EXPLORING THE TRANSFORMATIVE POTENTIAL OF RACIAL-ETHNIC DIVERSITY IN SCHOOLS AND CLASSROOMS: THE ROLE OF SOCIAL INTERACTIONS

A Dissertation Presented to

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APPROVAL OF THE DISSERTATION

This dissertation ("Exploring the Transformative Potential of Racial-Ethnic Diversity in Schools and Classrooms: The Role of Social Interactions", has been approved by the Graduate Faculty of The School of Education and Human Development in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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June 22nd, 2021

DEDICATION

To my friends who have consistently challenged me, supported me, and expanded my world. May everyone be so lucky.

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They say the dissertation is not the end but the only the beginning. But in so many ways this dissertation marks an end – an end to my time in Charlottesville and at the School of Education and Human Development (SEHD), a period that, for me, has been filled with tremendous personal and professional growth and learning. And it needs to be acknowledged that I would not be where I am today without the support, encouragement, and love of many.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Linking Document

Embrace diversity.
Unite –
Or be divided,
Robbed,
Ruled,
Killed
By those who see you as prey.
Embrace diversity
Or be destroyed.

-Octavia Butler, *Parable of the Sower*, p. 196

I have a hard time accepting diversity as a synonym for justice. Diversity is a corporate strategy. It's a strategy designed to ensure that the institution functions in the same way that it functioned before, except now that you have some black faces and brown faces. It's a difference that doesn't make difference.

-Angela Davis, Speech at University of Southern California, 2015

Racial-ethnic Diversity in the United States

The United States is currently the most racially and ethnically diverse it has ever been (US Census Bureau, 2019). At the turn of the 20th century the US population was 87.9% White, 11.6% Black, and .05% a race other than Black or White. By the turn of the 21st century the US population was 75.1% White, 12.3% Black, 3.7% Asian and Pacific Islander, 2.4% multiracial, and .9% American Indian and Alaska Native. In addition, 5.5 % of people in the 2000 census identified as a race other than what was specified and 12.5% of people identified as Hispanic or Latino (Grieco & Cassidy, 2001; Hobbs & Stoops, 2002). By mid-century it is predicted that US will be a diverse majority society. The US population is predicted to be 44.3% non-Hispanic White, 27.5% Hispanic/Latinx, 15% Black, 9.4% Asian and Pacific Islander, and 6.2% multiracial by the year 2060 (Vespa et al., 2018). The demographic changes leave no doubt that in terms of composition the US is a multiracial society.

The ethos of the United States has been of diversity, equality, and opportunity. Yet, from slavery to Jim Crow to school segregation predicated on racist housing policies the US, by

design, has never fully lived up to its proclaimed ideals (Kendi, 2016). Arguably the question of the 21st century will be if the US can successfully transition to a true multiracial democracy (Serwer, 2021). Establishing a true multiracial democracy is a complex and multifaceted challenge. Schools have been at the forefront of both racial-ethnic demographic changes (Forum on Child & Family Statistics, 2019) as well as the fight for racially-ethnically integrated institutions (i.e., Brown v Board, 1964; Joffe-Walt, 2020) and serve as an important setting to understand the implications of racial-ethnic diversity. As such, in this dissertation I contribute to the literature on the benefits of school and classroom racial-ethnic diversity by investigating *how* racial-ethnic diversity is associated with positive outcomes and how we can leverage certain methodological tools in that exploration.

The Role of Research in Supporting Diverse Schools and Classrooms

Social science research has played a role in supporting policies that create or maintain racial-ethnic diversity in schools. For example, Allport's (1954) intergroup contact hypothesis and Clark and Clark's (1950) doll studies played a role in the *Brown v. Board of Education* (1954) decision to desegregate public schools. Likewise, the research arguing that the educational benefits of diversity were a "compelling state need" played a role in the *Gratz v Bollinger et al.,* (2000) decision to uphold affirmative action policies in undergraduate admissions at the University of Michigan (Bowen et al., 1998; Gurin et al., 2002). Because of such landmark cases, social science research on the benefits of diversity has helped establish the narrative that diversity is related to positive academic and social benefits (Ayscue et al., 2017; Gurin et al., 2002; Tropp & Saxena, 2018). At the same time meta-analyses on studies about the relationship between racial-ethnic diversity and academic and social outcomes present contradictory findings (Thijs & Verkuyten, 2014; Yip et al., 2019).

While the integration of schools and the protection of school diversity has always been fraught (Equal Justice Initiative, 2014; Gellerman, 2014), the last two decades, in particular, have seen increased efforts toward school re-segregation; whether it is due to do districting policies that lean heavily on past-legalized neighborhood segregation (Tatum, 2017), the legal dismantling of policies designed to rectify neighborhood segregation (Stout v. Jefferson County Board of Education, 2017), and/or the coronavirus pandemic laying bare the harsh realities of economic inequities and the differential access to private educational resources (Green, 2020). In the face of these realities, paired with the mixed evidence on diversity from the empirical literature, there is an increasing call for diversity scholars to reflect on how diversity, and the benefits of diversity, are researched. In particular, the need to improve the conceptualization (Harrison & Klein, 2007) and the operationalization (Budesco & Budesco, 2012) of the construct of diversity as well as the need for an improved understanding of *how* diversity is related to positive outcomes (Graham, 2018) serves as the motivating literature for this dissertation.

Conceptualizing Diversity

Harrison and Klein (2007) argue that the contradictory findings in diversity research can be attributed to the lack of clarity in conceptualizing the construct of diversity. They argue diversity can be conceptualized as three distinct types of diversity (1) separation, (2) variety, and (3) disparity, where each type has specific properties that have measurement implications, and are related to outcomes in distinct ways. Separation diversity is defined as difference of opinion or position. Variety diversity is defined as difference in category or kind. Disparity diversity is defined as difference in the concentration of valued social resources. Ultimately, the authors argue that because demographic diversity, such as racial-ethnic diversity, can be conceptualized as separation, variety, or disparity diversity and that researchers either loosely define diversity or

do not defined diversity at all, these distinctions are obscured which means the theorized relationships from diversity to outcomes are imprecise. As Harrison and Klein (2007) conclude, "conceptualization must be aligned with operationalization. Theory must guide measurement" (p. 1213).

Operationalizing Diversity and the Change Processes

The multifaceted and dynamic nature of diversity means in practice diversity is difficult to capture with a single all-encompassing, representational statistic (Budescu & Budescu, 2012). For example, some studies operationalize the diversity of a setting as the proportion of minoritized students or the proportion of White students (e.g., Bankston & Caldas, 1996; Hopson, Lee, & Tang, 2014; Lee & Klugman, 2013; Ryabov & Van Hook, 2007). Other scholars operationalize the diversity of a setting as the heterogeneity of students (e.g., Juvonen, Nishina, & Graham, 2006; Karssen, van der Veen, & Volman, 2016; Rucinski et al., 2019; Williams & Hamm, 2017), where a measure of heterogeneity considers the number of different ethnic groups present and the distribution across ethnic groups (see Simpson's (1949) Diversity Index as an example). Another popular way scholars operationalize diversity is by measuring the proportion of same-ethnic peers in the setting (e.g., Benner & Yan, 2014; Geven, Kalmijn, & van Tubergen, 2016; Johnson, Crosnoe, & Elder, 2001). Some scholars conclude that while different measures of diversity may not capture the exact same construct, they are similar enough that the assumption can be made that they will be associated with outcomes in the same way (Rjosk et al., 2017). Other scholars, however, theorize and have empirically shown that different measures of diversity are related to the same outcomes in different ways (Conway-Turner, Williams, & Winsler, 2020; Engels et al., 2020; Madsen et al., 2016), suggesting the different measures of diversity are capturing different phenomena. Taken together, seemingly minor decisions about

the statistic used to represent the diversity of a setting have implications for how results are interpreted. As such, it is imperative that theory and measurement are aligned.

Mechanisms of Change: *How* Not If

The above two sections focus on the conceptualization and operationalization of the construct of diversity. Graham, on the other hand, (2018) focused on *how* the construct of diversity is related to outcomes. Highlighting the need of the current moment, Graham (2018) writes:

> "This is a critical time for studying issues about school diversity, because our courts continue to roll back the progress made in the decades following *Brown v. Board of Education* in 1954. Although psychological research played a pivotal role in the *Brown* decision, much of the research on the psychological benefits of school diversity in K-12 public schools has been portrayed as outdated, methodologically weak, too focused on Black-White comparisons, and theoretically impoverished – all of which can make it easier for critics of race-conscious policies to dismiss the evidence (Linn & Welner, 2007; Wells et al., 2016). I believe that the best counterargument to such criticisms will be rigorous programs of research with theory-driven and testable hypotheses about *how* ethnic diversity leads to better outcomes rather than *if* it does." (p. 65)"

Graham (2018) then puts forth a conceptual model of how racial-ethnic diversity in schools leads to improved intergroup attitudes and mental health outcomes. The three major mechanisms of change are (1) opportunities for cross-ethnic friendships, (2) exposure to multiple ethnic groups, and (3) balance of power among ethnic groups. Increased *opportunities for cross-ethnic friendships* is thought to lead to the presence of more relationships that would evoke the intergroup contact hypothesis (Allport, 1954) where positive cross-group relationships foster a reduction in cross-group prejudices. *Exposure to multiple ethnic groups* is theorized to lead to an increase in complex social identities. Social identity complexity is defined as "the perceived membership overlap among the groups with which a person aligns himself or herself" (Knifsend & Juvonen, 2013, p. 624). Social identity complexity is fostered through the visibility of and

personal experience with "cross-cutting group membership" (Knifsend & Juvonen, 2013, 2017) and as a result social identity complexity is hypothesized to be associated with both improved intergroup attitudes and positive mental health outcomes. *Balance of power among ethnic groups* (numerically) is hypothesized to increase attribute ambiguity (Graham et al., 2009) and in turn, reduces social vulnerability – less peer victimization, increased school safety – which is associated with positive mental health and academic outcomes.

Overview of The Dissertation

While I do not focus on specifically on compositional diversity and while I focus on different pathways of change and outcomes, the papers highlighted above have been consequential in my thinking throughout this dissertation. The importance of focusing on the *how* is what drives the research questions of each of the three papers and is what led me to a focus on social interactions. Likewise, the call to think deeply about how complex constructs are both conceptualized and operationalized drives the exploration into how the social interactions that catalyze the benefits of racial-ethnic diversity are theorized and measured; including how social network analysis and qualitative methods can be leveraged in the study of the benefits of racial-ethnic diversity. Finally, while the focus on my dissertation is primarily on the social interactions that catalyze the benefits of diversity, I attempt to ground the research in the understanding that any investigation of race/ethnicity must acknowledge and account for the context of racism and its implications on social contexts and social interactions within said contexts. Below I provide an overview of each of the three papers.

Paper 1

In paper 1, *Leveraging Social Network Analysis in the Study of Ethnically and Racially Diverse Schools and Classrooms*, I examine the literature around the benefits of diversity to

understand and identify four commonly used theoretical perspectives that explain the connection between setting level diversity and social and academic outcomes. The four theoretical perspectives are (1) intergroup contact hypothesis, (2) cognitive theory, (3) the belongingness perspective, and (4) the resource perspective. Common across all four theoretical perspectives is that social interactions drive change. Despite the importance of social interactions, compositional measures are often the main predictor in studies on the benefits of diversity (Budesco & Budesco, 2012). Compositional measures capture who is present but do not capture interaction.

Due to the importance of social interaction in understanding how racial-ethnic diversity is related to positive outcomes, I join other scholars (Clarke & antonio, 2012; Harrison & Klein, 2007; Hewstone, 2015) in the call to leverage social network analysis (SNA) in the study of racially-ethnically diverse schools and classrooms. In particular, I argue that SNA is well suited to capture both the nature and structure of social interactions that occur within diverse settings. I then provide suggestions for certain network metrics that can be used to operationalize the social interactions discussed in the four theoretical perspective. The paper closes with a discussion of the limitations of utilizing a social network perspective.

Paper 2

In Paper 2, *The Transformative Potential of Classroom Racial-ethnic Diversity: Using Social Network Analysis to Investigate How Diversity is Associated with Academic Outcomes*, I test the theory of change outlined by cognitive theory. Cognitive theory hypothesizes that cognitive growth occurs when one is confronted with new information and new ways of thinking. When cognitive theory is applied to racially-ethnically diverse settings it is hypothesized that a diversity of individuals provide a diversity of knowledge, ways of knowing, and modes of problem-solving. In addition, as outlined in paper 1, I leverage social network

analysis by using the social network metrics network integration and network density to operationalize the cross-group structure of the help-seeking network.

In alignment with expectations classroom diversity (as measured by Simpson's (1949) Diversity) alone did not predict outcomes. However, counter to expectations network density was negatively associated with academic outcomes. The relationships between network integration and academic outcomes were inconclusive. Network equity did moderate the relationship between network density and academic outcomes so that more equitable classrooms had a less steep negative relationships between density and outcomes. Network equity did not moderate the relationship between network integration and academic outcomes. Paper 2 provides an example for how social network analysis can be leveraged in the study of racially-ethnically diverse classrooms. At the same time, the unexpected results of paper 2 leave a lot of questions.

Paper 3

In order to further explore the unexpected findings in Paper 2, in Paper 3 *Unpacking the Intersection of Social Structure and Social Processes in Racially-ethnically Diverse Classrooms: A Comparative Case Study*, I utilize a comparative case study approach (Miles, Huberman, & Saldaña, 2014) to explore the nature and complexity of peer interactions in racially-ethnically diverse classrooms. In particular, I select two racially-ethnically diverse middle school classrooms – one class with a racially segregated friendship network and one class with a racially integrated friendship network. I use observation data to explore the nature and content of cross-race interactions and how the observation data maps onto the network integration scores. A secondary goal of the study was to explore the role of the teacher in facilitating an integrated peer network.

In the high integration classroom, there was in fact, more cross-race interactions than there was in the segregated classroom. Further, the segregated classroom had notable segregation in the interactions observed in the fieldnotes and the visuals of the network graphs between the White students and the non-White students. While the high integration classroom had more cross-group interactions it also had a wider range in tone of interactions. Many instances of isolation, teasing, and conflict were observed in this classroom.

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Leveraging Social Network Analysis in the Study of Ethnically & Racially Diverse Schools and Classrooms

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Abstract

The United States is currently the most racially and ethnically diverse it has ever been in history of the nation. The school-aged population is at the forefront of these changes. While racial-ethnic diversity has been found to be associated with positive academic and social outcomes for youth, there is also evidence to suggest the relationship between diversity and outcomes is more complex. As such there is a call to better understand *how* diversity is related is related to outcomes. Drawing from diversity research, we identified four commonly evoked theories that explain the relationship between diversity and positives. Common among the four theories was the role of social interaction to spark growth. We propose that social network analysis should be leveraged to operationalize the social interactions that catalyze the benefits of racial-ethnic diversity. Specific network metrics and other measurement considerations are discussed.

Keywords: Social Network Analysis; Diversity; Early Adolescence, Social Interactions

Leveraging Social Network Analysis in the Study of Ethnically & Racially Diverse Schools and Classrooms

The United States is currently the most racially and ethnically diverse it has ever been in history of the nation (US Census Bureau, 2019). Based on current demographic trends, the nation's population will to continue to diversify, with the school-aged population at the forefront of these changes (Forum on Child & Family Statistics, 2019). Diversity is an espoused value of the nation and the public education system. Beyond the moral imperative to embrace racial-ethnic diversity, diversity has the potential to be associated with positive social and academic benefits for everyone. For example, school-level racial-ethnic diversity has been found to reduce anxiety about difference, build capacity for empathy and caring about others, aid the development of leadership competencies, and catalyze social change (Tropp & Saxena, 2018). Further, racially-ethnically diverse school settings have been associated with reduced racial disparities in grades and test scores, as well as an increase in high school graduation rates (Ayscue et al., 2017).

However, despite the positive narrative about the benefits of racial-ethnic diversity the empirical reality is much murkier. Studies of racially-ethnically diverse schools and classrooms have revealed positive, neutral, *and* negative associations between classroom or school level racial-ethnic diversity and students' positive academic and social outcomes (see Linn & Welner, 2007; Thijs & Verkuyten, 2014; Yip et al., 2019 for a review). Some scholars have identified a lack of clarity in conceptualizing (Harrison & Klein, 2007) and operationalizing (Budesco & Budesco, 2012) classroom or school level racial-ethnic diversity as an explanation for the contradictory findings. Other scholars have linked the mixed findings to a lack of clarity in understanding *how* classroom or school level racial-ethnic diversity is related to positive

outcomes (Graham, 2018). Taken together, these two perspectives bring attention to questions requiring further attention: 1) what is classroom or school level racial-ethnic diversity (and how is it operationalized)? And 2) how is classroom or school level racial-ethnic diversity associated with students' positive academic and social outcomes (and how are those processes operationalized)?

Conceptualizing Diversity

What is Diversity?

Diversity is "the distribution of differences among the members of a unit with respect to a common attribute" (Harrison & Klein, 2007, p. 1200). While seemingly simple, diversity is a multifaceted and dynamic construct (Graham, 2006). Drawing from the management literature, it is useful to consider three distinct, but overlapping, types of diversity: (1) separation or "differences in position or opinion among unit members" (Harrison & Klein, 2007, p. 1200); (2) variety or "differences in kind or category" (Harrison & Klein, 2007, p. 1200); and (3) disparity or "differences in concentration of valued social assets or resources" (Harrison & Klein, 2007, p. 1200). The difference in meaning is visually depicted in Table 1 (modified from Harrison and Klein, 2007). Racial-ethnic diversity, and other forms of demographic diversity, can be conceptualized as variety, separation, or disparity diversity.

Conceptualizing racial-ethnic diversity as separation diversity emphasizes that race/ethnicity is connected to differences in values, beliefs, and attitudes. For example, *familismo* — a strong commitment to both immediate and extended family and values interdependence among the family— is a central cultural value for many who identify as Latinx. Evidence indicates familismo influences Latinx student behaviors in the classroom (Espinoza, 2010; Rodriguez, 2019) demonstrating how a diversity of values, beliefs, and attitudes may be present

in the classroom. When conceptualizing racial-ethnic diversity as variety diversity, the emphasis is on how individuals from diverse racial-ethnic backgrounds bring different knowledge, skills, or ability related to their racial-ethnic background. For example, Black children have strong oral narrative skills, or the ability to convey story, including the context of the story (Gardner-Neblett et al., 2012). Oral narrative skills are positively linked reading comprehension (Curenton, 2011; Gardner-Neblett & Iruka, 2015), though these strengths may go unrecognized in the classroom (Gardner-Neblett et al., 2012) demonstrating how a diversity of knowledge, skills, and abilibity is not always seen and/or valued. Conceptualizing racial-ethnic diversity as disparity diversity, emphasizes how power, prestige, and status are tied to people's racial-ethnic background. For example, in the US, and most of the globe, White people are in the dominant societal position, resulting in White people holding the power to set the bounds on what knowledge is valued (Collins, 1989; Yosso, 2005).

While racial-ethnic diversity can be conceptualized as variety, separation, or disparity, the type of diversity is rarely distinguished in school - or classroom - based research. Yet, the implications for how we conceptualize students' racial-ethnic diversity are twofold (Harrison and Klein, 2007). First, how we conceptualize classroom racial-ethnic diversity has implications for how diversity is associated with students' positive outcomes. Second, the different ways in which we conceptualize racial-ethnic diversity drive how we measure diversity as a construct. The two sections below unpack each of these implications.

How is Racial-ethnic Diversity Related to Students' Positive Outcomes?

Just as racial-ethnic diversity is complex, so are the pathways through which diversity impacts positive change. There is no single unifying theory, or series of theories, that describes how diversity is associated with positive outcomes. However, there are common theoretical

perspectives, across disciplines, that scholars draw from to describe potential mechanisms. In reviewing theoretical and empirical articles that link racial-ethnic diversity to positive academic and social outcomes, we identified four commonly cited theoretical perspectives: (1) intergroup contact hypothesis, (2) cognitive dissonance perspective, (3) the belongingness perspective, and (4) the resource concentration perspective. Below we describe each theoretical perspective. For each perspective, we make explicit its assumptions about the type of racial-ethnic diversity catalyzing change (i.e., separation, variety, or disparity) and discuss the processes theorized to drive specific outcomes (Brown and Juvoven, 2018). See Table 2 for an overview.

Intergroup Contact Hypothesis

The intergroup contact hypothesis states that intergroup contact, under certain conditions, reduces intergroup prejudice (Allport, 1954). However, one major critique of the contact hypothesis is that the theory does not explicitly identify *how* diversity leads to change (Pettigrew, 1998). Addressing this gap in the intergroup contact hypothesis, scholars have theorized that diverse settings afford individuals more opportunities for positive cross-group interactions and cross-group friendships. Through these positive interactions and close relationships, it is hypothesized that empathy and perspective taking skills are fostered, which in turn, are thought to ultimately improve intergroup attitudes and reduce prejudice (Graham, 2018; Pettigrew, 1998; Roberge & van Dick, 2010). In other words, positive relationships and interactions with individuals from a different racial-ethnic background are expected to counter stereotypes, reduce prejudices, and increase cross-group understanding.

Intergroup contact hypothesis evokes separation diversity (i.e., individuals are associating difference in racial-ethnic background with differences in values, beliefs, and attitudes). Separation diversity implies that all values, beliefs, and attitudes are seen as equal, just different

(as depicted by the horizontal line in Table 1). But the reality is individuals silo based on their belief system, and people, particularly people in the dominant social position think their belief system is superior, which in turn creates conflict, discrimination, and oppression. In fact, separation diversity is often associated with low group cohesion and high conflict (e.g., Reagans & Zuckerman, 2001). Importantly, the contact hypothesis states that the benefits of diversity will only be realized when the setting level conditions involve a diversity of individuals working together, as equals, towards a common goal, with support from authority figures (Allport, 1954), implying that the positive benefits will not be realized in unequal settings. As important as these setting level conditions are there is limited empirical investigation of setting level conditions in diversity research (Pettigrew, 1998).

Cognitive Dissonance Perspective

Gurin and colleagues (2002) drew from Piaget's (1971) ideas about cognitive disequilibrium to explain why diversity is associated with positive academic outcomes. It is hypothesized that working with people from different backgrounds creates a state of cognitive disequilibrium —a state of cognitive imbalance experienced when exposed to new information that then must be accommodated into existing schema or will prompt the development of new schema— which then sparks cognitive growth (Benner & Crosnoe, 2011; Gurin et al., 2002; Piaget, 1971; Williams & O'Reilly, 1998). In other words, as people from different backgrounds have to work together to solve a problem (whether it be math equations or planning a school function), their perspectives, knowledge base, and problem-solving strategies are expanded, all of which are key to academic success.

Cognitive dissonance perspective evokes variety diversity. An individual's racial-ethnic background affords access to different kinds of cultural knowledge, skills, and ability. When

differences in types of knowledge, skills, and abilities are brought in to the classroom, and accessed through collaborative working relationships, students are exposed to more ways of thinking and problem solving, resulting in better cognitive processing. However, one important assumption in the application of cognitive dissonance perspective is that all cultural knowledge is valued equally in the setting, which is not always the case, especially in the US school system (Yosso, 2005).

Belongingness Perspective

The belongingness perspective (Benner & Crosnoe, 2011) hypothesizes that as the number of same-race peers in a diverse setting increases, students feel a greater sense of school belonging, which in turn increases feelings of safety, self-worth, and positive academic outcomes (Conway-Turner et al., 2020; Juvoven et al., 2006; Lee & Klugman, 2013), and decreases feelings of loneliness, victimization, and problem behaviors (Geven et al., 2016; Juvoven et al., 2006; Madsen et al., 2016). A key premise of the belongingness perspective is that people are treated (and valued) differently, based on race/ethnicity, within the same setting. Likewise, the belongingness perspective has roots in social capital theory, particularly building off of the concept of "bonding capital" (Putnam, 2000). Same-group peers have been theorized to operate as a form of bonding capital (Johnson et al., 2020; Lee & Klugman, 2013) or connections made with similar others; such connections provide psychosocial support such as safety and feelings of belonging (Putnam, 2000). Thus, this theory posits that greater diversity in a setting is beneficial to the extent that it provides opportunities for *same*-race/ethnicity relationships and support for individuals from racial-ethnic minority groups.

The belongingness perspective evokes disparity diversity in that it conceptualizes racial-ethnic diversity as difference in power, prestige, and status due to inequities baked into the

system. Specifically, the belongingness perspective posits that diversity (conceptualized in this perspective as an increased presence of minoritized students) affords increased access to resources (i.e., same race peers) that provide positive psychological support to buttress against the negative consequences caused by structural inequities. This perspective may be particularly applicable for racially minoritized youth who are more likely than White students to face racial discrimination from school-based peers, teachers, and other school staff (Peguero et al., 2015; Seaton & Yip, 2009). An increase in the number of same-race peers creates greater opportunity for students of color to relate with peers who may have a similar background and may better understand racial discrimination experiences than White peers (DeCuir-Gunby et al., 2012; Tatum, 2017). Further, same-race peers are key supports in the developmentally normative process of racial identity development (Rivas-Drake et al., 2017; Williams et al., 2012) that is particularly protective and promotive for marginalized youth (Kiang et al., 2010).

Resource Concentration Perspective

The resource concentration perspective hypothesizes that as diversity increases, academic outcomes improve due to a concentration of social and structural resources that catalyze academic growth (Bankston & Caldas, 1996; Coleman et al., 1966; Goldsmith, 2011; Hopson, Lee, & Tang, 2014). Underlying this perspective is the idea that people have differential access to valued social assets and resources, resulting in differential power and status. For instance, in settings such as classrooms and schools, due to a long history of racism and oppression in the US, valued academic resources are concentrated among White students (Bonilla-Silva, 1997; García Coll et al., 1996; Yosso, 2005). Like the belongingness perspective, the resource concentration perspective draws on the social capital literature, specifically building off of the concept of bridging capital. Cross-group peers have been theorized to operate as a form of

bridging capital (Johnson et al., 2020; Park & Bowman, 2015) because cross-group peers provide access to resources and social assets to which one might not typically have access (Putnam, 2000).

Similar to the belongingness perspective, the resource concentration evokes disparity diversity because it acknowledges how differences in power, prestige, and status are tied to racial-ethnic background and may be particularly applicable for racially minoritized youth. White students, as a result of centuries of racism, have access to academic capital at higher rates than Black, Latinx, and Native students (Bonilla-Silva, 1997; Merolla & Jackson, 2019). Not only are White students more likely to be in school and classroom settings that are greater resourced (Levin, 2007; Loeb et al., 2005; Orfield & Lee, 2004), they themselves possess the valued academic capital such as who is perceived as academically inclined (Yosso, 2005). For example, in a study of racially-ethnically diverse classrooms White and Asian students were more likely to be sought after for academic support by their peers than Black and Latinx students (Molloy et al., 2020). In another study, Latinx, Black, and Native youth in ethnically diverse peer groups, that included White students, were more likely to be rated higher by their teachers in terms of academic competence (Williams & Hamm, 2017). Taken together, these studies suggest that because there is a disparity in how academic capital is distributed, and when minoritized students interact with White students they may be able to access some of the academic capital that is valued in US schools.

Conclusion: Social Processes (in Context) Catalyze the Benefits of Racial-ethnic Diversity

A common theme across the four theoretical perspectives described above is that social processes drive the desired change. Intimate interactions spark cognitive dissonance and growth in perspective and cognitive ability according to the intergroup contact hypothesis and cognitive

dissonance perspective. Similarly, social connections to others provide both psychosocial and instrumental resources that facilitate positive outcomes according to the belongingness and resource concentration perspectives. While it may be easy to assume that capital can be fostered by just being in the same setting, such as a classroom or a school building, capital can only be truly accessed through social connection (interactions & relationships; Adler & Kwon, 2002; Bebbington, 2007). Scholars across fields and perspectives agree that to better understand how racial-ethnic diversity impacts outcomes, there needs to be a focus on the proximal processes that occur within the diverse setting (Bowman, 2013; Brown & Juvoven, 2018; Hewstone, 2015; Stark et al., 2015; Williams & Hamm, 2017). Therefore, when examining the effects of diversity on academic and social outcomes, the mediating social interactions need to be considered and accounted for.

Tseng and Seidman's (2007) systems framework for understanding social settings further supports the importance of social processes and highlights the role of operationalizing social interactions at the setting level. This framework conceptualizes social processes as a setting level construct and posits that social processes, such as social interactions, are the key catalysts for positive change in diverse settings. According to Tseng and Seidman, social settings are comprised of resources (human, economic, physical, temporal), the organization of those resources, and social processes (transactions between two or more groups). Setting-level structural diversity (e.g., compositional diversity), can be considered a setting-level resource; however, "resources themselves are insufficient to change" outcomes (Tseng & Seidman, 2007, p. 219). Instead, it is *through social processes* that resources become effective change agents. For example, a top tier curriculum (i.e., resource) is not effective without high quality teacher-student instructional interactions (i.e., social processes). Likewise, simply having a diversity of

individuals (i.e., resource) in the same setting is not guaranteed to result in positive academic and social outcomes (Hewstone, 2015); instead, positive social interactions (i.e., social processes), as highlighted by the four theoretical perspectives described above, are key to unlocking the benefits of racial-ethnic diversity. While positive social processes remain the key catalyst for positive change across the four theoretical perspectives, it is important to keep in mind the social conditions of the setting because those conditions impact the nature and structure of social interactions.

Operationalizing The Social Processes That Catalyze Diversity

Limitations of Setting-level Measures of Racial-ethnic Diversity

In research that examines the benefits of racial-ethnic diversity, measures of compositional diversity such as Simpson's (1949) Diversity Index are often used (Budesco & Budesco, 2012). Compositional measures recognize racial-ethnic diversity as a setting-level construct (i.e., diversity is contingent on the composition of the whole and not any individual piece). When paired with the four theoretical perspectives described above, compositional or setting-level measures of racial-ethnic diversity *assume* that positive interactions are present in the setting. However, positive interactions are not guaranteed (Hewstone, 2015). For example, re-segregation and negative contact are both considered "enemies of contact" (Hewstone, 2015, p.432). Re-segregation can take the form of the prevalence of academic tracking along racial lines, which creates segregation within the school building throughout the day (Ford & King, 2014; Hopkins & Garret, 2010). Negative contact refers to things such as racial bullying (Peguero & Williams, 2013; Southern Poverty Law Center, 2016).

Addressing the limitation that positive interactions are not guaranteed, and acknowledging the importance of social processes in catalyzing the benefits of diversity, some

scholars have highlighted the need to measure compositional diversity at the classroom level instead of at the school level (Engels et al., 2020; Rucinski et al., 2019) as proximal processes of intergroup contact are better captured at the classroom-level. In other words, students from different racial-ethnic backgrounds are more likely to interact if they are in the same classroom as opposed to the same school. In general, more racially-ethnically diverse settings are associated with an increase in cross-group friendships (Bagci et al., 2014; Bowman, 2013; Echols & Graham, 2013; Joyner & Kao, 2000). Yet, the "enemies of contact" still remain at the classroom level; classroom interactions are not guaranteed to be racially-ethnically integrated. Indeed, studies of linguistically diverse classrooms exhibit a range of linguistic integration across the classrooms in the sample —from highly integrated to highly segregated (Kibler et al., 2019)— and negative peer interactions do occur within classrooms (Neal & Cappella, 2012; Serdiouk et al., 2015).

Limitations of Individual-level Measures of Racial-ethnic Diversity

Other scholars have focused exclusively on measuring individual level interactions and relationships. For example, researchers have explored how cross-race friendships, indicating close relationships and repeated interactions in racially-ethnically diverse settings, predict positive academic and social outcomes. A study of 6th graders showed that those who ate lunch with a cross-race peer were more likely to earn higher end of year GPAs and received higher ratings on teachers' academic expectations (Lewis et al., 2018). Similarly, the nomination of cross-race friends is linked to positive intergroup attitudes (Bell et al., 2019; Chen & Graham, 2015) and the quality of cross-race friends is associated with social outcomes (Bagci et al., 2014; Knifsend et al., 2018; Knifsend & Juvonen, 2017; Rastogi & Juvonen, 2019). In one study, while cross-race friendships were associated with outgroup attitudes, cross-race friendship stability

predicted outgroup attitudes above and beyond just measures of friendship (Rastogi & Juvonen, 2019). Mapping on to the theoretical perspectives described above, these findings suggest that it is the quality and type of interaction, more so than contact or exposure, that explains why diversity is associated with positive outcomes.

While individual level measures of social processes capture the presence and potentially the nature of positive social interaction, individual level measures ignore how social processes, especially as they relate to the classroom racial-ethnic diversity, are a setting level phenomenon (Tseng & Seidman, 2007), dependent on who is in the setting. Although measures of individual-level relationships and interactions address the need to operationalize the specific social processes theorized to catalyze change in diverse settings, they do so at the cost of capturing the setting-level nature at which these social processes reside.

Leveraging Social Network Analysis to Study the Benefits of Racial-ethnic Diversity

Increasingly there has been a call to utilize social network analysis (SNA) in the study of diverse settings (Clarke & Antonio, 2012; Harrison & Klein, 2007; Hewstone, 2015). Social network analysis is "a distinct research perspective" that is based on "an assumption of the importance of relationships among interacting units" (Wasserman & Faust, 1994, p. 4). A basic assumption of social network analysis is that actors (i.e., in this case students) operate within a connected social system, and that that system and the organization of that system, more so than individual attributes, influences perceptions, beliefs, decisions, and actions (Knoke & Yang, 2008; Wasserman & Faust, 1994). We argue that SNA[1] is well suited to operationalize the social processes necessary to catalyze racial and ethnic diversity because SNA can capture both the

[1] While SNA is well suited for the study of racially-ethnically diverse schools based on the theoretical perspectives we have highlighted here, it is important to note that SNA is a complex methodological perspective that is able to answer many different questions with many different measurement and analytic tools (see Robins, 2015; Wasserman & Faust, 1994 among others for an overview.)

overall network structure and the nature of social processes highlighted in the four theoretical perspectives described above (Robins, 2015).

While there has been an increase in the number of studies that utilize statistics drawn from data collected using peer nomination methods (see below for more detail on peer nomination methods; Crosnoe et al., 2013; Graham et al., 2014; Kawabata & Crick, 2011, 2015; Munniksma & Juvonen, 2012; Ryabov, 2011b), there are few studies that use a whole network perspective to investigate the benefits of racial-ethnic diversity on students' social and academic outcomes (see Molloy Elreda et al., under review; Wilson et al., 2011 for exceptions). Using a whole network perspective has the advantage of allowing researchers to operationalize peer relationships and interactions at the setting level, thus addressing the limitations of commonly used methods (i.e., compositional indexes or individual-level interactions). Next, we discuss what SNA is and how it can be leveraged in the study of racially-ethnically diverse schools and classrooms, particularly in relation to the four theoretical perspectives described above (i.e., intergroup contact, cognitive dissonance perspective, belongingness, and resource concentration).

The Nature of Relationships and Interactions in Diverse Settings

Decisions about the nature of the relationships or interactions are made at the time of data collection (Robins, 2015). Network data is most commonly collected from student report data – either through peer nominations or social cognitive mapping (Cairns et al., 1985; Gest et al., 2003). Both methods allow researchers to ask about a range of different relationships and interactions that are embedded in networks. Relationships and social processes are complex and multi-dimensional. In network terms you can think about the difference between a *relationship*, such as a friend, colleague, relative, etc. all of which have many different facets but represent a

certain type of connection and *relational ties* which refer to the different contents of social connection such as collaboration, advice giving, disliking etc. (Robins, 2015).

In particular, different types of prompts elicit information about different types of interactions, relationships, and networks. Prompts can include items such as "who are your best friends [in class/school]", "who do you work with [in class/school]", and "who do you hang out with [in class/school]". The mechanism behind why diversity is theorized to catalyze change should drive the design of these questions – for example, if cognitive dissonance perspective or the resource concentration perspective is being tested, it might make sense to ask about who students work with or who they go to for help. On the other hand, if close relationships are the theorized mechanism of change (as in the intergroup contact hypothesis or the belongingness perspective) it might make sense to ask about close friends or who students spend time with them either inside or outside of the classroom.

Social Network Metrics that Operationalize the Structure of Relational Ties

Next we describe select network metrics that could be used to operationalize the structure of the relational ties within the classroom. In particular, to operationalize the mechanisms of change laid out in the four theoretical perspectives described above, we are interested in network metrics that capture how integrated a classroom is across racial-ethnic groups. To best meet this goal, we discuss network integration and network density, including what each network statistic actually measures, and the benefits and downsides of each of them.

Network Integration. Network integration (or more commonly captured in SNA as the inverse, network segregation) captures how likely individuals in a given setting are to form connections with individuals who have similar or different attributes (Bojanowski & Corten, 2014). Several different metrics have been proposed to capture network integration, or its

inverse, network segregation (see Bojanowski & Corten, 2014 for an overview and the benefits of a range of segregation statistics). However, for brevity we focus on two – Freeman's Segregation Index (Freeman, 1978) and the odds ratio of a cross-race X social tie cross-tabulation adapted by Moody (2001).

Freeman's Segregation Index (Freeman, 1978) measures how likely it is for individuals from two different groups to be connected. The Segregation Index is calculated as

$$Segregation\ Index = \frac{expected\ \#\ of\ cross\ group\ ties - actual\ \#\ of\ cross\ group\ ties}{expected\ \#\ of\ cross\ group\ ties - minimum\ \#\ of\ cross\ group\ ties}$$

The Segregation Index then produces a statistic between zero and one, where higher numbers indicate increased levels of segregation. If the expected number of ties is less than the actual number of ties then the segregation index equals zero. If the segregation index is multiplied by -1, it can then be interpreted where higher values indicate a more integrated setting. One limitation of Freeman's Segregation Index (Freeman, 1978) is the statistic is only able to account for two groups, so it may be limiting for questions around racial-ethnic diversity.

The odds ratio, adapted by Moody (2001), measures preference for cross-group ties relative to same-group ties, within the context of the available opportunities for same- and cross-group ties. While this statistic uses the language of preference, the odds ratio operationalizes the heart of what integration attempts to measure – how likely individuals in a given setting are to form connections to other individuals with similar or different attributes (Bojanowski & Corten, 2014). The odds ratio is a particularly useful statistic for measuring racial and ethnic integration in schools and classrooms in the US because it allows for the possibility of multiple groups (Moody 2001, Serdiouk et al., 2019).

The odds ratio can be calculated at both the individual and setting level. For our specific purposes in this paper we will talk exclusively about how the odds ratio is calculated at the setting level. At the setting level the odds ratio is calculated as:

$$odds\ ratio = \frac{\#\ of\ cross\ group\ ties * \#\ of\ same\ group\ ties\ NOT\ made}{\#\ of\ same\ group\ ties * \#\ of\ cross\ group\ ties\ NOT\ made}$$

The natural log can be taken of the odds ratio to ease interpretation. The natural log of the odds ratio ranges from -∞ to ∞, such that positive values indicate a preference for cross-group ties, reflecting a more integrated settings, and negative values indicate a preference for same-group ties, or more segregated settings.

This odds ratio approach has been used in studies looking at what setting level features are associated with cross-group integration. For example, in one study of elementary school classrooms, higher levels of teacher emotional support were associated with greater cross-race integration, specifically among 5th grade boys (Serdiouk et al., 2019). In another study of high schools, racial heterogeneity and integrated school organization (less academic tracking, more grade level segregation, & integrated extracurricular participation) were positively associated with how racially-ethnically integrated the peer friendship network was at the school level (Moody, 2001). In a study examining linguistic diversity in classrooms, greater growth in classroom "linguistic integration" (i.e., between EL students and non-EL students) was associated with greater participation in the classroom and greater standardized test scores for all students (Molloy Elreda et al., under review).

Network Density. Network density is one way of operationalizing the level of connection among individuals within a given setting, such as within a school or classroom (Robins, 2015). Specifically, network density represents the total number of existing connections in a given

setting as a proportion of the total number of possible connections within that setting (Wasserman & Faust, 1994). Thus, network density is calculated as:

$$Density = \frac{\#\ of\ ties}{\#\ of\ students * (\#\ of\ students - 1)}$$

Higher values indicate greater density, or greater interconnectedness, within the network. When the intergroup contact hypothesis is applied, diverse classrooms with higher levels of density in friendship networks are likely to have more cross-group relationships, which are thought to build empathy and perspective taking than classrooms with less dense networks. On the other hand, when the cognitive dissonance perspective is applied classrooms with higher levels of network density in collaborative work relationships would indicate an increase in the types of interactions that may create cognitive dissonance and expand cognitive processing. For example, in study of middle and high school students, friendship density at the school level was associated with higher GPAs (Delgado et al., 2016).

One limitation in using network density is that the denominator is contingent on the number of students in the setting and therefore, the statistic is susceptible to changes in group size; thus, one should be cautious when comparing across groups of different sizes (Gest & Rodkin, 2011). Further, network density is unable to account for the amount of cross-group interaction occurring within the setting. The intergroup contact hypothesis, cognitive dissonance perspective, and the resource concentration perspective posit that positive engagement with people from a racial-ethnic background different than your own is what leads to positive change, not just increased interaction in general. A classroom could have relatively high network density but still be segregated along racial-ethnic lines. However, as network density increases – as the actual number of ties becomes closer to the possible number of ties (# of students * (# of students -1)), the odds of this statistic capturing an increase in cross-group ties becomes more likely.

Further, unlike the integration statistics mentioned above, using density to represent increased cross-group interactions does not force the researcher to select the bounds of racial categorization, which means that individuals who identify with a group that do not have large enough representation or a group that do not fit neatly into the four largest pan-ethnic group in the US are less likely to be excluded from analyses.

Social Network Metric that Operationalize Structure of the Social Context

As mentioned above, though social interaction is the primary catalyst for positive change in racially-ethnically diverse settings, the setting level conditions in which social interactions occur need to be attended to as they impact the structure and nature of the social interactions. Social network metrics may also be utilized to operationalize some setting level conditions. In particular, we explore how network equity can be leveraged to operationalize the setting level condition of equal status.

Network Equity. Network equity examines the distribution of ties within a given setting to determine if ties are evenly distributed (Capella et al., 2013). Network equity allows us to explore whether or not a classroom is one where a few students account for the majority of connections or where all students feel equally connected - or at least connected to an equal number of actors.

Network equity is the coefficient of variation of degree centrality (degree centrality refers to the number of ties an individual receives) and as such is computed by first calculating the degree centrality of each individual in the setting (note: Cappella et al., 2013 use a normed degree centrality that accounts for the total number of ties available in the classroom; Borgatti et al., 2012). The mean and standard deviation of degree centrality are then used to calculate network equity for each setting:

$$Social\ Network\ Equity = \frac{Degree\ Centrality\ SD}{Degree\ Centrality\ M}$$

When the inverse of the above calculated social network equity is taken (by multiplying by -1), the statistic can be interpreted where higher numbers indicate greater social network equity.

Though the network equity statistic does not take in to account demographic features (i.e., equal distribution across race/ethnicity), the network equity statistic can provide information about the overall distribution of ties of the network. Equally distributed classroom ties have been found to impact social and academic outcomes. For example, 5th grade classrooms with higher network equity scores were more likely to have more behaviorally engaged students in the spring (Capella et al., 2013). Likewise, in a sample of 6th-8th grade students, classrooms with across year growth in network equity were associated with growth in teacher rated academic participation (Molloy Elreda et al., under review).

Hurdles to Implementing SNA in the Study of Diverse Schools and Classrooms

Overall, social network analysis answers the call to better operationalize the processes that make diversity beneficial for all students. SNA allows for questions to be asked about a range of different relationships and interactions and for the measurement of the structural/setting level nature of those relationships. Yet, as with all methodology, there are still limitations to understand before employing SNA in the study of racially-ethnically diverse schools and classrooms.

First, if the network is the unit of analysis, data from multiple different networks is needed to run robust statistical analyses. There is debate in the field about the minimum threshold for the number of groups (clusters) needed to conduct a multilevel model (MLM) analysis (Huang, 2018a) with 30 (Kreft, 1996; Toninandel et al., 2014) and 50 (Maas & Hox, 2005) being widely cited as the minimum number of groups needed to effectively run an MLM.

Collecting school-wide data from 50, or even 30, schools is a major undertaking both in terms of financial resources as well as time. While changing the setting of interest to classrooms reduces the data collection burden, collecting data from as many as 30 classrooms still requires significant financial and human resources. However, there is evidence to suggest MLMs could be applied with as few as 10 groups (Bell et al., 2014; Huang, 2018b). See Huang, 2018a for more details.

Similarly, SNA requires a high within-setting level response rate to gather a complete picture of the network (Borgatti et al., 2013). Standard recommendations suggest at least a 60% response rate in peer nominations studies to effectively cover the whole network (Marks et al., 2013). This has been a limitation identified with both peer nominations and social cognitive mapping data collection methods (Neal & Neal 2017; Neal et al., 2021). Cognitive social structures, a process of having students identify every individuals' connections, has been recommended as a way to minimize issues of missingness (Krackhardt, 1987; Neal, 2008) but might seem burdensome to students. In addition, when possible, providing incentives, following up with participants, and potentially employing opt-out consent processes may be an effective strategy for ensuring higher response rates (Neal & Neal, 2017).

A third challenge is that race and ethnicity are not discrete categories that lend themselves well to quantitative exploration (Helms et al., 2005; Kaneshiro et al., 2011). For example, the different integration indices described above require researchers to draw distinct racial-ethnic lines based on checked boxes in demographic surveys. Response to those demographic questions are then expected to represent shared experience and understanding. While examining differences across large pan-ethnic groups does reasonably provide a proxy for some shared racial experience and is important for gaining a basic understanding of certain social

processes, future research needs to move towards being able to consider the heterogeneity within racial-ethnic groups (Celious & Oyserman, 2002; Krogstad & Noe-Bustamante, 2020; López et al., 2017), the role of intersectionality in identity formation and how that relates to lived experience (Bowleg, 2008; Bowleg & Bauer, 2016), and the large number of people not included when using only the largest pan-ethnic groups in the U.S. (i.e., multi-racial youth, Echols & Graham, 2020; Mauer et al., 2020; Nishina & Witkow, 2020; Native American youth, Conger et al., 2020; NCAI Policy Research Center, n.d.). Further, there is little value in looking at racial-ethnic group differences without considering the sociohistorical context and current oppression, racism, and power dynamics as they mediate peer processes (Fine, 2012). While SNA provides opportunities for the investigation of social structure and context to be embedded in the methodology, the work still falls on the researcher to contextualize the greater macro-context in which schools and classrooms reside. Future work needs to include a critical and contextual lens, especially when making group comparisons.

In addition, SNA cannot holistically account for the ways the racial and ethnic stratification of the United States, initiated by racism and White supremacy, impacts the social processes occurring in the school setting (García Coll et al., 1996; Williams, 2018). Despite this contextual reality, the mechanisms of change outlined by two of the commonly applied theoretical perspectives about the benefits of diversity – intergroup contact hypothesis and the cognitive dissonance perspective - assume that all people in the setting are treated equally (Benner & Crosnoe, 2011; Graham, 2018; Pettigrew, 1998; Williams & O'Reilly, 1998). In other words, according to intergroup contact hypothesis and the cognitive dissonance perspective, if social position, and social and cultural capital, were equally valued across all students then the benefits of diversity should be equally distributed. In contrast to the intergroup contact

hypothesis and the cognitive dissonance perspective, the two social capital perspectives do acknowledge the unequal distribution of education system resources – however they still rely on similar social and academic based interactions. While SNA can contextualize the distribution of specific social resources (i.e., through metrics such as network equity) the ways in which racism permeates setting level (i.e., classroom) interactions is complex and multifaceted. Ultimately, contextualizing and embedding our research in the realities of racism are necessary for ensuring our theories and our measurement accurately map onto lived experience.

Finally, it is difficult to ignore that while we are writing this paper the COVID-19 pandemic has disrupted what racially-ethnically diverse schools and classrooms look like including what social interaction within those settings looks like. Students may be in a hybrid or online school setting which may limit the in-person interaction and relationship building that we have discussed as key to making diversity beneficial. Further, if students are attending in person school, physical distancing measures may limit, or at the very least alter, what social time and group work time looks like in diverse schools and classrooms. Future research may need to adapt to account for how students are interacting in diverse online settings. The same kind of theoretical mechanisms described in this paper may or may not be as applicable in an online setting or an in person setting dominated by physical distancing. Finally, it is important to note that the pandemic may be quickening the re-segregation of schools, which was already occurring pre-2020 (Green, 2020).

While this paper focuses on the potential benefits of racial-ethnic diversity, diversity alone is not the end goal nor is it alone the means to an end. Diversity is, instead, increasingly becoming a setting-level reality that we cannot and should not ignore. As it stands, diversity is a setting level reality that can either benefit some people at the expense of others or it can be

thoughtfully cultivated and supported in a way that benefits all people. By having a clear understanding of the mechanisms that make diversity beneficial, as well as the mechanisms that make diversity harmful, and the specific ways to measure such mechanisms, scholars and educators alike can better support all students in racially-ethnically diverse schools and classrooms.

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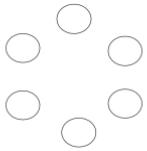
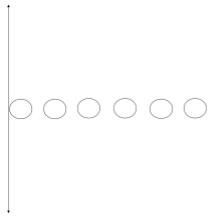
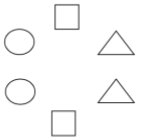
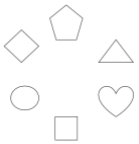
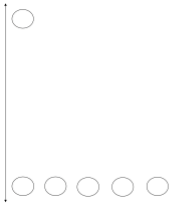
Table 1. *Summary and Visual Depiction of Diversity Type*

Definition	Separation Diversity	Variety Diversity	Disparity Diversity
	Differences in values, beliefs, attitudes	Differences in knowledge, skill, ability	Differences in power, prestige, status
Minimum Diversity			
Moderate Diversity			
Maximum Diversity			

Note: Adapted from Harrison and Klein (2007)

Table 2. *Summary of Mechanisms of Change, Diversity Type, and Network Type*

Mechanism of Change	Definition	Intergroup Contact Hypothesis	Cognitive Dissonance Perspective	Belongingness Perspective	Resource Concentration Perspective
		Close relationships and positive interactions in diverse settings	Access to more ways of thinking and problem-solving increase cognitive processes	Close relationships with same race peers, particularly for minoritized youth	Access to cross race peers, particularly for minoritized youth
	Target Outcomes	Reduced prejudice	Academic outcomes	Psychological safety	Academic outcomes
Diversity Type		Separation Diversity	Variety Diversity	Disparity Diversity	Disparity Diversity
Example Network Prompts		-“who are your best friends [in class/school]?” -“who do you hangout with [in class/school]?”	-“who do you work with [in class/school]?” -“who do you go to for help in class?”	-“who are your best friends [in class/school]?” -“who do you hangout with [in class/school]?”	-“who do you work with [in class/school]?” --“who do you go to for help in class?”

The Transformative Potential of Classroom Racial-Ethnic Diversity: Using Social Network Analysis to Investigate How Diversity is Associated with Academic Outcomes

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Abstract

In racially-ethnically diverse settings, interactions with people from a different background, with different ways of thinking, different background knowledge, and different modes of problem-solving are theorized to promote cognitive growth, which in turn impacts students' academic outcomes. Integrated classrooms – classroom with more cross-race academic helping connections – were hypothesized to be associated with academic outcomes. The current study leverages social network metrics (network integration and network density) and multilevel models to explore how cross-group help-seeking interactions are related to academic outcomes in racially/ethnically diverse middle school classrooms. Counter to expectations network density was negatively associated with academic outcomes; while the pattern of the relationship between network integration and academic outcomes was inconclusive. Implications for future research are discussed.

Keywords: Social Network Analysis; Diversity; Early Adolescence, Social Interactions

The Transformative Potential of Classroom Racial-Ethnic Diversity: Using Social Network Analysis to Investigate *How* Diversity is Associated with Academic Outcomes

School racial-ethnic diversity has long been a part of the national conversation related to civil rights, opportunity gaps, and realizing the full promise of a democratized society (Brown v Board, 1954; Joffe-Walt, 2020). The argument has been made, with evidence to support it, that racial-ethnic diversity increases academic outcomes for all youth (Ayscue et al., 2017; Gurin et al., 2002); however, other evidence shows school and classroom racial-ethnic diversity is also negatively associated with academic outcomes (Linn & Welner, 2007; Thijs & Verkuyten, 2014; Yip et al., 2019). These mixed findings suggest diversity has the potential to be "transformative" (King, 2016) yet there is still much to be understood about the conditions (Allport, 1954) and processes (Graham, 2018) that need to be in place for school racial-ethnic diversity to reach its transformative potential.

While the process of school desegregation, as well as the creation and protection of racially-ethnically diverse schools, has always been fraught, including violently so (Equal Justice Initiative, 2014; Gellerman, 2014), the last two decades have seen rapid re-segregation of schools and legal attacks on initiatives designed to support school diversity (Green, 2020; Reardon et al., 2012; Stout v. Jefferson County Board of Education, 2017; Tatum, 2017). As a result, the school re-segregation landscape has prompted scholars to reflect upon and reevaluate the role of empirical research in supporting the promise of diverse school settings as well as the academic opportunities and experiences of all students. For example, some scholars have attributed the contradictory findings to a lack of clarity in conceptualizing (Harrison & Klein, 2007) and operationalizing (Budesco & Budesco, 2012) the construct of diversity. Other scholars have attributed the mixed findings to a dearth of research aimed at understanding *how* diversity is

related to positive outcomes (Graham, 2018). In response, Johnson and colleagues (in progress) identified four theoretical perspectives that were commonly utilized in studies examining the positive benefits of racial-ethnic diversity: intergroup contact hypothesis, the cognitive dissonance perspective, resource concentration perspective, and belongingness perspective.

Common to each theoretical perspective is the idea that positive social interaction in diverse settings is the key mechanism of change (Johnson et al., in progress). Yet, studies of diverse schools and classrooms often use compositional measures of diversity as the core predictor (Budesco & Budesco, 2012) which assume but do not guarantee interaction, let alone positive interaction (Hewstone, 2015). As such, some scholars suggest social network analysis (SNA) be leveraged in diversity research to operationalize the social interactions that are theorized to make racial-ethnic diversity beneficial, (Clarke & antonio, 2012; Johnson et al., in progress; Harrison & Klein, 2007; Hewstone, 2015) because SNA affords an investigation of both the nature and structure of social interactions (Robins, 2015).

The current paper utilizes SNA to explore how classroom racial-ethnic diversity is associated with academic outcomes. In particular we draw on and test the cognitive dissonance perspective. Below, we describe this perspective and its limitations in relation to understanding the broader social context in which interactions occur. In addition, we discuss social network metrics that can be leveraged to study the relational context in diverse classrooms. Finally, we discuss how this line of inquiry is particularly relevant in a middle school setting.

Literature Review

How is Diversity Related to Positive Academic Outcomes?

The Cognitive Dissonance Perspective

The cognitive dissonance perspective draws on the Piagetian concept of cognitive disequilibrium (Piaget, 1971). Disequilibrium, also referred to as cognitive dissonance, is when new information is discrepant with one's existing understandings (i.e., cognitive schema). This creates the need to either assimilate (i.e., modify/change new information to fit existing schema) or accommodate (i.e., modify existing to schema to reconcile new information), which results in cognitive growth (Piaget, 1971). Research suggests that it is the interaction and collaboration that occurs in diverse settings, not just the presence of diversity in a setting, that sparks growth. In racially-ethnically diverse schools and classrooms, it is theorized that when students are in diverse settings they are exposed to different ways of thinking, different background knowledge, and different modes of problem solving that then serve to expand student's cognitive skills which, in turn, improve academic outcomes (Benner & Crosnoe, 2011; Gurin et al., 2002).

Similar arguments have been applied to the business context. Management researchers theorize that more diverse working groups increase problem solving perspectives and increase available information which ultimately leads to increased problem-solving ability and increased creativity (Williams & O'Reilly, 1998). For example, in a study of adults in racially-ethnically diverse workplace teams, greater team network density and greater team network integration were both associated with greater team productivity (Reagans & Zimmerman, 2001). It seems likely those same processes are occurring within the classroom as well. In sum, positive and collaborative interactions with individuals from different backgrounds are thought to spark cognitive growth.

Notably, it is the *interaction* with people from different backgrounds, not just a collection of people from different backgrounds, that leads to cognitive growth. Despite this, research tends to use measures that capture the racial-ethnic composition of settings, such as Simpson's (1949)

Diversity Index, as a core predictor of academic outcomes (e.g., Benner & Crosnoe, 2011; Benner & Yan, 2015; Rjosk et al., 2017). While more diverse settings are likely associated with an increase in cross-group interactions (Bagci et al., 2014; Bowman, 2013; Echols & Graham, 2013; Joyner & Kao, 2000), compositional diversity does not guarantee contact. Further, compositional measures do not guarantee the positive contact or the type of contact necessary to spark cognitive changes. For example, "enemies of contact" (Hewstone, 2015, p.432) exist in the form of re-segregation (Ford & King, 2014; Hopkins & Garret, 2010) and negative interactions (Peguero & Williams, 2011; Southern Poverty Law Center, 2016). Even at the classroom level – where some scholars argue that measuring compositional diversity is more likely to "pick up" the cross-group interactions theorized to be beneficial (Engels et al., 2020; Rucinski et al., 2019) – segregation (Kibler et al., 2019) and negative interactions (Neal & Cappella, 2012; Serdiouk et al., 2015) still exist.

Ultimately, to truly investigate *how* diversity is related to positive academic outcomes, as outlined by the cognitive dissonance perspective, there needs to be a way to operationalize both the nature of interactions that spark cognitive growth and the structure of cross-group interaction. Social network analysis meets both those needs and as such should be leveraged in the study of the benefits of racial-ethnic diversity (Clarke & antonio, 2012; Harrison & Klein, 2007; Hewstone, 2015; Johnson et al, in progress).

Operationalizing Social Interactions that Catalyze Growth in Diverse Settings

Social network analysis is a research perspective that assumes individuals operate within an interconnected social system (Wasserman & Faust, 1994). Further, SNA affords the ability to focus on the nature of social interactions and the overall structure of cross-group interaction. The nature of the social processes are captured at the data collection stage with network prompts that

illuminate the types of interactions and relationships of interest. The structure of cross-group relationships can be captured with different network metrics (Robins, 2015) – specifically statistics that measure the level of integration or the level of interconnectedness of a specific social setting may be well suited to understand the structure of interactions that catalyze the benefits of racial-ethnic diversity. Below we discuss how both decision points are important in the investigation of the change processes outlined by the cognitive dissonance perspective. In particular, we know it is the interaction with people from different backgrounds that sparks cognitive growth and therefore we need to be able to both operationalize 1) the specific nature of those academic interactions and 2) the structure of cross-group interaction.

Operationalizing the Nature of Academic Interactions. Network prompts related to who students interact with when engaging in coursework hold potential for capturing the nature of social interactions that spark cognitive dissonance. Yet there is limited exploration about the specific nature of those interactions in racially-ethnically diverse settings. Drawing from the higher education literature, there is a body of work exploring the relationship between "diversity experiences" and cognitive outcomes (see Bowman, 2010 for an overview). Diversity experiences are considered in three different buckets: 1) structural diversity (also referred to as compositional diversity), 2) informal interaction diversity – which includes frequency and quality of interactions with people from a different racial-ethnic background, and 3) classroom diversity – which refers to learning about people from a diversity of backgrounds (Gurin et al., 2002; Milem, 2003). Informal interaction diversity may provide insight into the nature of social interactions that catalyze the benefits of racial-ethnic diversity. For instance, a meta-analysis of diversity and racial bias interventions showed that a combination of learning about different groups *and* intergroup contact had a larger effect than just curriculum (Denson, 2009).

Despite the importance of social interaction in racially-ethnically diverse settings, there is limited description of the specific nature of these interactions. For example, one study examines the relationship between positive and negative "diversity interactions" and cognitive outcomes. Positive diversity experiences were operationalized using a three item, five-point scale asking students how often they engage in discussions about race in racially-ethnically diverse groups. Negative diversity experiences were operationalized using a four item, five-point scale asking students how often they have experienced negative (e.g., hurtful, tense) interactions in racially-ethnically diverse groups (Roksa et al., 2017). In a lab-based study of college students, the placement of White students in racially heterogenous discussion groups compared to racially homogenous discussion groups were used to represent the type of interaction that would be hypothesized to promote more complex thinking (antonio et al., 2004). While both of these studies begin to delineate the specific interactions that may spark cognitive growth, there is still room for greater specificity in both conceptualizing and operationalizing the nature of social interactions that are theorized to catalyze the benefits of racial-ethnic diversity.

To think about the specific nature of cross-group interactions we turn to the literature on help seeking. Though there is limited empirical investigation of the nature of helping seeking interactions in diverse settings (Ryan & Shim, 2012), the frame of help seeking may provide a framework for conceptualizing and operationalizing the specific nature of interactions that may spark cognitive growth in diverse settings. Help seeking is often delineated into two types: 1) expedient help seeking – asking for the answer and 2) adaptive help seeking –asking clarifying questions about the problem-solving process (Karabenick, 2003; Ryan et al., 2005). We expect adaptive help-seeking behavior to capture the nature of interactions that spark cognitive dissonance and cognitive growth because it involves students' sharing their thought processing.

Operationalizing the Structure of Cross-Group Interactions. Another key feature of the cognitive dissonance perspective is that the interaction occurs across difference. In order to operationalize the structure of cross-group interactions that might spark cognitive growth in racially-ethnically diverse settings we turn to network metrics. In particular we focus on network density and network integration. Network density measures the interconnectedness of individuals in a setting by dividing the total number of connections by the number of possible connections within a setting, in this case a classroom (Robins, 2015; Wasserman & Faust, 1994). Higher values indicate greater interconnectedness, so that we expect classrooms with greater network density to have more cross-group academic interaction and as a result, more positive academic outcomes.

Network integration specifically measures how much cross-group interaction is occurring compared to homogenous interaction. There are a number of statistics used to capture network integration (or network segregation; Bojanowski & Corten, 2014), in this study we utilize the odds-ratio of a cross-race by social tie cross-tabulation adapted by Moody (2001). The odds ratio measures a preference for cross-group ties (i.e., interaction or relationships) compared to same-group ties. The natural log is often taken of the odds ratio to ease interpretation so that values range from $-\infty$ to ∞, and values greater than zero indicate a preference for cross group ties (greater integration) and values less than zero indicate a preference for same group ties (greater segregation; Moody, 2001). We expect classrooms with greater network integration will be positively associated with academic outcomes.

The odds ratio is well suited for the study of racially/ethnically diverse schools, especially in the US, because it does not limit the number of groups, compared to other integration/segregation measures such as Freeman's (1978) Segregation Index (Moody, 2001;

Serdiouk et al., 2019). At the same time, the odds ratio, similar to other measures of integration, does require the researcher to define the bounds of racial-ethnic categories which may bring different challenges. For example, multiracial youth are often excluded from studies of cross-group interaction because researchers struggle to identify who youth would consider as a cross-group interaction (Echols & Graham, 2020) and youth who identify with a racial-ethnic group with small numbers, such as Native youth, are often excluded in research (NCAI Policy Research Center, n.d.). In addition, researcher-defined bounds of racial-ethnic categories ignore within group heterogeneity (Celious & Oyserman, 2002; Krogstad & Noe-Bustamante, 2020; López et al., 2017) and the role of intersectionality in the lived experience of identity (Bowleg, 2008; Bowleg & Bauer, 2016). While network density does not specifically capture cross-group interaction, a diverse classroom with relatively high network density would be assumed to have greater cross-group interaction than less dense classrooms. Therefore, network density may provide an alternative measure of cross-group interaction that does not require the researcher to set the bounds of racial-ethnic identification.

Does the Social Context Matter?

The cognitive dissonance perspective draws on the foundation laid forth in Allport's (1954) intergroup contact hypothesis, in that certain kinds of interactions in a diverse setting will spark psychological change (Gurin et al., 2002). However, key to intergroup contact hypothesis is the idea that the benefits of diversity will only be realized if four setting level conditions are met: (1) equal status, (2) common goals, (3) intergroup cooperation, and (4) support from authority figures (Allport, 1954).

Implicit in the writing about the cognitive dissonance perspective is the assumption that everyone's knowledge and ways of knowing are equally valued, appreciated, and considered.

And if the contact conditions are not met in the school or classroom it is unlikely academic interaction in diverse settings will spark cognitive dissonance, and therefore cognitive growth. Due to centuries of racial oppression and exploitation, this is often not the reality in US classrooms as resources and capital are distributed along racial/ethnic lines (Bonilla-Silva, 1997; García Coll et al., 1996). For example, in a study of racially-ethnically diverse classrooms White and Asian students were more likely to be sought after for academic support by their peers than Black and Latinx students (Molloy Elreda et al., 2021), suggesting equal status, particularly in terms of academic "expertise", may not be present in the classroom. Despite the importance of these setting level conditions, measuring them has been difficult in practice. As a result, few studies employing intergroup contact hypothesis actually examine the four necessary conditions (Pettigrew, 1998). Social network analysis may also be able to measure at least part of the social context necessary to catalyze cognitive change in diverse settings.

Operationalizing the Social Context

Network equity can be used to operationalize whether or not academic capital within the setting is equally distributed. Specifically, network equity examines the distribution of ties within a given setting (Capella et al., 2013). Network equity is the coefficient of variation of degree centrality and as such is computed by dividing the standard deviation of degree centrality – or the number of ties given or received – by the mean of degree centrality (Capella et al., 2013). When the inverse is taken (by multiplying by -1) to help ease interpretation, higher values indicate greater network equity. Classrooms with greater network equity indicate that network ties are more evenly distributed as opposed to a few students receiving a majority of the ties. As a result, we hypothesize that the pathways outlined by the cognitive dissonance perspective (greater cross-group academic interaction will lead to improved academic outcomes) will be more likely

to occur in classrooms with higher levels of network equity. Network equity does not consider how social resources are spread out across the racial/ethnic groups, however, if a classroom is both diverse and has high levels of network equity it can be assumed that there is a somewhat even dispersion of academic social resources across racial-ethnic groups.

Cognitive Growth in Racially/Ethnically Diverse Middle Schools

While research has been done on the relationship between racially-ethnically diverse settings and academic and cognitive outcomes in secondary schools (e.g., Benner & Crosnoe, 2011), a large portion of this work has been done at the college level (e.g., antonio et al., 2004; Bowman, 2010; Gurin et al., 2002) and with adults (e.g., Hawlina et al., 2017; Reagans & Zimmerman, 2001). However, environmental and developmental factors make early adolescence a key time to start exploring the social interactions within diverse settings that lead to cognitive growth. First, youth experience contextual changes as they go through the US public school system, particularly with regard to school ethnic-racial composition. Elementary schools are more likely to be smaller neighborhood schools and therefore more likely to include a higher percentage of same-race peers. As youth progress through secondary school, schools may become more integrated (Frankenberg and Orfield, 2007; Orfield, 2001) so that middle school may be some students first experience learning in a racially-ethnically diverse setting. Further, as youth enter adolescence, identity exploration becomes a key task, including ethnic-racial identity development, making race salient in new ways (Williams et al., 2012). At the same time, during middle school years, peers begin to take on more importance in youths' lives (Blakemore & Mills, 2014; Brown & Larson, 2009). Finally, cognitive changes that begin in early adolescence mean youth are able to engage in more complex problem solving and able to hold differing perspectives (NASEM, 2019). Taken together, early adolescence is an ideal time to be studying

how racially-ethnically diverse settings are associated with positive academic and cognitive outcomes.

The Present Study

The present study draws on data from two racially-ethnically diverse middle schools to explore *how* racial-ethnic diversity is associated with academic outcomes. First, we test to see if the racial-ethnic composition of the classroom is positively (or negatively) associated with academic outcomes. Because social interaction in diverse settings, not just the presence of a diversity of individuals, catalyzes the benefits of racial-ethnic diversity (Johnson et al., in progress), we hypothesis that the racial-ethnic composition of a classroom will not be associated with academic outcomes. Second, we explore whether or not academic social interactions, as measured by network density and network integration, will positively predict academic outcomes for students in racially-ethnically diverse classrooms. We hypothesize that classrooms with academic help networks that are more densely connected as well as classrooms with academic help networks that are more integrated are more likely to be associated with positive academic outcomes because, per the cognitive dissonance perspective, it is intellectual interaction with people from different backgrounds that spark cognitive dissonance and lead to cognitive growth (Gurin et al., 2002). Finally, we explore how the social context, as measured by network equity, moderates the relationship between academic interactions and academic outcomes. We hypothesize that classrooms with a more equitable distribution of academic ties are more likely to experience the positive relationship between increased cross-group academic interaction and positive academic outcomes because of the setting-level condition of equal status that is necessary for these social and cognitive processes to occur (Allport, 1954).

Method

Participants and Procedures

Data come from 39 sixth, seventh, and eighth grade Math and English Language Arts (ELA) classrooms in two racially-ethnically diverse middle schools located in the mid-Atlantic region of the United States. The schools are two of six middle schools in a countywide school district, recruited to meet the linguistic diversity needs of the larger project. For the present analyses, we included classrooms with greater than 60% student consent rates (based on generally accepted recommendations to achieve reliable peer nomination data; Borgatti et al., 2006; Marks et al., 2013). The resulting sample included 640 consented students (48% female) across 39 classrooms with an average student consent rate of 84%, ranging from 62.5% to 100%. The sample included 17 6th grade classrooms, 11 7th grade classrooms, and 11 8th grade classrooms; 20 were ELA classrooms and 19 were Math classrooms. Five percent of the sample identified as Asian, 20% identified as Black, 29% identified as Latinx, 9% identified as multiracial, 27% of the sample identified as White, and the remaining 10% identified as a race other than what was specified in the demographic surveys.

Data were collected in the fall approximately one month after the beginning of the school year; in the winter immediately following the winter break; and in the spring during the last month of the school year. At each measurement occasion, online surveys were completed via Qualtrics by students and teachers. Student surveys focused on network items; in addition, students were asked to complete a demographic survey during the fall data collection period. Students completed the surveys during their Math or ELA class period. Teachers completed their own surveys at a time that was convenient to them after the student surveys were administered. Teacher surveys asked about teacher demographics, teaching experience, and academic ratings for each consented student in the class of interest.

Measures

Social Network Items

A series of social network survey items, administered at each time point, asked students to select peers in their class with whom they have certain types of relationships and interactions. Students were allowed to select as many or as few peers as they wished from their class roster. For the present study, we focused on the following item: "Who do you talk to when you're trying to get work done in this class? (For example, you ask them for help?)." This item was adapted from commonly used items in studies on help-seeking behavior (Moody et al., 2011; Ryan & Shim, 2012). Throughout the paper, when referencing this item and the network statistics derived from it we will refer to it as the "help seeking network". From this item network density, network integration, and network equity were calculated to operationalize setting level descriptors of the help seeking network. For each network statistic the average was taken across the fall, winter, and spring timepoints to represent the distribution of help seeking relationships indicative of the classroom throughout the year.

Network Density. Network density was calculated as the total number of ties within the classroom as a proportion of the total number of possible ties within the classroom (Wasserman & Faust, 1994). Higher values indicate greater density, or greater interconnectedness, within the help seeking network.

Network Integration. Network integration was calculated as the natural log of the odds that students nominated cross-race peers relative to the odds that they nominated same-race peers (Moody, 2001). The odds ratio was calculated for each classroom using the following formula:

$$\alpha = AD/BC$$

Where A = the total number of same-race nominations made in a given classroom, B = the total number of cross-race nominations made in the classroom, C = the number of same-race peers that participating students in the classroom did *not* nominate, and D = the number of cross-race peers that participating students in the classroom did *not* nominate. Then the natural log of α was calculated to account for the highly skewed nature of α. Values of the natural log of α range from -∞ to ∞. The natural log was multiplied by -1 to ease interpretation. Negative values represented a network-level preference for same-race ties (more segregated) and positive values represented a preference for cross-race ties (more integrated). The statistic was calculated with the four largest racial/ethnic groups in the sample: Asian, Black, Latinx, and White. the average integration score was then taken across the fall, winter, and spring time points for each classroom.

Network Equity. Network equity was calculated as the coefficient of variation of degree centrality. In other words, network equity was calculated by dividing the classroom level standard deviation of degree centrality by the classroom level mean of degree centrality (Capella et al., 2013). The inverse was then taken (multiplied by -1) so that higher numbers could be interpreted as greater social network equity.

Compositional Diversity

Compositional diversity was measured with the Simpson's (1949) Diversity Index. Simpson's Diversity Index is able to account for both the number of different racial-ethnic groups and relative size of each racial/ethnic group. The diversity index is calculated as

$$D = 1 - \sum_k (\frac{n_k}{N})^2,$$

where *N* is the total class size and n_k is the number of youth in racial-ethnic group *k*. The statistic ranges between 0 and 1, which represents the probability that any two randomly selected students will be from different racial/ethnic groups. Higher scores indicate greater diversity.

Academic Outcomes

Four different measures were used to represent academic outcomes: state standardized test scores, teachers' rating of student content understanding, teachers' rating of students' expected course grade, and final course grade. For all consented students in the study, the school district provided *state standardized test scores* at the end of the study year and the end of the year prior. For the purpose of this paper, state standardized test scores were from the content area of the observed classroom. Scores ranged from 200 to 600. In the fall, winter, and spring of the study year, teachers were asked to rate each *students' understanding of the topics in class* and the *grade they expected them to receive*, relative to other students in the class. For students' understanding of the topic teachers rated students on a scale from 1 ("very weak") to 5 ("very strong"). For students' expected grade, teachers rated students on a scale from 1 ("F") to 5 ("A"). Finally, *course grades* were obtained with the school record data. In particular, we utilized 1st quarter and 4th quarter grades in the observed classroom.

Demographics

Data about students' gender and racial-ethnic identification were collected via self-report at the beginning of the school year from consented students. Information about classroom level (honors, standard, etc.) and grade level were collected from school records. In addition, we controlled for the percent of English Learners (obtained via school records). In US schools the largest percentage of English Learners are also racially minoritized students (Flores &

Rosa, 2015). As such controlling for linguistic diversity – as measured by the proportion of EL students – allows us to disentangle what might be driven by linguistic diversity and what might be driven by racial-ethnic diversity.

Data Analysis

In order to test our hypotheses, we ran a series of multilevel models with students nested within classrooms. First, we predicted each one of the academic outcomes from the Simpson's (1949) Diversity Index. Next, we predicted each one of the academic outcomes from network density and then network integration. Finally, a second set of models was computed to see if compositional diversity or classroom network equity moderated the association between network integration or network density and academic outcomes. At the individual level, all models controlled for students' gender (1 = female, 0 = male) and their baseline score of the academic outcome being predicted. At the classroom level, all models controlled for the racial-ethnic composition (measured through Simpson's (1949) Diversity Index), academic track (using dummy variables for "honors" and "remedial" levels, with "standard" classes as the reference group), and grade level (using dummy variables for 7th grade and 8th grade, with 6th grade as the reference group)[2]. Models were tested in MPlus version 8 (Muthén & Muthén, 1998-2017), using full-information maximum likelihood (FIML) to incorporate cases with missing data. All non-dichotomous predictor and outcome variables used in the models were standardized using z-scores prior to analysis.

Results

Preliminary Analyses

[2] Subject (using a dummy variable for math, with ELA as the reference group) was also added as a control variable per feedback received in the proposal. Subject was not included in the final analyses as no substantive changes were made.

Table 1 presents means and standard deviations (prior to standardization) for all substantive variables in our study including correlations among these variables. At the classroom level, the average Simpson's (1949) Diversity Index was .67 (SD = .09). Classrooms Diversity Indices ranged from .41 to .80, with scores closer to 0 indicating limited diversity and scores closer to 1 indicating greater diversity. An average Diversity Index of .67, with a range of .41 to .80, suggests the classrooms in this study exhibit moderate to high racial/ethnical diversity. Further, the classroom level network equity scores averaged -.57 (SD = .10) and ranged from -.74 to -.34. Values closer to 0 indicate networks where ties are more equally distributed so that -.34 represented the most equitable classroom within the sample. The classroom level network density scores averaged .18 (SD = .05) and ranged from .09 to .32. Higher numbers indicate more dense classrooms. Finally, the classroom level network integration scores averaged -.63 (SD = .52) and ranged from -2.27 to .45. Scores below 0 indicate more segregated networks than would be expected by chance while scores above 0 indicate more integrated networks than would be expected by chance. These values suggest that the majority of classrooms in the sample were more racially/ethnically segregated than would be expected by chance.

Preliminary correlations at the classroom level (Table 1) suggest a small but significant, negative correlation between network density and network integration (r =.18) as well as network density and classroom diversity (r =.17). Further, preliminary correlations suggest a high positive correlation between network density and network equity (r =.67). Likewise, there was a moderate, positive correlation between classroom diversity and network equity (r =.35).

Correlations at the student level (Table 1) suggest that classroom diversity was not significantly correlated with most of the academic outcomes but there was small positive correlation between classroom diversity and teacher rated expected grades in the fall (r = .15).

There was a small, negative correlation between network equity and all four academic outcomes of interest: spring state standardized test scores (r = -.10), spring teacher rated content understanding (r = -.09), spring teacher rated expected grade (r = -.10), and final quarter grade (r = -.12). Likewise, there was a small, negative correlation between network density and all four academic outcome variables: spring state standardize test scores (r = -.20), spring teacher rated content understanding (r =-.11), spring teacher rated expected grade (r = -.13), and final quarter grade (r = -.20). Likewise, there was a small, negative correlation between network integration and spring expected grade (r = .12), as well as final quarter grade (r = .09) but network integration was not significantly correlated with spring state standardized test scores or spring teacher rated content understanding.

Primary Analyses

Table 2 depicts the four models predicting students' end of year academic outcomes from two statistics that represent the social context: classroom diversity and network equity[3]. Tables 3 through 6 depict the sixteen models predicting students' end of year academic outcomes from either network density or network integration. Both network density and network integration were selected to represent increased cross-group, help-seeking interactions. We then tested to see whether classroom diversity or network equity moderated the relationship between increased cross-group help-seeking interactions and students' end of year academic outcomes. All models controlled for the baseline score of the outcome variable, students' gender, grade, classroom level, the percent of EL students, and classroom diversity, when classroom diversity was not a predictor of interest.

Social Context as Predictors

[3]Diversity and network equity were tested independently in separate models. The results were comparable when diversity and network equity were together in the same model.

Simpson's Diversity Index was not significantly associated with state standardized test scores, teacher rated content understanding, teacher rated expected grades, and final quarter course grades (Table 2). Counter to expectations, network equity was also not significantly associated with any of the academic outcomes (Table 2).

Social Interactions as Predictors Moderated by Context

Network Density. Counter to expectations network density was negatively associated with state standardized test scores (Table 3; $\gamma = -0.14$, $p = 0.013$). Further, the negative association between network density and students' final quarter grade was trending towards significance ($\gamma = -0.16$, $p = 0.063$). There was no significant association between network density and teacher rated content understanding or teacher rated expected grade. Taken together, these trends suggest that as classroom helping networks became more dense, test scores and grades declined but that the density of the help network was not associated with teachers' perceptions of students' performance within the class.

Next, we tested to see if the level of classroom diversity moderated the relationship between network density and academic outcomes. The interaction between network density and classroom diversity was not significantly associated with state standardized test scores or teacher rated understanding (Table 3). There was a trend toward a significant interaction between classroom diversity and network density predicting teacher rated expected grade ($\gamma = -0.07$, $p = 0.061$). Follow-up analysis of the simple slopes suggests that for classrooms with greater diversity increases in network density were significantly associated with a decrease in teacher rated expected grade (Figure 1a, $B = -.17$, $p = .004$). Further, there was a significant interaction between classroom diversity and network density predicting students' final course grade ($\gamma = -0.21$, $p < .001$), with follow-up analysis of the simple slopes indicating that for classrooms with

greater diversity, network density was negatively associated with final course grades (Figure 1b, B = -.32, p < .001) but for less diverse classrooms, there was a trend toward a significant positive association between network density and final course grade (Figure 1b, B = -.10, p = .091). Overall, the pattern suggests that when the academic helping network is densely interconnected in highly diverse classrooms, both teacher-rated expected grade and final course grade decline. Yet, that same interaction is not associated with other academic indicators.

Finally, we tested to see if the equity of the academic helping network, or the equal distribution of helping ties, moderated the relationship between network density and academic outcomes. The interaction between network density and network equity was not significantly associated with state standardized test scores or final course grades (Table 4). However, there was a significant interaction of network equity by network density predicting teacher rated content understanding (Table 4; γ = .11, p = 0.001). Follow-up analysis of the simple slopes suggests that in both low equity (Figure 2a, B = -.36, p < .001) and high equity (Figure 2a, B = -.13, p = .003) classrooms network density was negatively associated with teacher rated understanding; however, the slope was less steep for high equity classrooms, suggesting the density penalty is less severe in classrooms where the help seeking is more evenly distributed. In addition, there was a trend toward a significant interaction between network density and network equity predicting teacher rated expected grade (γ = .08, p = 0.077). Follow-up analysis of the simple slopes suggests that in both low equity (Figure 2b, B = -.34, p = .021) and high equity (Figure 2b, B = -.19, p = .024) classrooms network density was negatively associated with teacher-rated expected grade. However, similar to content understanding, the slope was less steep for high equity classrooms.

Network Integration. Counter to expectations, network integration, as measured by the natural log of the odds ratio, was not associated with state standardized test scores or students' final course grade (see Table 5). Further, network integration positively predicted teacher rated expected grade (γ = -.13, p = 0.016). In alignment with expectations the positive association between integration and teacher rated content understanding trended toward significance (γ = .08, p = 0.064). The trends from this set of models are inconclusive and contradictory, however, they do indicate that network integration is associated with academic outcomes in a way that is different from network density.

Similar to above, we next tested to see if diversity moderated the relationship between network integration and academic outcomes as well if network equity moderated the same relationship. The interaction between diversity and network integration did not significantly predict state standardized test scores, teacher rated content understanding, teacher rated expected grades, or students' final course grade (Table 5). Likewise, the interaction between network equity and network integration did not significantly predict academic outcomes (Table 6).

Discussion

Overall, results of the present study provide partial support for the hypotheses outlined at the beginning of this paper. In particular, compositional diversity alone was not associated with academic outcomes. Instead, social interaction, as measured by network density and network integration, predicted academic outcomes. However, counter to expectations, increased density of the help seeking network within a classroom was negatively associated with academic outcomes. Further, when compositional diversity was the moderator, results indicated that in more diverse classrooms the relationship between density and academic outcomes was more negative than in less diverse classrooms. With network equity as the moderator, classrooms with

higher levels of network equity saw a less negative relationship between network density and academic outcomes than classrooms with lower levels of network equity. Network integration told a more complex story. Network integration was marginally positively associated with teacher rated content understanding yet negatively associated with teacher rated expected grade. There was no relationship between network integration and state standardized test scores and final course grades. Finally, neither classroom diversity nor network equity moderated the relationship between network integration and students' academic outcomes.

Social Context as Predictors of Academic Outcomes

The cognitive dissonance perspective posits that academically-based interactions with people from different backgrounds will introduce new ways of thinking and problem solving, which can activate cognitive dissonance and lead to cognitive growth. Therefore, it is this specific interaction in diverse settings, and not just the racial-ethnic diversity of the setting, that ultimately leads to positive academic change (Johnson et al., in progress). This may explain why compositional diversity alone was not related to academic outcomes. Findings lend partial support to the idea that future research on the benefits of racial-ethnic diversity should focus on the social interaction occurring within diverse settings, and not just the compositional diversity of a setting.

Social Interaction as Predictors of Academic Outcomes

Operationalizing the Nature of Academic Interactions

Key to the cognitive dissonance perspective is the idea that certain interactions in diverse settings will spark cognitive dissonance; in particular these are interactions that force students to confront and then integrate different ways of thinking and problem solving. In this study the question: "Who do you talk to when you're trying to get work done in this class? (For example,

you ask them for help?).” was designed to operationalize academic help-seeking interactions that could be assumed to create opportunities for students to confront new knowledge and have to integrate different ways of knowing. In particular we aimed to capture adaptive help seeking which includes students asking questions about the process as opposed to just asking for the answer (expedient help seeking; Ryan et al., 2005). However, the network prompt may not be specific enough to differentiate between expedient and adaptive help seeking. Evidence suggests that as students transition to middle school they are more likely to engage in expedient help seeking (Ryan & Shim, 2012), suggesting that the majority of classroom-based help-seeking behavior would be expedient. Further, there is evidence to suggest that middle schools in the US are not structured in a way to support adaptive help-seeking and peer-based inquiry learning (Eccles & Roeser, 2011).

Likewise, participants may have interpreted the prompt (“Who do you talk to when you’re trying to get work done in this class?) as “who do you casually chat with while you are getting work done?” As a result, classrooms with high levels of network density may be capturing classrooms that have an increased number of expedient help-seeking interactions or off-topic interactions as opposed to densely interconnected, adaptive help-seeking networks. This might explain the consistent negative association between network density and academic outcomes. Likewise, this might explain why density (i.e., more expedient help-seeking or more off-topic interactions in general) was consistently negatively associated with academic outcomes compared to integration (i.e., more cross-group expedient help-seeking or more off-topic interactions, which is a more stringent threshold) which had an inconsistent relationship with academic outcomes. Future studies should employ qualitative methods to explore what kinds of academic help seeking interactions are present in racially-ethnically diverse classrooms with

densely connected networks compared to less densely connected networks. For example, one qualitative study of linguistically diverse classrooms compared the nature of students' participation in linguistically integrated classrooms compared to linguistically segregated classrooms and found that students in highly integrated classrooms were more likely to actively participate. Active participation in highly integrated classrooms looked like EL students demonstrating academic expertise and acknowledging a lack of understanding more frequently than in low integration classrooms (Kibler et al., 2020). Observational data, combined with cognitive interviewing (Beatty & Willis, 2007) could be leveraged to design network prompts with the types of interactions specifically required to operationalize the interactions necessary for the cognitive dissonance perspective to be activated. Qualitative methods may also provide insight into the nature of academic help-seeking interactions for which dissonance may be more (or less) beneficial.

Operationalizing Cross-Group Interactions

Another key aspect of the cognitive dissonance perspective is that the interaction occurs across difference. It is exposure to new ideas and new ways of problem solving that sparks cognitive dissonance and forces integration of new knowledge which strengthens cognitive processes. If everyone in the classroom is thinking the same way, it is unlikely cognitive dissonance will occur. Network integration and network density were selected to operationalize increased interaction across differences so that higher levels of network integration or network density would equal more cross-group interaction.

Network integration, as measured by the odds ratio (adapted by Moody, 2001), explicitly measures cross-group interaction. In particular the odds ratio measures preferences for cross-group ties relative to same-group ties, within the context of available opportunities for same- and

cross-group ties. One downside of the odds ratio and other measures of network integration is that the researcher must set the bounds of racial similarity and difference. For example, in this study, only Asian, Black, Latinx, and White students were included in this measure. This excludes students in these classrooms who identify as a race other than the four listed here and any student who identifies as multiracial. Network density was also included in this study as a potential alternative to measuring cross-group interaction. Network density does not explicitly measure an increase in *cross*-group interactions, rather network density solely accounts for the interconnectedness of a setting as measured by the total number of ties as a proportion of the total ties possible within the setting. However, in this study network density and network integration were related to academic outcomes differently, which aligns with the small but negative correlation between density and integration. Future studies should utilize observations paired with network data (see Kibler et al., 2019; 2020 for an example in linguistically diverse classrooms) to see how the network data maps on to the interaction patterns that are observed within the classroom.

These findings point to challenges of using racial-ethnic background as a proxy for difference. On one hand, there is evidence that students of different racial backgrounds experience the classroom differently (Larson et al., 2019; Voight et al., 2015) and bring different knowledge and ways of knowing to the classroom (Collins, 1989; Yosso, 2005). On the other hand, using race as a proxy for difference ignores within group heterogeneity as well as other social and contextual factors that may shape experiences (Celious & Oyserman, 2002; Krogstad & Noe-Bustamante, 2020; López et al., 2017). For instance, Black and White youth from a rural setting might have more in common in terms of cultural knowledge and problem-solving strategies than Black and White youth from an urban setting. Further, using race-ethnicity as a

proxy for difference ignores that oppressive systems value homogenization (Yosso, 2005). So even if students of different racial-ethnic backgrounds were bringing in a diversity of thought, schools may not be creating an environment where students can express their full self and all their knowledge into the setting (Flores & Rosa, 2015; Henderson et al., 2020). Future research needs to be able to address both the within group heterogeneity and the setting level conditions that surround academic interactions between students. Observational and interview studies could be leveraged to examine both within-group differences of how students negotiate learning and the setting level conditions that need to be in place to welcome difference in knowledge and ways of knowing.

Social Context as a Moderator of Social Interactions and Academic Outcomes

While network density was negatively associated with academic outcomes, network equity did moderate the relationship so that classrooms with higher levels of network equity had a less steep negative relationships between network density and academic outcomes. Findings lend partial support to the idea that certain setting level conditions need to be in place for the cognitive dissonance perspective to work as hypothesized (Allport, 1954). Network equity measures how evenly distributed the academic help-seeking interactions (ties) are within a setting and can be used as one way to capture the setting level conditions necessary for the processes of the cognitive dissonance perspective to be effective (Johnson et al., in progress). For example, if one classroom has only a few students who are perceived as the "go-tos" for academic help it seems unlikely that the social conditions meet Allport's (1954) equal status requirement. Future research should consider how else to operationalize the setting level conditions necessary for the social processes important to the cognitive dissonance perspective to work. Despite the prevalence of multi-level, ecological theories in developmental psychology

(i.e., Bronfenbrenner, 1977), there is a consistent struggle to translate multi-level, ecological theories into empirical research (Dunn et al., 2014; Luke, 2005). This is equally true in studies that employ intergroup contact hypothesis as the theoretical framework (Pettigrew, 1998).

Social network analysis and multi-level models have been proposed as potential tools for investigating multi-level phenomenon (Dunn et al., 2014; Luke, 2005). Nevertheless, multi-level theoretical research remains complex. Questions remain about the level (e.g., friendship group, classroom, school, community) at which the conditions of contact need to be in place for the cognitive dissonance perspective to operate effectively. For example, some studies have found that classroom level interventions can be effective in creating more equitable settings (Debnam et al., 2017; Luria et al., 2017). However, if school level discipline rates, graduation rates, after-school participation rates, etc. are unequal is it unlikely that classrooms, regardless of specific and thoughtful interventions, meet the conditions necessary for the cognitive dissonance perspective to be effective. Further, if the community has inequity in housing, healthcare, criminal justice and other systems, the conditions inside schools and classrooms may also be inequitable and unlikely to meet Allport's (1954) conditions. Future research needs to grapple with the complexity of racism and oppression at multiple levels of the ecosystem and how that influences interactions within schools and classrooms (i.e., García Coll et al., 1996).

Academic Outcomes

The cognitive dissonance perspective is theorized to impact cognitive processes – such as cognitive flexibility and problem-solving skills. Academic outcomes, such as test scores, grades, and content understanding, are thought to rely on these cognitive processes. But we also know that test scores, grades, and teachers' perceptions of students are heavily influenced by racial bias (Berry et al., 2011; Harvey et al., 2015). Due to the biased nature of test scores and grades, there

is question about whether or not these are the right metrics for measuring the cognitive benefits of racially-ethnically diverse classroom settings. Future studies should explore how the social processes in diverse settings are associated with non-academic cognitive outcomes such as cognitive flexibility and problem-solving skills.

Conclusion

Findings from this study contribute to the growing need to understand *how* diversity is related to outcomes. In sum, as hypothesized, compositional diversity did not predict academic outcomes. Counter to expectations, network density was negatively associated with academic outcomes and the relationship between network integration and academic outcomes was inconclusive. Further, there is some evidence to suggest that network equity moderates the relationship network density and academic outcomes so that more equitable classrooms experience a less steep negative relationship between density and academic outcomes. Questions still remain about the nature of the academic interactions that would effectively spark cognitive growth in racially/ethnically diverse settings and the role of setting level conditions in supporting these academic interactions. However, the results of the current study can support future research investigating the academic benefits of racially/ethnically diverse school settings.

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Table 1. *Descriptive Statistics and Inter-Correlations of Primary Variables*

	Mean (SD)	**Min, Max**	1	2	3	4	5	6	7	8	9	10	11
Classroom-level composition and network characteristics													
1. Network Density	*.18(.05)*	*.09, .32*	-										
2. Network Integration	*-.63(.52)*	*-2.27, .45*	*-.176***	-									
3. Network Equity	*-.51(.10)*	*-.74, -.34*	*.667****	*.002*	-								
4. Simpson's Diversity Index	*.67 (.09)*	*.41, .80*	*.169****	*.082**	*.350****	-							
Academic Outcomes													
5. Prior Spring State Standardized Test S	381.63 (53.37)	244, 580	-.127**	-.063	-.084	-.034	-						
6. Fall Content Understanding	3.52 (1.11)	1, 5	-.147***	-.032	-.154***	-.066	.360***	-					
7. Fall Expected Grade	3.17 (1.29)	1, 5	.119**	.062	-.013	.151***	-.227***	.076	-				
8. First Quarter Grade	3.76(.99)	1,5	-.052	-.119**	-.042	.056	.418***	.570***	-.013	-			
9. Spring State Standardized Test Scores	392.76 (50.29)	259, 600	-.196***	-.030	-.095*	-.073	.623***	.456***	-.202***	.485***	-		
10. Spring Content Understanding	3.50 (1.09)	1, 5	-.114**	.061	-.093*	-.075	.461***	.559***	-.010	.481***	.653***	-	
11. Spring Expected Grade	3.81 (1.01)	1, 5	-.132**	-.120**	-.101*	-.013	.390***	.507***	.082	.600***	.562***	.726***	-
12. Final Quarter Grade	3.79 (.98)	1,5	-.196***	-.091*	-.123**	-.015	.310***	.496***	.071	.593***	.483***	.550***	.708***

Note. Italicized values were computed at the classroom level. *p <.05, **p<.01, ***p<.001

Table 2. *Multilevel Models Predicting Students' Academic Outcomes from Simpson's Diversity Index and Network Equity*

	Model 1: State Standardized Test Scores	**Model 2: Teacher Rated Understanding**	**Model 3: Teacher Rated Expected Grade**	**Model 4: Final Quarter Course Grade**
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Level 1				
Baseline Score on Outcome	.66(.06)***	.56(.05)***	.10(.09)	.57(.04)***
Gender	-.03(.07)	-.13(.08)	.16(.10)	.12(.07)
Level 2				
Simpson's Diversity Index	-.04(.05)	-.06(.06)	.03(.05)	<.01(.07)
Network Equity	.01(.09)	-.02(.08)	-.01(.08)	-.15(.10)
Percent EL Student	-.10(.19)	.05(.11)	-.22(.14)	.15(.17)
Class "Track" Level: Honors	-.02(.23)	-.07(.10)	.29(.14)*	.14(.18)
Class "Track" Level: Remedial	-.02(.13)	-.07(.09)	-.14(.11)	-.10(.12)
7th Grade	-.23(.14)	-.13(.09)	.06(.12)	-.10(.15)
8th Grade	-.26(.14)+	-.05(.10)	.04(.11)	-.11(.13)

Note. Table presents unstandardized coefficients, with standard errors in parentheses. +p <.19, *p<.05, **p<.01, ***p<.001

Table 3. *Multilevel Models Predicting Students' Academic Outcomes from Network Density with Interactions by Classroom Diversity*

	Model 5: State Standardized Test Scores		**Model 6: Teacher Rated Understanding**		**Model 7: Teacher Rated Expected Grade**		**Model 8: Final Quarter Grade**	
	5a: Main Effects Only	5b: With Interaction	6a: Main Effects Only	6b: With Interaction	7a: Main Effects Only	7b: With Interaction	8a: Main Effects Only	8b: With Interaction
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Level 1								
Baseline Score on Outcome	.65(.06)***	.65(.06)***	.56(.05)***	.56(.05)***	.11(.09)	.10(.09)	.57(.04)***	.58(.03)***
Gender	-.03(.07)	-.02(.07)	-.12(.08)	-.12(.08)	.16(.10)	.17(.10)+	.12(.07)+	.13(.07)+
Level 2								
Simpson's Diversity Index	-.05(.05)	-.05(.05)	-.07(.05)	-.07(.05)	.02(.05)	<.01(.05)	-.02(.07)	-.12(.05)*
Network Density	**-.14(.06)***	-.14(.05)*	-.06(.06)	-.06(.06)	-.10(.06)	-.10(.05)+	**-.16(.08)+**	-.11(.04)*
Percent EL Students	.01(.12)	.01(.12)	.06(.09)	.06(.09)	-.17(.12)	-.18(.12)	.05(.13)	.11(.13)
Class "Track" Level: Honors	-.09(.23)	-.07(.24)	-.09(.11)	-.08(.11)	.24(.14)+	.28(.15)+	.04(.20)	.15(.20)
Class "Track" Level: Remedial	-.05(.13)	-.04(.13)	-.07(.09)	-.07(.09)	-.15(.10)	-.12(.09)	-.10(.12)	-.06(.10)
7th Grade	-.33(.15)*	-.34(.15)*	-.15(.09)+	-.15(.09)+	.02(.11)	.02(.11)	.10(.15)	.08(.14)
8th Grade	-.22(.13)	-.21(.12)+	-.03(.11)	-.02(.11)	.08(.12)	.10(.12)	-.06(.11)	-.02(.10)
Moderation by Diversity Index								
Density X Diversity Index	-	-.04(.04)	-	-.02(.04)	-	**-.07(.04)+**	-	**-.21(.03)*****

Note. Table presents unstandardized coefficients, with standard errors in parentheses. +p <.19, *p<.05, **p<.01, ***p<.001

Table 4. *Multilevel Models Predicting Students' Academic Outcomes from Network Density with Interactions by Network Equity*

	Model 9: State Standardized Test Scores		**Model 10: Teacher Rated Understanding**		**Model 11: Teacher Rated Expected Grade**		**Model 12: Final Quarter Grade**	
	9a: Main Effects Only	9b: With Interaction	10a: Main Effects Only	10b: With Interaction	11a: Main Effects Only	11b: With Interaction	12a: Main Effects Only	12b: With Interaction
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Level 1								
Baseline Score on Outcome	.65(.06)****	.65(.06)***	.56(.05)***	.57(.05)***	.13(.09)	.14(.09)*	.57(.04)***	.58(.04)***
Gender	-.03(.07)	-.03(.07)	-.13(.08)	-.13(.08)	.16(.10)	.16(.10)	.12(.07)+	.12(.07)+
Level 2								
Simpson's Diversity Index	-.06(.04)	-.06(.04)	-.07(.06)	-.07(.05)	.01(.05)	.01(.04)	-.01(.07)	<.01(.07)
Network Density	**-.21(.08)***	-.21(.10)*	-.08(.06)	-.25(.06)***	**-.15(.07)***	-.27(.11)*	-.13(.10)	-.09(.12)
Network Equity	.17(.10)	.17(.11)	.03(.09)	.12(.07)+	.11(.09)	.17(.09)+	-.06(.10)	-.08(.11)
Class "Track" Level: Honors	-.10(.23)	-.10(.23)	-.10(.11)	-.14(.11)	.22(.13)	.19(.14)	.06(.20)	.06(.19)
Class "Track" Level: Remedial	-.04(.12)	-.04(.12)	-.07(.09)	-.15(.09)+	-.13(.10)	-.21(.10)*	-.11(.11)	-.08(.12)
7th Grade	.33(.14)*	-.33(.14)*	-.15(.09)+	-.19(.08)*	.03(.10)	<.01(.11)	.09(.15)	.11(.16)
8th Grade	-.23(.13)+	-.22(.12)+	-.03(.11)	-.07(.11)	.09(.12)	.07(.11)	-.06(.11)	-.04(.11)
Moderation by Race								
Density X Equity	-	<.01(.04)	-	**.11(.03)****	-	**.08(.04)+**	-	-.03(.07)

Note. Table presents unstandardized coefficients, with standard errors in parentheses. +p <.19, *p<.05, **p<.01, ***p<.001

Table 5. *Multilevel Models Predicting Students' Academic Outcomes from Network Integration with Interactions by Classroom Diversity*

	Model 13: State Standardized Test Scores		**Model 14: Teacher Rated Understanding**		**Model 15: Teacher Rated Expected Grade**		**Model 16: Final Quarter Grade**	
	13a: Main Effects Only	13b: With Interaction	14a: Main Effects Only	14b: With Interaction	15a: Main Effects Only	15b: With Interaction	16a: Main Effects Only	16b: With Interaction
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Level 1								
Baseline Score on Outcome	.66(.06)***	.66(.06)***	.56(.05)***	.56(.05)***	.11(.08)	.11(.08)	.57(.04)***	.57(.04)***
Gender	-.03(.07)	-.03(.07)	-.13(.08)	-.13(.08)	.15(.10)	.14(.09)	.12(.07)	.12(.07)
Level 2								
Simpson's Diversity Index	-.04(.06)	-.04(.06)	-.07(.06)	-.07(.05)	.04(.05)	.03(.04)	-.02(.07)	-.01(.07)
Network Integration	-.02(.05)	-.02(.05)	**.08(.05)+**	.09(.05)+	**-.13(.05)***	-.12(.05)*	.01(.05)	-.01(.05)
Percent EL Student	-.09(.13)	-.09(.13)	.02(.09)	.02(.08)	-.24(.10)*	-.24(.10)*	-.05(.14)	-.04(.14)
Class "Track" Level: Honors	-.01(.22)	-.02(.23)	-.08(.11)	-.05(.12)	.31(.13)*	.34(.14)*	.10(.19)	.08(.19)
Class "Track" Level: Remedial	-.02(.13)	-.02(.13)	-.09(.08)	-.09(.08)	-.12(.11)	-.12(.10)	-.10(.14)	-.10(.13)
7th Grade	-.29(.14)*	-.29(.14)*	-.09(.09)	-.09(.09)	.01(.12)	.01(.11)	.13(.16)	.13(.16)
8th Grade	-.26(.13)+	-.26(.14)+	.02(.09)	-.06(.10)	.02(.09)	.01(.10)	-.13(.13)	-.13(.13)
Moderation by Diversity Index								
Integration X Diversity	-	<.01(.13)	-	-.05(.06)	-	-.06(.06)	-	0.02(.05)

Note. Table presents unstandardized coefficients, with standard errors in parentheses. +p <.19, *p<.05, **p<.01, ***p<.001

Table 6. *Multilevel Models Predicting Students' Academic Outcomes from Network Integration with Interactions by Network Equity*

	Model 17: State Standardized Test Scores		**Model 18: Teacher Rated Understanding**		**Model 19: Teacher Rated Expected Grade**		**Model 20: Final Quarter Grade**	
	17a: Main Effects Only	17b: With Interaction	18a: Main Effects Only	18b: With Interaction	19a: Main Effects Only	19b: With Interaction	20a: Main Effects Only	20b: With Interaction
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Level 1								
Baseline Score on Outcome	.66(.06)***	.66(.06)***	.056(.05)***	.56(.05)***	.11(.08)	.11(.08)	.57(.04)***	.57(.04)***
Gender	-.03(.07)	-.03(.07)	-.12(.08)	-.12(.08)	.15(.10)	.15(.10)	.12(.07)	.12(.07)
Level 2								
Simpson's Diversity Index	-.04(.05)	-.04(.05)	-.07(.06)	-.07(.06)	.04(.05)	.04(.05)	<.01(.07)	<.01(.07)
Network Integration	-.02(.05)	-.05(.07)	**.08(.04)+**	.02(.11)	**-.13(.05)***	-.06(.10)	-.01(.04)	-.03(.04)
Network Equity	.01(.09)	.03(.10)	-.02(.08)	.02(.10)	-.01(.08)	-.06(.09)	-.15(.10)	-.13(.10)
Percent EL Students	-.10(.19)	-.12(.20)	.05(.10)	.02(.11)	-.23(.13)+	-.20(.12)	.15(.17)	.14(.16)
Class "Track" Level: Honors	-.01(.22)	-.02(.23)	-.08(.11)	-.10(.11)	.31(.13)*	.32(.13)*	.14(.18)	.13(.18)
Class "Track" Level: Remedial	-.02(.13)	-.03(.13)	-.09(.08)	-.11(.08)	-.12(.10)	-.10(.10)	-.10(.13)	-.11(.13)
7th Grade	-.29(.14)*	-.30(.15)*	-.09(.09)	-.12(.11)	<.01(.11)	.03(.12)	.10(.15)	.09(.16)
8th Grade	-.26(.19)+	-.27(.14)+	-.04(.09)	-.05(.09)	.02(.09)	.05(.10)	-.11(.12)	-.11(.13)
Moderation by Network Equity								
Integration X Equity	-	.03(.06)	-	.07(.08)	-	-.07(.07)	-	.03(.04)

Note. Table presents unstandardized coefficients, with standard errors in parentheses. +p <.19, *p<.05, **p<.01, ***p<.001

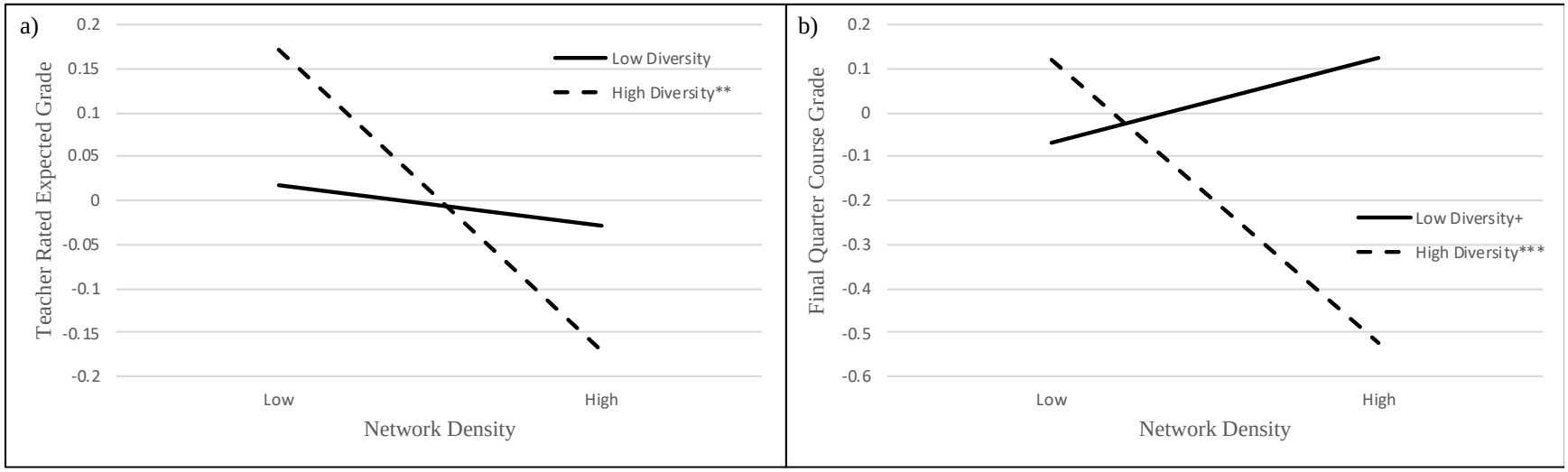

Figure 1. Moderating Effects of Classroom Diversity on the Relation between Across-Year Mean Network Density and Students' Academic Outcomes.

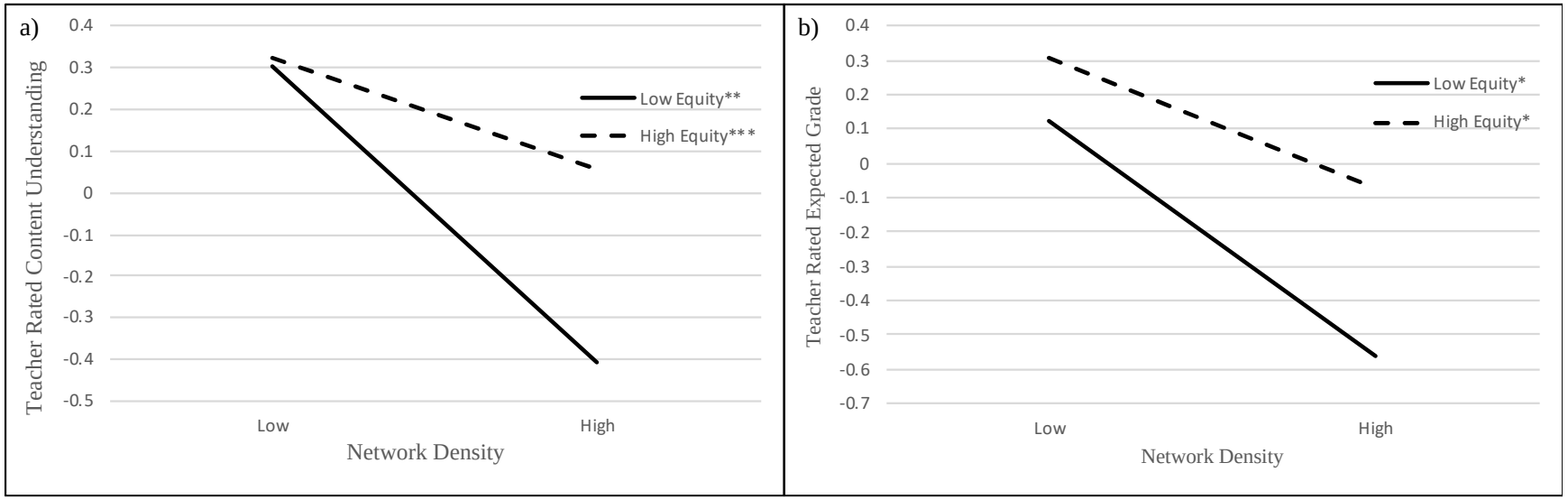

Figure 2. Moderating Effects of Network Equity on the Relation between Across-Year Mean Network Density and Students' Academic Outcomes.

Unpacking the Intersection of Social Structure and Social Processes in Racially-ethnically Diverse Classrooms: A Comparative Case Study

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Abstract

As the US education system becomes more racially and ethnically diverse, there is a need understand the pathways in which racial-ethnic diversity may or may not be beneficial in order to optimize benefits and minimize harm. The current study explores the nature and complexity of peer interactions in racially-ethnically diverse classrooms by examining both structure (i.e., network integration) and process (i.e., observed peer interactions). In particular we ask (1) How do integration scores map onto observed peer interaction within the racially-ethnically diverse classroom, and vice versa? (2) How, if at all, do teacher practices and classroom activity structures vary as a function of integration scores? To answer these questions, we use a comparative case study approach (Miles, Huberman, & Saldaña, 2014) of two racially-ethnically diverse middle school English Language Arts (ELA) classrooms. The classroom with the higher integration score did in fact have more observed peer interactions. But the classroom with the higher integration also had a wider range in the nature and tone of peer interactions. Teacher practices, such as how classroom time is structured, may shape the racial integration within the classroom but future research is needed.

Keywords: Case Study; Diversity; Early Adolescence, Social Interactions

Unpacking the Intersection of Social Structure and Social Processes in Racially-ethnically Diverse Classrooms: A Comparative Case Study

Racial-ethnic diversity is increasingly becoming a setting level reality in US classrooms (Forum on Child & Family Statistics, 2019; US Census Bureau, 2019). The increasing racial and ethnic diversity of the student population is rife with opportunities both in terms of academic and social outcomes (Ayscue et al., 2017; Gurin et al., 2002; Tropp & Saxena, 2018). For example, school-level racial-ethnic diversity has previously been found to reduce students' anxiety about difference, build capacity for empathy and caring about others, aid the development of leadership competencies, and catalyze social change (Tropp & Saxena, 2018). Further, racially-ethnically diverse school settings have been associated with reduced racial disparities in grades and test scores, as well as an increase in high school graduation rates (Ayscue et al., 2017). At the same time, racial-ethnic diversity may also lead to negative outcomes, particularly for racially minoritized students (Goldsmith, 2004; Seaton, Yip, & Sellers, 2009; Yip, Cheon, & Wang, 2019). For example, increased school diversity was found to be associated with increased interracial conflict (Goldsmith, 2004), and in more diverse school settings Black adolescents report greater peer discrimination (Seaton, Yip, & Sellers, 2009).

As the US education system becomes more racially and ethnically diverse, it is imperative for developmental researchers to consider setting-level diversity as an important feature of students' school experiences (Graham, 2018; Yip et al., 2019). Further, there is a need understand the pathways in which racial-ethnic diversity may or may not be beneficial in order to optimize benefits and minimize harm. Theorists have identified social interaction within diverse settings as the catalyst to unlocking the benefits of diversity (Allport, 1954; Benner & Crosnoe, 2011; Gurin et al., 2002; Pettigrew, 1998; Williams & O'Reilly, 1998). Peer-to-peer interactions

are embedded in groups (e.g., classrooms), and group structure influences and constrains what interactions and relationships are possible (Hinde, 1987; Rubin et al., 2007). Although multilevel investigations that consider the intersection between peer interactions and group structure can be methodologically complex (Cairns et al., 1999; Rubin et al., 2007), they are necessary for understanding processes underlying the benefits (or harms) of diverse settings. Social network analysis has been proposed as a methodological tool to operationalize, at the setting level, the structure of relationships and interactions within diverse peer settings (Clarke & Antonio, 2012; Harrison & Klein, 2007; Hewstone, 2015; Johnson et al., in progress_a). While social network analysis can be leveraged for studying relational complexity, it does not provide insight into the specific nature of peer interactions in diverse school settings.

In the current study we employ a comparative case study analysis (Miles, Huberman, & Saldaña, 2014) of two racially-ethnically diverse middle school classrooms that differ in their levels of peer social integration. Ultimately, our goal is to understand how the integration measure (i.e., structure, as indicated by social network data) maps onto the observed peer interactions (i.e., social processes) of the classroom. We are guided by Gest & Rodkin's (2011) conceptual model for how classroom peer ecologies are related to youth outcomes as well as Yip, Cheon, & Wang's (2019) conceptual model considering the benefits and challenges of diversity as contact in context.

Literature Review

Middle school presents a unique developmental period in youths' lives as they learn to navigate an increasingly racially-ethnically diverse peer world. For many, the transition to middle school aligns with a shift from neighborhood schools, which are often more racially homogenous, to larger, more racially diverse schools (Frankenberg and Orfield, 2007; Orfield,

2001). At the same time, developmental shifts that occur during early adolescence mean youth are more primed to pay attention to peer dynamics (Blakemore & Mills, 2014; Brown & Larson, 2009), including peer racial dynamics (Tatum, 2017). In other words, peer interactions become central as young adolescents make sense of the world around them. As such, in the current study we focus on early adolescents' relationships within the context of racially-ethnically diverse middle school classrooms.

The Classroom Peer Ecology

The "peer ecology" is one-way peer researchers conceptualize the complex peer environment and is closely aligned with the conceptualization of the group. The concept of the peer ecology derives from Bronfenbrenner's (1977) bioecological model where the microsystem is "the immediate, proximal settings in which behavior unfolds" (Rodkin & Hodges, 2003, p. 385). The classroom peer ecology then specifically represents the microsystem that involves youth interacting with each other within a given classroom. The concept of the peer ecology acknowledges that development does not occur individualistically or even dyadically but is embedded in a larger, more complex social structure. Gest & Rodkin (2011) operationalize the peer ecology as the characteristics of social status (e.g., hierarchy, group norms) and of social networks (e.g., tight-knitedness, group distinctiveness, homophily, ethnic integration, diversity). Many dimensions of the peer ecology may be important when considering the pathways in which classroom diversity is beneficial. In the current paper, we will focus on network structure – specifically classroom diversity and classroom integration.

Classroom Diversity

Structural diversity, a descriptive part of the peer ecology, describes the composition of a unit (i.e., peer group, team, classroom) with respect to a particular characteristic (i.e., race,

religion, language status) – structural diversity describes who is in the room (Harrison & Klein, 2007; Yip et al., 2019). Structural diversity is important as the racial-ethnic composition of a setting has implications for what processes can and cannot occur but there is general agreement that structural diversity, alone, is not enough to catalyze the benefits of diversity (Hewstone, 2015; Williams, 2018; Yip et al., 2019). First, the conditions in which diversity is embedded are important. For example, the intergroup contact hypothesis posits that the positive benefits of intergroup contact will only be realized if the setting supports equal status, common goals, intergroup cooperation, and support from authority figures (Allport, 1954). While it is certainly possible for these conditions to be in place in schools and classrooms (Darling-Hammond & Friedlaender, 2008; Gorski, 2017), this is often not the case in US schools and classrooms (Finn & Servoss, 2015; Flores, 2007). Second, Yip and colleagues (2019) emphasize the difference between structural diversity and interpersonal diversity, where interpersonal diversity is defined as "the frequency and degree of contact and interpersonal interactions with same or different ethnic/racial group others at varying degrees of proximity" (p. 64) and acknowledge that interpersonal diversity is often required to engender positive (or negative) outcomes.

The emphasis on interpersonal diversity aligns with key theoretical perspectives in diversity research that ultimately highlight social interaction in diverse settings as the key catalyst for positive change in academic and social outcomes. For example, it is through intimate interactions within friendships that individuals gain perspective taking and empathy building skills that reduce prejudice (Allport, 1954; Pettigrew, 1998). Building off of intergroup contact hypothesis, it is also theorized that working with people from different backgrounds creates a state of cognitive disequilibrium, or a state of cognitive imbalance caused by exposure to new information and ways of thinking, which in turn sparks cognitive growth (Benner & Crosnoe,

2011; Gurin et al., 2002; Piaget, 1971; Williams & O'Reilly, 1998). In each example, the presence of structural diversity is a pre-requisite but it is social interaction with people from different racial backgrounds in a diverse setting that is key to creating change.

In conceptualizing the daily peer interactions that occur within a classroom the literature on peer ethnic-racial processes may be helpful. Peer ethnic-racial processes have been defined as the "dynamic processes related to ethnicity/race in peer groups" (Wang, 2021, p. 650). These processes range from positive to negative and include interactions such as support against discrimination, preparation for bias, cultural socialization, racial victimization, racial discrimination, and racial teasing (Wang, 2021). The constructs Wang (2021) outlines as peer ethnic-racial processes focus specifically on peer interactions where race is central and, often, explicit. But beyond race-centric interactions, other types of interactions occur within classrooms and are impacted by the racial-ethnic diversity of the setting. Similar to peer ethnic-racial processes, these interactions are also complex and range from positive to negative. For example, the intergroup contact hypothesis centers positive cross-group interactions that occur within friendships. These interactions don't necessarily have to be about race but the context of who is present in the room matters (Pettigrew, 1998). On the other hand, micro-exclusions are "moment to moment challenges to group members sense of competence and belonging" that serve to communicate a lack of belonging, a dismissal of expertise, and/or push one to the margins (Adams-Wiggins, 2020, p. 2). Again, these interactions do not have to be about race but the racial composition of the setting may influence what micro-exclusions are enacted and how they are interpreted. Daily interaction – both positive and negative and everything in between – drive the larger peer structure but daily interactions are also constrained by the larger peer structure. By better understanding the nuanced nature and complexity of these peer interactions, especially

in the context of the network structure, we may begin to better understand the pathways in which diversity is and is not beneficial, and ultimately build better setting level supports to support positive pathways.

Integration of The Friendship Network

There are numerous network metrics used to capture the network structure of the classroom peer ecology that have been found to be related to youth outcomes. For example, students in classrooms with more equitably distributed friendship ties were more likely to experience higher levels of behavioral engagement during class time than in classrooms with a less equitable distribution of friendship ties (Cappella et al., 2013). In addition, students in classrooms with more hierarchical structures were more likely to experience peer victimization as opposed to classrooms with more egalitarian structures (Schäfer et al., 2005). Understanding the cross-group structure is key to operationalizing the processes that catalyze the benefits of classroom diversity (Allport, 1954; Benner & Crosnoe, 2011; Gurin et al., 2002; Pettigrew, 1998; Yip et al., 2019). Network integration captures how likely individuals in a given setting are to form connections with individuals who have different attributes (Bojanowski & Corten, 2014). As such, network integration is one potential metric for capturing the cross-group interactions necessary for catalyzing benefits of peer racial-ethnic diversity (Johnson et al., in progress_a).

There are limited examples of studies where classroom-level integration metrics are used, to predict academic or social outcomes. More common approaches focus on cross- or same-race friendship ties or on the diversity of the peer group. In studies that examined the presence of cross- and same-race, cross-race friends, above and beyond same-race friends, were associated with increased feelings of safety (Chen & Graham, 2017; Graham et al., 2014; Munniksma & Juvonen, 2012), decreased peer victimization (Graham et al., 2014; Kawabata & Crick, 2011,

2015), and improved intergroup attitudes (Chen & Graham, 2017; Knifsend & Juvonen, 2014). Friend group diversity was found to be associated with improved teacher-rated interpersonal competence and increased ethnic-racial identity (Rivas-Drake et al., 2017; Williams and Hamm, 2017). In one study in which researchers measured classroom integration, linguistic integration between English learners and their peers was found to be associated with academic development for all students within the classroom (Molloy Elreda et al., under review) suggesting an integration metric may be operationalizing, at the structural or classroom level, the processes/interactions theorized to catalyze change in diverse settings.

At the same time, integration may not always lead to positive outcomes or even be associated with outcomes. Johnson and colleagues (in progress_b) explored how integration of the academic helping network was associated with academic outcomes, hypothesizing that increased cross-group academic helping connections (i.e., more integrated classrooms) would spark cognitive dissonance and then cognitive growth. Classroom integration was found not be associated with academic outcomes. The null results raise questions about the limits of singular measures of network structure and about what the quantitative measure of integration was actually capturing. As such the primary goal of the current study is to investigate the congruence between a social network measure of classroom integration and observed peer interactions within the context of a racially-ethnically diverse classroom.

The Role of Teachers in the Peer Ecology

A secondary goal of the current study is to understand how teacher practices may shape the peer ecology in racially-ethnically diverse classrooms. Teachers can shape how the classroom peer network develops - influencing what relationships have the opportunity to form and the climate of peer relationships (e.g., positive and supportive, or negative and aggressive;

Audley-Piotrowski, Singer, & Patterson, 2015; Farmer et al., 2016; Farmer, McAuliffe Lines, & Hamm, 2011). Gest and Rodkin (2011) theorize that teachers can impact the peer ecology through general classroom-level teacher-student interactions and more explicit network-related teaching and classroom management. General classroom-level teacher-student interactions have been measured by the Classroom Assessment Scoring System for Secondary Classrooms (CLASS-S) framework, which conceptualizes teacher-student interactions in secondary school classrooms as a feature of the classroom setting. CLASS-S is made up of three domains: emotional support, classroom organization, and instructional support (Pianta, Hamre, & Mintz, 2012). In contrast, direct management of the peer network can include teacher practices around seating charts and group work as well as beliefs about their role in facilitating the peer network (Gest & Rodkin, 2011).

General classroom teacher-student interactions are thought to broadly create a positive environment in which students' peer relationships can thrive. In particular, emotional support is theorized to model empathetic and caring relationships in the classroom. In previous research, emotional support has been found to be positively associated with classroom peer dynamics. For instance, in one study, 1st, 3rd, and 5th grade classrooms with high levels of emotional support were associated with greater cross-race integration (Serdiouk et al., 2019). Likewise, in another study of K-4th grade classrooms higher levels of emotional support were linked to less rigidity in the social hierarchy of the classroom (Mikami et al., 2011). Direct management of the peer network has also been associated with the formation of the peer ecology. For example, in a study of middle school classrooms, teachers who were more likely to intervene in the peer network when they witnessed aggression often had classrooms with higher rates of peer acceptance (Chang, 2003). In an examination of middle school teachers' role in shaping bonding and

bridging relationships between English Learners (ELs) and their non-EL peers, it was found that teachers who emphasized the important role bonding relationships play for EL students were more likely to have more bonding relationships, or same-language status relationships, at the expense of bridging relationships, in their classroom (Johnson et al., 2019). Taken together, teachers, do play a role in shaping the peer ecology and therefore the interactions that occur within the peer ecology of their classrooms.

The Current Study

The goal of the current study is to explore the nature and complexity of peer interactions in racially-ethnically diverse classrooms by examining both structure (i.e., network integration) and process (i.e., observed peer interactions). We use a comparative case study approach (Miles, Huberman, & Saldaña, 2014) of two racially-ethnically diverse middle school English Language Arts (ELA) classrooms. A comparative case study approach allows for the integration of different sources of evidence in order to build a deep understanding of the processes occurring within each case. Based on network integration scores (Moody, 2001) we selected one classroom socially integrated by race and one classroom socially segregated by race. With each classroom as the unit of analysis, or the case, we sought to understand the peer interactions that occur within diverse classrooms and how those interactions were similar or different based on the level of social integration. In particular, we ask

1. How do integration scores map onto observed peer interaction within the racially-ethnically diverse classroom, and vice versa?
2. How do teacher practices and classroom activity structures vary as a function of integration scores?

Methods

Research Context

The data were collected from two middle schools located in the same school district in the mid-Atlantic region of the United States. The larger project investigated 46 6th, 7th, and 8th grade English Language Arts (ELA) and Math classrooms with the overall goal of exploring peer relationships in linguistically diverse settings (Kibler et al., 2019). All 46 classrooms participated in social network surveys and CLASS-S observation. Maximum variation sampling (Patton, 2015) was used to select 13 focal classrooms for in-depth qualitative study. The sampling aimed to create maximum variation in terms of content area, grade level, instructional quality (as measured by CLASS-S; Pianta, Hamre, & Mintz, 2012), and English Learner population density (Kibler et al., 2019).

The 13 focal classrooms included five 6th grade classrooms, four 7th grade classrooms, and four 8th grade classrooms. Six classrooms were ELA and seven classrooms were Math. The average classroom Simpson's (1949) Diversity Index, which represents the probability that any two randomly selected students would be from different racial-ethnic groups, was .66. In a classroom with a Simpson's Diversity Index of .66, there is a 66% chance that two randomly selected students from that classroom belong to different racial-ethnic groups. The average class size was 18 students (range 13 – 25). In total the focal classrooms represented 240 students with a 90% student/parent consent rate. Eight percent of the sample identified as Asian, 18% of the students identified as Black, 32% identified as Latinx, 8% identified as multiracial, 22% identified as White, and 1% of the sample identified as a race not specified in the demographic survey.

Data Collection

Network Surveys

In order to obtain information about students' peer relationships in the classrooms, social network surveys were administered (items drawn or adapted from Moody et al., 2011; Ryan & Shim, 2012) in the fall, winter, and spring. These surveys asked students about both social and academic ties. For this study we focused on a peer nomination item assessing close friendships. The item asked, "Who are your closest friends in class?", prompting students to rate each classmate on a five-point scale ranging from "Not a friend at all" (1) to "Very close friend" (5). Responses were then dichotomized, such that responses of 4 ("Close friend") or higher were considered a friendship nomination.

Observational Protocol

Observations were conducted during eight to 10 sessions over the course of the school year. Each observation consisted of one full class period (about an hour and 15 minutes). The same observer was paired with the same classroom throughout the year and they had no prior experience or relationship with the teacher or the school. The observation team consisted of the PI of the project and graduate students. Based on the goals of the larger project observers spoke at least two languages and had bicultural experiences, such as growing up or living outside of the US for multiple years (Kibler et al., 2019).

The observation team utilized an observational protocol that was developed during the pilot phase of the larger project. In addition to extensive field notes, observation sessions were audio- and video-recorded. Audio and video recordings were used to supplement notes and clarify dialogue. The observation team was trained to attend to individual teacher-student interactions and peer interactions. In particular, in line with the goals of the larger project, four focal students – two EL students and two non-EL – were selected in each class to anchor periods of the observations. Observers were instructed to spend at least 15 minutes focused on each focal

student. This ensured the details of peer interaction were being captured, as opposed to just a broad overview of classroom activities.

All names in the study, including those in the field notes, are pseudonyms. For consented students we use first names only. Non-consented students are designated by initials. The initials are not connected to their actual initials but instead are a part of naming system that started with "XA". The inferences made in the fieldnotes by the observer are indicated throughout the paper in italics.

Demographic Surveys and School District Data

Student and classroom level demographic data were collected via student report and school district reports. Students reported on their race/ethnicity in the fall, at the beginning of the school year. As a result, we only have racial demographic data for consented students. The school district provided data on students' grades and test scores as well as classroom-level information such as class subject, academic track, grade level, and mobility (i.e., the number of students moving in and out of the classroom during the year).

CLASS-S

The Classroom Assessment Scoring System for Secondary classrooms (CLASS-S; Pianta, Hamre, & Mintz, 2012) was used to assess global teacher-student interaction quality in each classroom. CLASS-S is comprised of three overarching domains: emotional support, classroom organization, and instructional support. Each domain is comprised of three to five dimensions (e.g., positive climate, behavior management, quality of feedback). Each dimension is given a score from one to seven, with a score of seven indicating the dimension was present in most or all of the classroom activities and included most or all of the students in the classroom. For each classroom observation, two CLASS-S-trained research assistants individually coded

four 15-minute segments of instructional time, as per training manual guidelines. Scores for each dimension were averaged across coders, and domain scores were created by taking the average of relevant dimensions.

Integration Score Calculation and Case Selection

Classroom network integration was calculated as the natural log of the odds that students nominated cross-race peers as friends relative to the odds that they nominated same-race peers (Moody, 2001). The odds ratio was calculated for each classroom using the following formula:

$$\alpha = AD/BC$$

Where A = the total number of same-race nominations made in a given classroom, B = the total number of cross-race nominations made in the classroom, C = the number of same-race peers that participating students in the classroom did *not* nominate, and D = the number of cross-race peers that participating students in the classroom did *not* nominate. Then the natural log of α was calculated to account for the highly skewed nature of α. Values of the natural log of α can range from -∞ to ∞. Finally, the natural log was multiplied by -1 so that negative values represented a network-level preference for same-race ties, indicating more segregated networks than would be expected by chance. Positive values represented a preference for cross-race ties, indicating more integrated networks than would be expected by chance. Network integration was calculated with the four largest racial-ethnic groups in the sample: Asian, Black, Latinx, and white. For each classroom, the average integration score was then taken across the fall, winter, and spring time points.

To explore how friendship integration scores mapped onto the observed interactions within a given classroom we selected two classrooms from the focal sample (i.e., the classrooms with observational data) – one classroom with a low integration score (segregated) and one with

a high integration score. Friendship integration scores of the full sample of 46 classrooms ranged from -3.09 to .49, with a mean of -.69. The focal sample (the 13 classrooms with observational data) had friendship integration scores that ranged from -3.09 to -.30 with a mean of -1.03. Ms. Shaw's 4th block 7th grade English Language Arts classroom was selected as the least integrated classroom with an integration score of -3.09. Mr. Hansen's 1st block 7th grade English language Arts class was selected as the most integrated of the focal classrooms with an integration score of -.30. Mr. Hansen's classroom had an 84% consent rate and Ms. Shaw's classroom had an 80% consent rate. More demographic details on each classroom are described below.

Analysis

Once the classrooms were selected, in each of the 16 field notes the first author color-coded students' names based on their racial demographic data in order to easily identify cross- and same-race interactions when reading the field notes. The first author then read four fieldnotes, starting with the least integrated classroom, and identified cross- and same-race interactions. Throughout this process, she made note of common patterns in relation to the nature/content interactions (e.g., teasing, support). Every week the first and second author met to discuss what was being observed in the data. Points of confusion were discussed and assumptions were challenged. The pattern was repeated until all 16 field notes were read and coded.

Next the first author read the interactions to identify prevalent within-class patterns. Network graphs were created for each classroom at each of the three time points using the social network data and the visNetwork R package (DataStorm, 2016-2017). The coded interaction data and prevalent within-classrooms patterns were then reread and interpreted in the context of the

network graphs (and network data). Finally, comparisons were made between the two classrooms. The first and second author were in conversation throughout this process.

Positionality Statement

I am a monolingual white woman who worked on this project as both a master's level graduate research assistant and a research staff member. In both roles I supported data collection and both quantitative and qualitative data management. I was not a part of the observation team but sat in on weekly meetings discussing and planning for observations. As a part of a class project I shadowed a focal classroom observer and wrote up my own set of field notes but those are not included in this project. I also administered social network surveys, so I did spend some time in these classrooms though not to the depth of the observation team. As a white woman my inclination is to question the role of the white youth in racially-ethnically diverse settings. Are the white students contributing to the positive pathways, or are they the one's causing harm? Whiteness is not the focus of this study but it will always be present throughout my analyses. Finally, as a constructivist/interpretivist I believe that a key part of interactions, relationships, and the group/network structure is socially constructed. What I, as the observer, notice happen between two, or more, people will never tell the complete story without gaining access to how those involved interpreted the exchange.

Methodological Limitations

The two classrooms were observed by different fieldnote writers, who each brought their own experiences and lens to the project. To minimize the differences between fieldnote writers, the larger project team engaged in "quality control" of the fieldnotes. The PI reviewed the first set of field notes and another member of the observation team reviewed the 2nd set. In addition, observers were trained to pay particular attention to peer interactions which provides some

uniformity in the fieldnotes. However, individual differences in field note taking still exist, affecting detail, depth, and focus.

Mr. Hansen's classroom had an 84% consent rate and Ms. Shaw's classroom had an 80% consent rate. While both of these are well above the accepted threshold of 60% for reliable peer nomination data (Borgatti et al., 2006; Marks et al., 2013), each class still had three and four non-consented students, respectively. Information was not available on these students' racial-ethnic group identification; thus, the non-consented students' observed interactions were not taken into account during the qualitative analysis. Non-consented students were also not included in the social network data. Likewise, multiracial students were not included in the calculation of the integration statistic. This is in line with previous research on cross- and same-race connections (see Echols, Solomon, & Graham, 2014; Knifsend, Bell, & Juvonen, 2017), as it is difficult to select who a multiracial student would consider a same- or cross-race friend with the available data.

Findings

Integration Scores and Observed Classroom Interactions

Both classrooms had high levels of racial-ethnic diversity with Ms. Shaw's classroom having a Simpson's Diversity Index of .76 and Mr. Hansen's classroom having a Simpson's Diversity Index of .68. The students in both classrooms were more likely to nominate same-race peers as opposed to cross-race peers but in Mr. Hansen's classroom (integration = -.30) this preference was minimal, whereas it was more prevalent in Ms. Shaw's classroom (integration = -3.09). More detailed racial demographic information can be found in for each class Figure 1. Below we describe how the observed classroom interactions map onto the network scores using network maps to visualize the network data.

Ms. Shaw's 4th Block – Low Integration Classroom

Ms. Shaw's 4th block classroom was selected as the most racially segregated classroom in the sample. The segregation in the classroom is particularly stark between white students and non-white students. The log odds integration score does not pick up on the nuances of which groups are or are not isolated but in examining the network graphs of Ms. Shaw's fall, winter, and spring class, the white students, denoted with the blue circle, were either almost completely isolated from the rest of the class (fall and winter) or almost completely insulated (spring). More specifically, in the fall (integration score = -2.91), only one white student identified a non-white student as a friend within the classroom (Henry (white boy) → Parker (multiracial boy)). As a result, the white students, with the exception of Henry, were completely disconnected from the rest of the class. In the winter (integration score = -2.92), the white students, with the exception of Henry, were completely isolated from the rest of the class – with none of the white students nominating Henry as a friend and vice versa. Henry remained connected to Parker and a non-consented student. Neither relationship is accounted for in the integration statistic.

In the spring, although at first glance the visual of the network graph (Figure 2c) might look the most integrated, when you remove the multiracial students (denoted by the yellow circle) and the non-consented students (denoted by the gray circle), the white students remain completely isolated from the rest of the network. In fact, the white students become even more insulated in the spring, taking a up a larger percentage of same-race ties made within the class. At the same time, fewer cross-race ties are made in the spring compared to the fall and winter. As a result, Ms. Shaw's spring classroom is more segregated (integration score = -3.44) than at the beginning of the school year. Underscoring the white students' isolation and potential self-segregation the observer captured this interaction between Henry and Maddie during the winter

survey (1/28/15) (of note, Maddie is one of the more central white students at each time point): "Henry asks Maddie if she has started the survey. Maddie and Henry whisper and I can't hear everything that they're saying even when the audio is on Henry's desk. Maddie jokingly says that she doesn't have any friends and that this was "awkward" *[joking tone]*." Their conversation suggests Maddie was potentially not making an effort to form friendships with her classmates.

This segregation is notable within the field notes as well – the majority of the interactions, particularly positive social interactions that were captured in the field notes are same-race interactions. For example, in the 1/28/15 field notes there was a group of white students socializing and goofing off after completing our network survey:

> Most students have finished the survey and are working on their writing. Graham is dancing next to Henry and Maddie. He falls on the floor *[seemingly on purpose]* and Henry and Maddie start laughing. Graham asks why they're laughing when he's just fallen *[he says this jokingly; he was trying to make them laugh]*. Graham falls again and Henry asks, "Did you fall again? The same spot?"

On another day (2/23/15), we see a group of Black girls dancing together in class, "Most students are working. Daisy was dancing (hand gestures in her place) and she is joined by Monique who leaves her place and goes over to Daisy and dances with her before heading back to her place. Kiona is also dancing."

Maddie (white girl) and Graham (white boy) are frequently seen socializing with Henry and Amy (white girl) occasionally also joining in. Daisy (Black girl) and Kiona (Black girl) are also frequently seen socializing with Monique (Black girl) occasionally joining in. Both of these patterns map on to the network data (see Figure 2a, 2b, & 2c). Lori (Latinx girl) and Nicolas (Latinx boy) also shared a lot of interactions together but only in the fall did Nicolas report Lori

as a friend. Lori never nominated Nicolas as a friend during the school year, despite interacting with Nicolas in a friendly manner throughout the school year.

White students do participate in five of the eight cross-race interactions identified throughout the class that are not identified as teasing (teasing is discussed below). In general, these cross-race interactions contain minimal depth: "Xavier stands with Ms. Diana Shaw and Graham in the middle of the class watching Graham work on the laptop which Ms. Diana Shaw was holding. They look at the laptop and laugh, but nothing is said" (11/21/14). Henry is present in three of the five cross-race interactions where a white student is present. "A few minutes later, I observe Henry playing with Parker – they were battling each other with pencils as mock swords." (2/23/15).

Mr. Hansen's 1st Block – High Integration Classroom

Mr. Hansen's 1st block classroom was selected as the most racially integrated classroom in the focal sample, with an integration score of -.30. An integration score of -.30 stills indicates that the students in Mr. Hansen's classroom prefer same-race relationships to cross-relationships but this preference is much less pronounced than in Ms. Shaw's classroom. And the difference in integration scores is visibly notable in the network graphs (see Figure 2) as Mr. Hansen's classroom network is much denser (more connected). The integration scores fluctuate a bit throughout the year (the fall integration score = -.37, winter integration score = -.11, spring integration score = -.41). In addition, unlike Ms. Shaw's classroom there are no breaks in the network (i.e., everyone is connected to someone) and no clear self-isolation by one racial-ethnic group.

The integration is apparent in the field notes as well. The frequency and content of both same- and cross-race interactions map onto the network graphs where students report both same-

and cross-race friends, with a slight tendency towards same-race friends. Throughout the school-year there are ample examples of positive cross- and same-race social interactions. The content of these interactions does not seem to differ whether it is a same-race or cross-race interaction. Regardless of the composition of the dyad or group, students shared food, discussed their home life, and just chatted with each other (see Table 1 for examples).

Isolation Within a Socially Integrated Classroom. Despite the tight-knit social fabric of Mr. Hansen's classroom, there are few students that appeared to be on the "outside" of the social interaction. For example, there were a handful of examples of where Adam (white boy) attempted to connect with the other boys in class but he was often met with disinterest. For example,

> Adam goes from looking at his laptop to the board and raises his hand to make a suggestion about the sentence correction. When he gets the answer right, he says, "See? I smart." He repeats the phrase "I smart" a couple of times, but neither Javonte nor XE respond *(they are not also making eye contact with Adam).* (11/09/2015)

Despite the social isolation observed throughout the fieldnotes, Adam consistently nominated at least three friends throughout the school year and was nominated by an average of four friends at each timepoint. This included Javonte (Black boy) nominating him as a friend at each of the three timepoints.

Cora (Black girl) and Leah (white girl) were also on the outskirts of the observed social interactions within Mr. Hansen's classroom. Unlike Adam, Cora is more obviously isolated based on the network data. In the fall she nominated two friends and was only nominated by one friend (no mutual connections). In the winter she nominated one friend (a non-consented student) and was only nominated by one friend. In the spring Cora nominated one friend and was

nominated by two (see Figure 2d, 2e, & 2f). Throughout the observed social interactions there are a few instances were Cora was ignored by her peers. For example,

> When Mr. Wilson reads the sentence off the board, she looks back and forth from the board to her computer. At the same time, both XF and Lorraine, who are seated at her station, raise their hands to talk to a teacher *(interesting that they don't ask Cora whatever questions they had)*. Cora says "48" out loud but to herself *(likely referring to the number of the sentence projected on the board).*

On the other hand, Leah starts the year with lots of connections – she nominated five friends and was nominated by four friends. But as the school year progressed those connections dwindle. In the winter Leah nominated three friends and was nominated by only one friend. In the spring Leah nominated one friend and was nominated by one friend – a different friend than in the winter. Leah, like Cora, was also often observed as being ignored by her peers. For example,

> XH gives Leah a hug when Leah calls her over to her seat, which is next to *Lorraine*'s desk pod. Leah does not get up to join the rest of them and has her head down on the desk while the others are chatting. *(Leah seems a bit removed from the group of girls. I wonder how Leah fits in with the rest of the girls, because she is the only white girl in the classroom and does not seem very intimate with any particular girl*).

During the particular instance the fieldnote writer noted that Leah is the only white girl in Mr. Hansen's classroom and wondered if this demographic [isolation] may contribute to social isolation.

Within a tight-knit friend group of boys, we also see one student on the outside of that "clique". The four boys seem to be central to the "action" that occurs within the classroom: Gabriel (Latinx boy; Spanish speaker), Elias (Latinx boy; Spanish speaker), Gage (multiracial –

Black and Latinx – boy; Spanish speaker), and Javonte (Black boy); with Javonte on the outside of this "clique". The following example from the 3/3/16 field notes highlighted the ways in which Javonte may be on the outside of this clique.

> Elias and Gage are speaking to each other across the classroom in Spanish.
>
> Elias: "Mierda!" (Shit!)
>
> Gage: "Ni mierda! Mierda!" ("Shit!"; *He's making fun of the high voice of the other boy.*)
>
> Elias: "Cuál opinion..." ("Which opinion..."; *He trails off while talking.)*
>
> Gage: "Está nombrado..."("He's famous"; *I think that's what I'm hearing. It's really fast and under his breath.*)]
>
> Elias laughs. Javonte, who was watching the two of them, laughs artificially. *(If I am interpreting this correctly, I thought this was a fascinating moment of Javonte trying to "get in" on the Spanish conversation between the two boys).*[4]

Despite there being observed interactions of Javonte being on the outside of this clique, in the winter and the spring the three Spanish speaking boys all nominated Javonte as a friend and Javonte nominated them as a friend (Gabriel moved to a different ELA class for the spring network survey). These examples of observed isolation show both agreement and disagreement between the network data and the observation data.

Teasing Within a Socially Integrated Classroom. Teasing is prevalent throughout the school year in Mr. Hansen's classroom. Teasing was present occasionally in Ms. Shaw's class but at the same rate in Mr. Hansen's class. We observed both instances of physical and verbal teasing. The physical teasing took the form of "playful" punches, taps, and wrestling. For

[4] Note: the transcription and the translation of the conversation was done use audio recorders placed at students' desk. The transcription and the translation was done by a Spanish speaking member of the team who was not the field note writer for this class.

example, in one scene while rehearsing their radio ads Javonte read Elias' line and in response: "Elias says, 'That was my line' and playfully punches Javonte" (11/09/2015). Verbal teasing usually involved some kind of exaggeration with the goal of "messing with" the other person. For example, when it is revealed that two classmates are dating the following scene unfolded between Cora and Brandon:

> "Cora asks (*dramatically, in disbelief*), 'You're dating who?' She repeats the question three times (*insinuating that it isn't possible for the two to be dating*), and Emmet answers with Leah's name each time, with laughter. Cora grabs a marker and writes on the white board, '911 call you need help'" (12/07/2015).

There were more instances of cross-race teasing than same-race teasing but this may be attributable to more opportunity for cross-race interactions. Despite the prevalence of cross-race teasing, race was not a central focus of the teasing interactions. In other words, there were no observed instances of racial teasing, defined as teasing that includes an explicit reference to race/a racial stereotype (Douglass et al., 2016). Likewise, there does not seem to be content differences between cross- and same-race teasing interactions. However, that does not mean race was not a factor in the initiation or the interpretation of the teasing interactions but that is outside the scope of the current analysis. Overall, the teasing appeared playful and seemed to be used as a way for students to connect with each other and share familiarity.

Conflict Within a Socially Integrated Classroom. Despite being the most socially and racially integrated classroom, there were also noticeable instances of peer conflict within Mr. Hansen's classroom. Throughout a radio ad assignment (11/09/2015), Leah and Andres (Latinx boy) were in the same group. Andres was particularly annoyed with Leah and did not hide his frustration. In one particular interaction the observer captured:

> Mr. Wilson [the teaching assistant] comes around and asks where the "next break" is in the script, and Andres answers the question. Leah says something *(which I didn't catch then or in the audio)* and Andres says something to her in Spanish—*it turns out that he said, "Callate la boca," which is an extreme way of saying "Shut up"*—in a tone of annoyance *(this looked as though it was meant to offend her, because he was speaking directly to her in Spanish when she doesn't understand Spanish and Andres seems perfectly capable of saying anything he wants to conversationally)*.

This kind of antagonism between Andres and Leah was observed throughout the 11/09/2015 observation as the two continued to navigate the group assignment together.

During another class period (03/03/2016), Leah and Javonte entered the classroom clearly frustrated with each other:

> Javonte walks to his desk, followed by Elias, while Leah puts her bag down at her desk and walks towards Mr. Hansen. Javonte says confrontationally, "You don't tell me to move." Leah retorts from the other side of the classroom, "You're not supposed to be blocking the door." Javonte replies, "Well, shut up. Don't talk to me like that." Leah replies, "*You* don't talk to me like that!" Javonte mimics Leah's tone and says, "Don't talk to me like that! What do you think this is?"

At one point during the class this conflict boiled over to Javonte "telling on" Leah for playing a game on her computer during class time and resulted in Leah receiving a lunch detention. Later on, during the same class period in which Leah and Javonte have conflict, Leah and Andres again butted heads during group work. Andres was attempting to transfer files from an iPad to a MacBook. Leah was insistent on telling him how to do it:

Leah points at the icons of the video files, and says, “This one, this one, this one…” Andres seems to be following her directions, but Leah says in frustration, “You didn’t click it. Don’t click anything that you don’t know.” Andres says impatiently, “I’ll try to figure it out,” and Leah says exasperatedly, “Oh my gosh.” Leah gets up and walks over to Mr. Hansen to tell him, “Andres isn’t letting me download them and he’s trying to figure it out himself. And I know how to do it.” Mr. Hansen turns to the group and says, “Andres, this is a group thing.” He then says to Leah, “Just because you know how to do it, you all need to work together.” Leah replies, “Well, he’s not letting me.”

Teacher Practices and Activity Structure

Both Ms. Shaw and Mr. Hansen structured their classroom activities in similar ways (see Table 2 and Table 3 for an overview). Both teachers relied heavily on teacher-led instruction with Ms. Shaw engaging in teacher-led instruction for seven of eight observations and Mr. Hansen using teacher-led instruction in all eight observations. We also observed each teacher using group work at the same rate (three times across eight observations). In Ms. Shaw’s classroom we observed that she structured her classroom time with more independent work time for students (four observed instances compared to Mr. Hansen’s one). More emphasis on independent work may limit opportunities for peer interaction especially when coupled with teacher-led instruction.

Counter to expectations, based on the pathways laid out by Gest and Rodkin (2011), Mr. Hansen had lower CLASS-S scores than Ms. Shaw. This is particularly surprising in the emotional support score. Mr. Hansen scored a 3.58, 3.96, and 3.17 on emotional support in the fall, winter, and spring respectively. Ms. Shaw scored a 5.46, 5.29, and 4.54 on emotional support in the fall, winter, and spring, respectively. To explore this further, we examined the

correlations between the CLASS domains and integration scores at each of the three time points. Emotional support and classroom organization were not correlated with integration scores at any time point. But instructional support was negatively associated with network integration in the winter ($r = -.61$).

Comparisons, Inferences, and Questions

More Diversity of Interactions in More Integrated Classrooms

Mr. Hansen's classroom, which was more racially and socially integrated, had more observed peer interactions in general and more observed cross-race interactions than Ms. Shaw's classroom. However, not only did Mr. Hansen's classroom have more observed social peer interactions than Ms. Shaw's classroom, Mr. Hansen's classroom had a wider range in tone of interactions. Specifically, while there were more positive interactions in Mr. Hansen's classroom there were also more negative interactions. In Mr. Hansen's socially integrated classroom conflict, isolation, and teasing were all present on a much larger scale than Ms. Shaw's classroom.

A more integrated classroom may be assumed to be indicative of more social harmony and largely positive interactions. While we did observe more positive cross-group peer interactions in the more integrated classroom, we also observed a broader variety of interactions– including conflict. Conflict is a normative part of any relationship (Laursen & Pursell, 2009) and provides a critical developmental challenge for adolescents (Laursen, Finkelstein, & Betts, 2001). Peer conflict presents the opportunity to learn the important social skills of resolving conflict (Dunn, 1993). As such conflict, in the context of friendship and especially during adolescence, may not be inherently bad. There is evidence to suggest that while conflict occurs at a similar rate between friends and non-friends, conflict within the context of friendship is more

likely to be resolved and resolved equitably (Laursen, Finkelstein, & Betts, 2001; Laursen & Pursell, 2009).

In the absence of observational data, integration scores might be interpreted as an indicator of more harmonious cross-group interactions. The observational data from these two classrooms suggest it may instead reflect a greater number of cross-group interactions that vary in tone. Ultimately, this finding suggests the interactions and relationships that comprise the overall group structure are complex and multidimensional (Rubin et al., 2007). Social network analysis techniques do afford multiplexity, or the potential for multiple different relationships to exist between two people, to be observed (Powell & Hopkins, 2015). The capacity for multiplexity is one reason social network analysis is recommended in utilizing network analysis in the study of racially-ethnically diverse peer settings (Kornienko & Rivas-Drake, 2021); however, pairing it with observational data may provide a more nuanced perspective. Javonte's relationships with Gabriel, Elias, and Gage illustrate this point – he was observed having positive interactions and harmless teasing interactions with the three other boys (see Table 1 for an example); he also repeatedly used teasing to be more antagonistic towards the three of them – particularly Elias. But all of this occured in the context of friendship (per the network data), and in the context of an integrated classroom.

A Need for Multiple Perspectives

If one were to look at the network graphs produced from Mr. Hansen's classroom compared to the network graphs produced from Ms. Shaw's classroom, the potential conclusion would be that interaction, particularly cross-group interaction, is more prevalent in Mr. Hansen's classroom. As has been discussed throughout this paper, this holds true in the observation data – Mr. Hansen's classroom has a larger volume of cross-group interactions. However, what is also

notable when the integration scores are paired with the observation data is that not every students' experience within the classroom is the same.

Despite being the more socially integrated class, certain students in Mr. Hansen's classroom still remained disconnected from their peers. Leah and Cora were two examples of students who were observed as being on the outside of social interaction during the observations. By the spring both nominated few friends and were nominated by few friends. Yet the integration statistic alone did not capture these individual experiences. In Ms. Shaw's class Henry serves an example of someone whose primary classroom connections are with cross-race peers, despite the integration statistic indicating cross-race friendships are unlikely in this class. These three examples illuminate the importance of understanding peer interactions at different levels—individual, interaction, relationships, and group (see Rubin et al., 2007) —as each level provides different context, interpretation, and understanding. The emergence in the analysis of dynamics related to gender highlight the need to combine modes of investigation in order to observe and understand the peer ecology in its multilevel complexity.

Gender Differences in Observed Classroom Interactions. In both Ms. Shaw's and Mr. Hansen's classroom the boys dominated the observed social interactions. This was particularly apparent in Mr. Hansen's classroom where at least one of four central boys was present in a majority of the peer interactions. Our inferences about social patterns may be limited by differences in how boys and girls are socialized to interact within the classroom. For example, teachers have been found to engage boys more frequently in the classroom dialogue, being more forgiving of interruptions and contributions without a raised hand than when those come from girls (Koch, 2003). As a result, girls' interactions within the classroom may be "quieter". In addition, this may also tie into differences in the content and formation of boys' and girls'

friendships, with girls' close friendships characterized by greater intimacy, self-disclosure, and validation than that of boys' close friendships (Rubin et al., 2004; Zarbatany, McDougall, & Hymel, 2000). Further, boys' close friendships are more likely occur within a larger social network, often based around concrete activities, whereas girls' close friendships are more likely to occur in dyads or small groups (Baumeister & Sommer, 1997). The nature of interactions that are central to girls' close friendships, interactions that promote intimacy and self-disclosure, and the structure of girls' close friendships, smaller groups, may be more difficult to pick up in observations. Ultimately, this may speak to the need to pair observational data with data that come directly from the youths' perception. Beyond the presence or absence of perceived friendship other questions still remain, such as how are the individuals involved interpreting their interactions and relationships, and what subtleties and peer cultural norms are adult observers not able to notice or have access to? The need for a triangulation of data sources may be particularly important in the racially-ethnically diverse classroom as social norms and peer cultures as well as perceptions and interpretations may be influenced by an individuals' racial-ethnic background.

The Teacher's Role in Facilitating Peer Interactions in Racially Diverse Classrooms

How classroom time is structured influences what is possible in the peer ecology (Audley-Piotrowski et al., 2015; Gest & Rodkin, 2011). For example, Ms. Shaw's use of individual work time compared to Mr. Hansen's may serve to limit the opportunities for cross-race connections to form within the classroom. At the same time, Mr. Hansen and Ms. Shaw utilized teacher-led and group work activities at similar rates. Beyond how the classroom time is structured, the ways in which those activities are carried out by the teacher may impact the peer ecology differently. For example, teacher-led activities could be a dynamic full class discussion

where students are engaging with and learning about each other through the teacher. Or full class discussion could be rigid and prescribed, with limited student participation.

To explore these differences, we compared CLASS-S scores which measure teacher-student interaction quality (Pianta, Hamre, & Mintz, 2012). Counter to expectations, Mr. Hansen had lower CLASS-S scores, across the board, compared to Ms. Shaw. Further, within the focal sample, CLASS-S scores were not consistently correlated with integration scores. Instructional support, however, was negatively correlated with classroom integration during the winter time point. Taken together, this suggests that the emotional support, instructional support, and classroom organization constructs being measured by CLASS-S may not be offer insights into the social integration by race in middle school classrooms. In line with these findings, another study found that teachers with socially integrated classrooms by language-status utilized a range of practices different than teachers with less integrated classrooms. These practices expanded beyond what is measured in the CLASS-S constructs. In particular, teachers in integrated classrooms used more praise and praised language practices more specifically. In addition, teachers of segregated classrooms were more likely to use sarcasm, particularly around discipline (which may be especially challenging for students who are learning English), to form social connections with students, whereas teachers in integrated classrooms where more likely to ask questions about students' interests (Kibler et al., 2019). These practices may be relevant to cultivating a racially integrated classroom but other practices may be relevant as well. Future research should leverage observation and interview methods to gain insight into the teacher practices that promote socially integrated classrooms by race.

Conclusion

The goal of the current study was to explore the nature and complexity of peer interactions in racially-ethnically diverse classrooms by examining the intersection of structure (i.e., network integration) and process (i.e., observed peer interactions). The classroom with the higher integration score did have more observed cross-race interactions, and more interactions in general. Further in the segregated classroom, the white students were noticeably separated in both network data (as visualized by the network graphs) and in the observed interactions. Not only did the integrated classroom have more interactions, there was also a wider range in the tone of interactions. In the integrated classroom, teasing, social isolation, and conflict were prevalent alongside positive peer interactions. Finally, teacher practices believed to foster emotional support were unrelated to racial integration within the classroom, while higher levels of formal instructional supports were related to less classroom integration..

The current data and analyses should be understood in the context of when the data were collected. The data were collected prior to a high density of nationally publicized events informing broad considerations of race and racism. Just one example of this change in environment was the 2016 presidential election. During and after the 2016 presidential election there was an increase in race-based bullying reported in schools (Costello & Dillard, 2018; Southern Poverty Law Center, 2016). All of these changes are relevant to peer interactions in racially-ethnically diverse middle school classrooms.

Despite the shift in the racial-ethnic context, findings from the current study provide information on how the observation data complemented the network data. In particular, the observation data aligned with what we would expect to see in each of the classrooms based on the integration statistic. More interactions in general and more cross-race interactions in particular were present in the more integrated classroom. And fewer general and cross-race

interactions occurred in the more segregated classroom. At the same time, the observation data expanded upon the integration statistic and provided a more complex and nuanced glimpse into the nature of interactions occurring in a middle school classroom that is socially integrated by race. This has implications for both research and practice.

Establishing a true multiracial democracy is a complex and multifaceted challenge. Schools have been at the forefront of both racial/ethnic demographic changes (Forum on Child & Family Statistics, 2019) as well as the fight for racially/ethnically integrated institutions (i.e., Brown v Board, 1964; Joffe-Walt, 2020) and serve as an important setting to understand the implications of racial/ethnic diversity. The present findings shed light on the complex reality that is the peer ecology in a racially-ethnically diverse middle school classroom. Indeed, while integration is generally thought of as positive, it also came with a wider range of interactions, including negative interactions. Our findings also support the case for future mixed methods research when investigating the pathways through which racial-ethnic diversity may or may not be beneficial in order to optimize benefits and minimize harm as multi-level, multi-dimensional investigations better represent the complexity of human relationship.

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Appendix

Table 1. *Example Excerpts of Students' Peer Interactions in Mr. Hansen's Class*

Nature of Interaction	Cross or Same Race	Excerpt
Students Shared Food	Cross-Race Interaction	Javonte first whispers Elena's name *(because students are supposed to be watching the morning announcements)*, and when she doesn't hear, he says more loudly, "Elena!" He gestures with his hands that he would like some of the chips she is eating, and Elena offers him some. Javonte leans over and grabs some chips. (02/04/2016)
	Same-Race Interaction	Upon watching the video again, I notice that Elena is holding out her plastic container of cookies for Lorraine to walk over and get. Lorraine goes to her seat and eats the cookies (12/07/2015)
Students Talked About Their Home Life	Cross-Race Interaction	Adam says he had a great week *(I think he means weekend)* and asks Javonte, "What'd you do?" Without really waiting for a reply, Adam says, "My weekend's not really over," and explains his living arrangement, where he lives with his mom during the week but gets two weekends with his dad. He explains the arrangement in some detail and how he likes going to his dad's house. *(He says something I didn't quite understand about counting some of the weekdays as "weekend" depending on where he is or what he likes).* Javonte says, "My schedule, it's like, my mom, dad, dad, dad, dad, dad, a year later, dad, dad, dad, dad, dad, then mom…" Initially Adam was speaking to Javonte, but XE also starts listening to the conversation and says that he goes with his dad on weekends. (11/09/2015)
	Same-Race Interaction	Elias and Gage are talking to each other across the classroom, while the morning announcements are playing. Elia**s** says something about his father going to El Salvador, and Gage responds, "I know that. And his cousin [is going, too] right?" Elias corrects him by saying, "No, just him." (02/04/2016)
Students Chatted with Each Other	Cross-Race Interaction	There is a lot of social chatting going on now. Emmet, Veronica, and Brandon, specifically are talking with each other (11/09/2015)
	Same-Race Interaction	Students arrive one by one into the classroom. When Javonte and Calvin walk in, they are talking to each other about a match that they watched over the weekend, recalling specific players' throws and catches. (12/07/2015)

Table 2. *Ms. Shaw's Observed Classroom Activities*

Date	**Observed Classroom Activities**
11/21/2014	Ms. Shaw answers questions about the quiz, students take a quiz, students work individually on fairy tale projects, one student presents on fairy tale
12/03/2014	*Greek god/goddess speed dating activity*, full class student presentation of Greek god/goddesses, Ms. Shaw explains persuasive letter writing
01/28/2015	Full class discussion on persuasive writing methods, Individual persuasive writing activity
02/23/2015	[short class because of snow] Ms. Shaw introduces activity; students individually work on assignment (identifying persuasive techniques in ads)
03/04/2015	Guest Speaker (about career fair), Ms. Shaw introduces advertising campaign assignment, *students work on advertising campaign assignment*
03/18/2015	Full class review of a worksheet, *students work in groups on their advertising campaign assignment*
04/01/2015	Full class review of ad campaigns from 1st, 3rd, and 4th block
04/22/2015	Ms. Shaw discusses homework, Ms. Shaw explains task, Students work independently on transferring research notes to writing

*Italics represent group work

Table 3. *Mr. Hansen's Observed Classroom Activities*

Date	**Observed Classroom Activities**
11/09/2015	Caught Ya activity**, *Group work radio project*
12/07/2015	Caught Ya activity, teacher led review of vocabulary, teacher read aloud
02/04/2016	Caught Ya activity, teacher led presentation of persuasive techniques in the media
02/18/2016	Caught Ya activity, teacher read aloud, Kahoot! Quiz, introduction to advertising group assignment
03/03/2016	Caught Ya activity, teacher read aloud, *advertising project group work time*
03/15/2016	Caught Ya activity, Teacher introduces Thesis Statement Worksheet, Individual work time
04/13/2016	Caught Ya activity, *peer review of persuasive essays*, teacher read aloud
04/19/2016	Caught Ya activity, teacher led vocabulary review, teacher read aloud

*Italics represent group work

**Caught Ya activity individuals work and then full class review of the work; often reviewing grammar constructs

Figure 1. *Racial Demographic Data by Class*

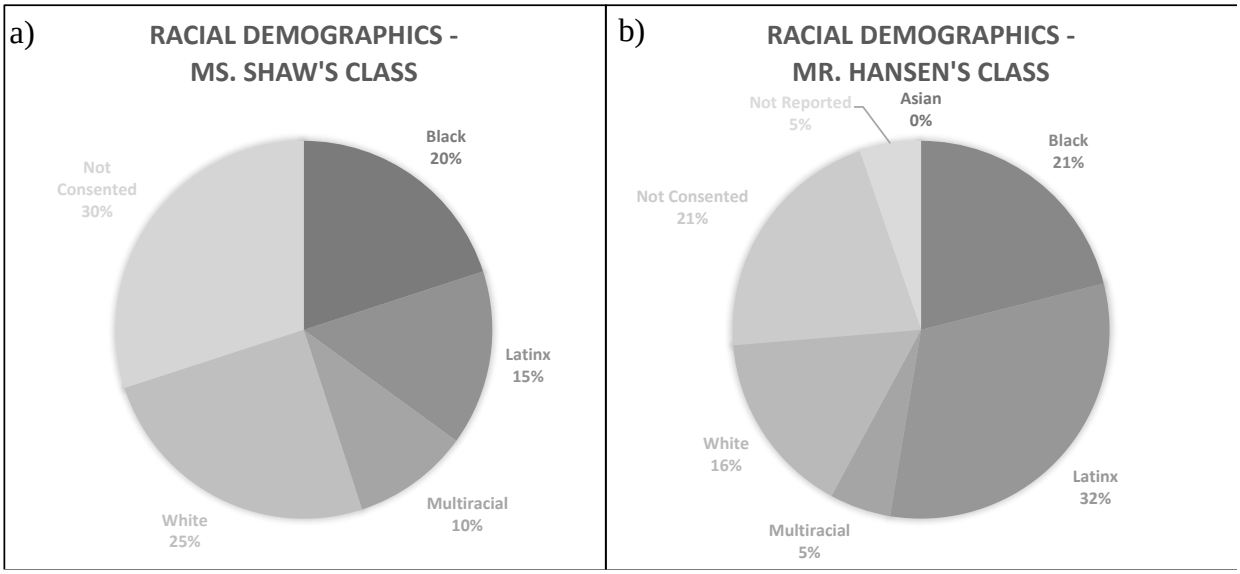

Figure 2. *Network Graphs for Mr. Hansen's and Ms. Shaw's Classroom*