aged children are likely to serve as a basis for animosity between youths who join gangs. If homophily is responsible for the

formation of these playgroups, then it is likely that deep-seated rivalries will occur between similar individuals as well.

The second way in which homophily operates in our model is through decisions to engage in violence. In theory, a gang member could victimize any member of a community. Despite all of the moral panic surrounding gang violence, gang members do not operate this way. Victims tend to be individuals with which gang members have had prior contacts, or at the very least, if they *are* strangers, others that are involved in violence in a community (Decker and Curry 2002; Maxson et al. 1985; Pizarro and McGloin 2006; Rosenfeld et al. 1999). Gang members, and their victims, are similar in many ways, with race being only one of the similarities. Our main theoretical contribution in this paper is to suggest that given the choice of potential victims, gang members are likely to pick the most status-enhancing target.¹¹ As we discuss below, status rewards are likely to operate in such a way that the closer the target, the more status it will generate. When socially close target are also socially similar, the decisions to engage in violence resemble the homophilous choices that characterize the more positive relationships that emerge in playgroups.

Gangs therefore are not necessarily directly born out of homophily but the violence they engage in has been shaped by homophilous processes that often pre-date the formation of the gang, or even a member's affiliation with the gang. In this context, individuals band together in an effort to protect themselves against potential attacks. Since violence is likely to occur between similar others, the best protection for an individual is to join forces with others who, notwithstanding an agreement of non-violence, would benefit from their victimization. In such a system, gangs are formed among socially close others, which translates in many communities into racially homogenous gangs.

What follows from this model is that the same principle—homophily—can be used to predict violent exchanges and group formation. If we are to accept the adage that birds of a feather flock together, we must accept that a logical correlate is that birds of a feather also fight together.

The Special Nature of Status-Enhancing Rewards: Implications for Patterns of Violence

The assumption that gang members fight to increase or at least maintain their status is hardly a controversial one. Certainly, gang members may engage in violence for many other reasons, as, for example, in the commission of robberies, and domestic violence. Nevertheless, prior gang research is generally in agreement that status and reputation seeking is a central component of gang violence. As Short and Strodtbeck (1965, p. 215) observed status management through conflicts “provides much of the *raison d'être* of the gang”. They further explain:

“The gang provides an audience for much of the acting out which occurs in situations involving elements external to the group, and it is the most immediate system of rewards and punishments to which members are responsive much of the time. [...] behavior, including delinquent behavior, arises in the course of patterns of interaction in the pursuit of in-process rewards of such interaction.” (Short and Strodtbeck 1965, pp. 215–216)

¹¹ Realistically gang members are never *actually* presented with a choice of victim. Perhaps a more realistic way to express how this process might occur is to flip it over: Gang members may choose to let go of perceived slights when the target may not grant them much status, whereas it may be difficult to stay aloof when the target might be a well-known foe to the gang, and therefore, a potentially high value for status-enhancement.

Short and Strodbeck (1965) pointed out that status is a reward that arises from social interactions. As Gould (2003) argues, status, honor or reputation are in fact entirely symbolic rewards that are accessed by an individual only through others' recognition that the individual possesses it, or as the author puts it: "To have honor, to be honored, is to be thought honored by others" (p. 7).

Yet, little research has considered the implications of this observation. Symbolic benefits arising from acts of violence are not as straightforwardly secured as other types of rewards, such as financial gains. If most violence was motivated by financial gain, violent actors would only need to be worried about the direct return an act of violence would generate (i.e. the financial value of the goods extracted during the act of violence). In that case, maximizing financial gain from violence can be done simply by targeting richer individuals.

Unlike for financial gains, individuals have much less agency in their quest to maximize their access to symbolic benefits. Since these benefits are socially constructed, how much status is gained from a specific attack not only depend on the identity of the victim, but on others' appreciation of the victim as a 'worthy' target. Only then can the attacker enjoy the benefits associated with increased status. In that case, maximizing status benefits from violence necessitates choosing targets that are likely to elicit an emotional reaction from socially close others. For example, attacking a stranger might yield some status but attacking a rival gang member with a long history of interactions with others in the gang is likely to be viewed as a much greater accomplishment.¹²

Thus, we posit that targets socially closer to other members of the gang are more likely to meet these criteria and by extension maximize the status granted by the gang to the attacker. To the extent that social distance within racial groups is shorter than between groups, the targets chosen are likely to be of the same racial group as the attacker. In our model, this mechanism is sufficient to produce racially homogenous gangs in mixed settings as long as there is a small amount of social distance between racial groups.

Future research should look for evidence of such a mechanism. Prior research has found that gang conflicts and homicides are much more likely to occur between victims and offenders who know one another (Hughes and Short 2005; Decker and Curry 2002; Pizarro and McGloin 2006) and are more likely to be the result of personal concerns and activities than they are to be motivated by their membership in a gang per se (e.g. Rosenfeld et al. 1999). Yet, some have argued that in many cases it would seem that gang members do not attack specific individuals much less consider their choices of targets, but rather attack indiscriminately individuals *because* they are rivals and/or live in different neighborhoods (see for example Vasquez et al. 2010, 2012). Furthermore, individuals often join gangs with lengthy histories of violence and established rivalries. These institutionalized patterns of violence (e.g. Papachristos 2009) most likely provide new members with "default" targets for violence. Such violence is less about individual decisions about targets and more about the group's history. Vasquez et al. (2015) found that gang members who perceive rivals as indiscriminately blameworthy are more likely to retaliate against any member of

¹² The logic behind our model does not necessarily rule out that actors may attack strangers who may be in the wrong neighborhood, or commit drive-by shootings against a rival gang regardless of the identity of the actual victim. Such actions may indeed generate status for the individuals engaged in them. Our argument, and one that has not to our knowledge been (and therefore should be) empirically tested, is that attacks on individual targets well-known to the gang such as on a member who previously attacked, disrespected a fellow member or the gang as a whole are likely to be much more valuable in terms of status.

the rival gang regardless of whether or not this member was involved in the actions that fuelled the retaliation.¹³

While the archetypal gang attack is often described as a prideful territorial protection against an enemy invader, or a retaliation for a perceived slight to the gang's honor, the decision to engage in potentially deadly violence, we argue, remains an individual one. It might be heavily influenced by gang subculture, peer pressure, economic strain, machismo, or other psychological influences, but ultimately the decision to hurt or kill another human being is a personal decision that is unlikely to be taken lightly. The idea that much gang violence is a result of the individual decisions of those who generate them has much more empirical support than the notion that gang violence is an expression of group-think, especially in the context of the recurrent findings that gangs are not very well organized and therefore unlikely to be efficient at guiding the behavior of their members (e.g. Bouchard and Spindler 2010; Cloward and Ohlin 1960; Decker 1996; Decker and Curry 2002; Klein 1995; Short and Strodtbeck 1965).

Race, Ethnicity, Gang Violence and the Changing Demography of Urban Settings

Klein and Maxson (2006, p. 221) argued “[e]thnicity is one of the most widely discussed, and little studied, aspect of gangs”. The authors further posit that while existing research may suggest that “group processes trump ethnicity” (p. 223), this assertion would be much stronger if gang researchers had paid more attention to the influence of race and ethnicity on gang behavior using comparative studies. We are equally surprised by the lack of attention to race and ethnicity in gang research and agree that future research should be conducted to fill this rather peculiar gap in our knowledge about gangs.

One implication of our analyses is that changes in the demographic makeup of a community are likely to influence patterns of associations, rivalries, and alliances. We posit that this can be the case even in settings where these relations have such lengthy histories that they have become, as Papachristos (2009) has argued, institutionalized. Take for example, the Little Village neighborhood in Chicago. One can trace the history of this area through multiple ethnographies conducted at different points in time. Thrasher (1927, pp. 132–136) described the area as “a frontier between hostile immigrant colonies” where “old world antagonisms” fuelled rivalries between Jewish and Polish settlements. A few decades later, Suttles (1968, p. 28) described rivalries between an Italian gang in the Addams area and “the Italians over on Western” (the northeastern boundary of Little Village) and the “ethnic invasion” of Mexicans, displacing previous Slavic residents in the area. By the mid-1990s, when Irving Spergel helped designed, and evaluate the Little Village Gang Violence Reduction Project, the neighborhood had become almost exclusively Mexican and Mexican–American, with an estimated 30% of its population being

¹³ It should be noted that Vasquez et al.’s relied on vignettes to ask gang members about hypothetical scenarios where they would encounter rival gang members. One should be cautious to infer from these findings how actual behavior would play out when individuals are faced with decisions to attack a rival gang member. For example, Descormiers and Morselli (2011) found, gang members, when talking generally about rival gangs, will commonly make unequivocal and broad sweeping statements such as “Everything that’s Blue [Crips], we clean up. [...] we don’t take the time to verify if you are loco [Hispanic] or if you are really a Blue. We clean up.” (p. 306). Yet, Descormiers and Morselli (2011) found that these statements were more nuanced when gang members moved away from discussing generalities about rival relationships, and discussed relationships with specific individuals under specific circumstances. In some cases, gang members would describe even positive relationships between individuals in rival gangs because of family ties, geographical proximity or unique access to criminal opportunities.

undocumented immigrants (Spergel et al. 2006). Today, Little Village remains a predominantly Mexican neighborhood (Vargas 2016). Gangs in Little Village are primarily Latino, and although Vargas (2016) reports some conflicts between the Latin Kings and the Gangster Disciples—a predominantly African-American gang—most violence in Little Village occurs between Latino gangs on the west and east side of the neighborhood.

The story of Little Village is not unique. Howell (2015) has described the history of street gangs in many other American cities in much the way. Yet, despite the many descriptions linking periods of upheaval in the racial and ethnic composition of communities with the emergence of street gangs in urban areas, we know little about the dynamics involved. An interesting case study would be to examine how the arrival of Salvadoran immigrants in Mexican communities in Los Angeles, and the subsequent emergence of Mara Salvatrucha (or MS-13) has influenced patterns of violence between Mexican and Salvadoran gangs, as well as with African-American gangs that are traditionally found in close geographical proximity. One would predict that upon their arrival in a community Salvadorans and Mexicans would quickly become socially close given the similarity in their cultures (see Vigil 2002). Still, their relatively recent arrival in LA's communities may make them sufficiently socially distant from Mexican gangs, and therefore lead to the emergence of Salvadoran gangs, and intra-Salvadoran patterns of violence. Vigil (2002) provided some evidence that Mara Salvatrucha tended to fight with rivals who were mainly of Salvadoran origins.

The arrival of new immigrant groups in a community is likely to lead at least to *some* tension between them and resident groups, as appeared to be the case in the early days of Little Village. Indeed, there are several examples of gangs that formed as a response to other hostile groups. However, we propose that this may be only a transition phase. New ethnic groups eventually become more established in a community and start building social networks that are likely to be governed by processes of racial and ethnic homophily, and homophily in turn leads to greater social distance between ethnic groups. Conflicts fuelled by ideology (e.g. hate groups, terrorist organizations) may be sustainable in spite of considerable social distance, but we argue that conflicts based on socially defined symbolic rewards are not.

The emergence of Haitian gangs in Montreal perhaps best exemplifies a combination of such a transition phase with the mechanisms linking social distance, status-enhancing violence, and race we propose in this paper. In the 1980s and 1990s, waves of Haitian immigrants have led to the emergence of a Haitian gang subculture in Montreal (Tremblay et al. 2016). Tremblay (2011, p. 70) relates the words of Beauvoir Jean—a veteran of one of the first Haitian gang in Montreal—who explains the emergence of his gang as a response to being the victim of racism. Ultimately, what started as an attempt to organize against a common enemy, turned into a status game that pitted them against one another:

“When someone calls you a baboon, a monkey or a macaque, you have few options: act like a baboon, shower them with insults, move on, or fight. [...] Racism on the streets stops when those who say out loud what others think in private start getting scared. People congratulate you. [...] You discover you're powerful and people around you feed you with this power. It's a delicious feeling, as comforting as a whiff of crack. You're 17, and enjoying that status—not tomorrow, not four years from now—but right now. [...] But what you do in your own little corner of the city, others can do elsewhere and soon you're competing against as many gangs as there are ghettos. [...] You used to fight those who called you a baboon, but now you're fighting amongst baboons”.

Conclusions: Future Directions, Game Theory and Generative Explanations

In *Micromotives and Macrobehavior*, Schelling warns social scientists that: “If we see pattern and order and regularity, we should withhold judgment about whether it is the pattern and order of the jungle [...], and inquire first of all what it is that the individuals who comprise the system seem to be doing and how it is that their actions, in the large, produce the patterns we see” (1978: 22). In many cases though, such inquiries are difficult to do using standard social science tools. Game theory can be useful tool to advance such research.

We agree with Birks et al. (2012) that game theory has been underutilized used in criminology (see also McCarthy 2002). One of the goals of game-theoretic models is to generate new hypotheses to be empirically tested. Our model generates an explanation for the simultaneous presence of intra-racial violence and the formation of racially homogeneous gangs in neighborhoods where racial groups are not fully integrated. This is not a new finding, but the theoretical exercise we have engaged into mathematically recreate this finding generates hypotheses that could potentially be directly tested. For example, our model suggests that as social distance between racial groups in a community decreases, status-enhancing violence between groups should increase. Recent work by Hipp could be extended to examine how rates of inter and intra-racial gang violence varies in communities with variations in the social distance between racial groups. Although our metric for social distance is agnostic to the actual indicators that could potentially be used to construct a distance matrix, an empirical test of our theoretical model could potentially use the approach used by Hipp (2010) and Hipp and Boessen (2012) as it captures the spirit of what we mean by social distance between racial groups. Furthermore, our model suggests that as social distance between groups decreases the likelihood of heterogeneous gangs increases. To our knowledge, we know of no study that has examined this question.

Another hypothesis deriving from our model is that attacking socially closer individuals confers more status than socially distant others. This idea is consistent with Gould (2003) notion that conflict—especially honor-based conflict—tends to occur between social equals, a notion that has found some support in the context of gang violence (Papachristos 2009). Testing such a hypothesis would require in-depth analysis of conflicts between gang members. Short (1998) has urged gang scholar to pay closer attention to the situational and circumstantial elements of interactions between gangs and individual gang members, a call recently reiterated by Decker et al. (2013). Most of what we know about instances of gang violence has relied on examination of police records with often-incomplete information about the individuals involved or the circumstances surrounding the events (e.g. Maxson et al. 1985; Rosenfeld et al. 1999).

Maxson and Esbensen (2012) have argued that ethnographic research is crucial in order to understand how group processes, status formation and violent behaviors operate in the gang context. We wholeheartedly agree that more attention should be paid to interactions between groups and members, and that a return to the in-depth ethnographic methods that once characterized gang research is sorely needed. We hope that our work can motivate empirical research on these processes, whether it serves to falsify or support our theoretical claims.

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Appendix 1: Gang Stability

Below we state the formal definition of gang stability, for which we will need to define some notation. We will use Γ to refer to an arbitrary gang formation, which is a partition of the set of actors, with each subset in the partition corresponding to a gang. Let $v_i(\Gamma)$ denote the indirect utility function of actor i , that is, the utility that actor i would receive in the gang formation Γ given that all agents make optimal violence choices in the second stage.

Definition A gang formation Γ is stable if the following hold:

- I. For all gangs G, H in Γ and all actors i in G , $v_i(\Gamma') \leq v_j(\Gamma)$ for some actor j in $H \cup \{i\}$, where $\Gamma' = \Gamma \setminus \{G, H\} \cup \{G \setminus \{i\}, H \cup \{i\}\}$
- II. For all gangs G in Γ and all subsets H of G , $v_j(\Gamma') \leq v_j(\Gamma)$ for some actor j in H , where $\Gamma' = \Gamma \setminus \{G\} \cup \{G \setminus H, H\}$.

Note that part I of this definition encompasses deviations (1) and (2) as described in the text, where (1) is realized by considering any gang G that contains only a single (non-gang) member.

Appendix 2: Proof of Theorem

To assist in the proof of the theorem, we will first partially characterize the set of stable gang formations via the following two lemmas. The first lemma establishes for each race an optimal gang size that all members of that race would be willing to add or remove members in order to bring their gang closer to the optimal size. In particular, there is a smaller optimal size for mixed gangs. The second lemma demonstrates that given sufficiently large or small social distance, the optimal size for mixed gangs is one member (no mixed gangs) or equal to the homogenous gang size (with equal sized populations), respectively.

Lemma 1 For any α and each race A and B (which could be either X or Y), there exists threshold sizes K_{AA} and K_{AB} with $n_A \geq K_{AA} \geq K_{AB}$ such that for any member i of A whose gang has M members:

1. if $M > K_{AA}$ then any other member of A in the same gang prefers to remove i from the gang, and if $M < K_{AA}$ and at least two members of A are not in the gang, then any member of A in that gang would prefer to induct any other member of A into the gang, and
2. if $M > K_{AB}$, then any member of B in the same gang prefers to remove i from the gang, and if $M < K_{AB}$ and at least two members of A are not in the gang, then any member of B in the gang would prefer to induct any member of A into the gang.

Proof 1 (1) We will begin by identifying the conditions under which the members of a particular racial group A will be made better off by removing one of their members. We will first address the case in which the gang does not contain all members of group A . In this case, a member i of A prefers to remove another member j of A from his gang if the

subsequent damages resulting from his victimization are outweighed by the reduction in costs of maintaining cohesion within the gang. That is, if

$$\frac{\theta}{n_A - 1} \frac{1}{4\beta^2} < \frac{c}{2} M(M - 1) - \frac{c}{2} (M - 1)(M - 2) = c(M - 1).$$

Note that the reversal of this inequality is precisely the condition under which the members of *A* in the gang prefer to induct any non-gang member of *A* into the gang, which would further imply their willingness to induct any member of *A* into the gang since gang members pose a greater threat than non-gang members. The left hand side of the above inequality does not depend on *M*, while the right hand side is clearly increasing linearly in *M*. As such, there must exist a critical value M^* such that if $M > M^*$, then the members of group *A* in that gang would be made better off by removing one of those members from the gang and if $M < M^*$, then those members would be made better off by adding any member of *A* to the gang. If this value M^* is such that $M^* \leq n$, then we may simply set K_{AA} equal to the smallest integer that is larger than M^* and part (1) of the Lemma will be immediately satisfied. The remainder of the proof will deal with the case in which $M^* > n$.

In the case that $M^* > n$, the previous inequality is violated for any possible gang within this system. This does not negate the statement in the Lemma, as if any gang contained all n_A members of group *A*, those members would be prohibited from using violence within their racial group. As such, there is an additional benefit to removing a member of *A* from the gang in that the remaining members would gain a target for their violence within their group, and thereby have access to a means of obtaining additional status. In this case, the members of *A* in the gang would prefer to remove another member of group *A* from the gang if

$$\frac{\theta}{n_A - 1} \frac{1}{4\beta^2} < \frac{1}{4\beta} + \frac{c}{2} M(M - 1) - \frac{c}{2} (M - 1)(M - 2) = \frac{1}{4\beta} + c(M - 1).$$

Here, the additional term on the right hand side of the inequality is the reputational benefit that may be acquired by committing violence against the new target within *i*'s race less the cost of committing the violence. As we are considering the case in which all members of group *A* are in the gang, then it must be that $M \geq n_A$. It follows from the fact that the right hand side is increasing in *M* that if this inequality holds for $M = n_A$, then it must also hold for any $M > n_A$.

Consider $M = n_A$, then note that the above inequality may be rewritten as

$$\frac{\theta}{n_A - 1} \frac{1}{4\beta^2} < \frac{1}{4\beta} + c(n_A - 1),$$

which is precisely the statement of the regularity condition. We conclude that under our assumptions, if $M \geq n_A$, then any member of *A* in the gang would be made better off by removing one of those members from the gang.

It follows from these two cases that a value of K_{AA} equal to the smallest integer that is weakly larger than M^* if $M^* \leq n$ or $K_{AA} = n_A$ otherwise will satisfy statement (1) of the lemma.

(2) The proof of the second part of the lemma is identical in method to that of the first. The only difference is that the value of the victimization and net benefit from removing the member will be smaller due to the violence occurring between the ethnic groups. Specifically, the three inequalities above become

$$\frac{\theta}{n_A - 1} \frac{\alpha^2}{4\beta^2} < c(M - 1),$$

$$\frac{\theta}{n_A} \frac{\alpha^2}{4\beta^2} < \frac{\alpha^2}{4\beta} + c(M - 1), \text{ and}$$

$$\frac{\theta}{n_A} \frac{\alpha^2}{4\beta^2} < \frac{\alpha^2}{4\beta} + c(n_A - 1).$$

While the third inequality is not the same as the regularity condition, as it was before, some simple manipulations will reveal that it is implied by the regularity condition. \square

Lemma 2 The following are true:

- (1) For α sufficiently close to zero, $K_{AB} = I$, and
- (2) For α sufficiently close to one, if $n_X = n_Y$, then $K_{AA} = K_{AB}$ for any ethnic groups A and B

Proof 1 (1) Recall that the violence that actors use against others who are not members of their own racial group is $\alpha^2/4\beta$. As α approaches zero, then so does this violence. It follows that when α is close to zero, then actors always prefer to remove members of the other race from their gangs, as there is very little threat from their victimization, and so $K_{XY} = I$.

(2) For α close to one, the total violence that each individual directs at each racial group is approximately equal. Further, if $n_X = n_Y$, then the violence directed at each individual is approximately equal as well. It follows that the inequalities defining K_{AA} and K_{AB} in the proof of Lemma 1 must be satisfied under the same conditions, and so $K_{AA} = K_{AB}$.

As a technical note, if $K_{AA} = M^*$ as computed in the proof of Lemma 1, then as long as α is less than one, it is possible that $K_{AA} > K_{AB}$. However, this is only possible if M^* takes an integer value, which can only occur for an arbitrarily small (measure zero) subset of the parameter space. If this were the case, any arbitrarily small perturbation of the parameters will make it so that M^* is not an integer, and thus this case may be ignored. \square

We next present the proof of Theorem 1. Each statement in the theorem will be proved separately.

Proof of Theorem 1 (1) First, we will show that gangs must be racially homogenous in any stable gang formation. Second, we will show that in any stable gang formation, within each race A , no gang is larger than K_{AA} and all but at most one gang have K_{AA} members.

Suppose that there is a racially mixed gang in a stable gang formation. Consider a deviation of type 3 whereby all members of race X within that gang leave and form a new gang. Let M_X and M_Y denote the number of members of each racial group in the gang with $M_X + M_Y = M$. Then it is beneficial for the members of X to leave and form a new gang if

$$M_Y \frac{\theta}{n_A - 1} \frac{1}{4\beta^2} < \frac{c}{2} M(M - 1) - \frac{c}{2} (M - M_Y)(M - M_Y - 1) = \frac{c}{2} (2M - M_Y - 1).$$

Note that the right hand side is positive and independent of α , and the left hand side approaches zero as α approaches zero. Thus, for α sufficiently small, this inequality must be satisfied, violating the gang formation as stable. We conclude that for sufficiently small α , all gangs must be racially homogenous in any stable gang formation.

Next, note that if a homogenous gang composed of members of race A has $M > K_{AA}$ members, then by definition of K_{AA} and by Lemma 1, it must be that its members each prefer to remove a member from the gang. Thus, some subset of $M-1$ members of that gang would benefit by leaving and forming a new gang. We conclude that in any stable gang formation, any gang with members of race A may have no more than K_{AA} members.

Lastly, suppose that there are two homogenous gangs with members of race A which both have fewer than K_{AA} members. Then by Lemma 1, each gang would be willing to add a new member from the other gang. It follows that at least one member would switch from the smaller gang to the larger gang (or either gang if they are the same size). We conclude that at most one gang with members of race A may have fewer than K_{AA} members.

(2) The proof of this part is almost identical to the previous part. Suppose that $n_X = n_Y$ and that α is sufficiently close to one that $K_{AA} = K_{AB}$ for each racial group A and B . We will use K to denote this threshold size since $K_{XX} = K_{XY} = K_{YX} = K_{YY}$. We will show that in any stable gang formation, no gang may have more than K members and that at most one gang may have fewer than K members.

First, suppose that a gang has more than K members. Then by definition of K and Lemma 1, the members of either race within that gang would benefit from removing a member of either race from the gang. It follows that any subset composed of all but one member of the gang would benefit from a deviation of type 3, leaving and forming a new gang. We conclude that in a stable gang formation, no gang may have more than K members.

Next suppose that two gangs each have fewer than K members. Then as we argued in the previous part, either gang would be willing to add a member of the other gang, and so a switch will occur to the larger gang. We conclude that in any stable gang formation, at most one gang may have fewer than K members.

(3) First note that there always exists a stable gang formation in which at most one gang is racially mixed. This equilibrium can be constructed by forming as many homogenous gangs as possible with K_{AA} members, and then one additional gang in each racial group with the remaining members. The gangs with K_{AA} members will be unwilling to add any new members from either racial group and are thus stable. There may be some switching between the two leftover gangs, but this would result in at most one mixed gang.

The potential for the existence of mixed gangs is verified by our simulations, which arrived at numerous stable gang formations with racially mixed gangs for values of α such that $K_{AA} > K_{AB}$ for each racial group A and each other racial group B . \square

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