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## AFFECT AND RACIAL/ETHNIC ACHIEVEMENT DISPARITIES

*This paper reports on an exploratory study on the role of affect in mathematics achievement disparities. Qualitative data was used to develop a survey (N = 513) to examine relationships between students' emotional experiences during class and their perceptions of group work, relationships with teachers and math achievement. Analyses were conducted by racial/ethnic group. Results for African American students were significantly different than those for students from other groups, including: negative emotions were more associated with lower grades, and less frequent negative emotion was more associated both with positive views of group work and stronger relationships with teachers.*

### Introduction

Affect influences how students perceive assignments, relate to teachers, participate in class, and ultimately their achievement. This paper reports on exploratory research into how affective issues may contribute to achievement disparities in mathematics. More specifically, the study reported here considered negative emotions and analyzed how these emotions relate to students' perceptions of group work, relationships with teachers, and math grades.

The research was conducted at a medium-sized, urban, public high school with a diverse student body (no racial/ethnic group was in the majority). The school had a math department that in many ways matched the ideals promulgated by leaders in the field of mathematics education. Teachers were predominantly math majors from top schools and credentialed by leading programs. They worked collaboratively on developing norms across classrooms and improving teaching practices and materials. They were involved in professional organizations and had connections with the higher education community. They used high quality mathematical tasks for their courses and emphasized group work, multiple representations, and conceptual understanding. In addition, they made serving all their students a priority. Their classes were untracked. They had a block schedule. Extra help from teachers was available daily, before school, during lunchtime, and after school.

However, analyses of achievement trends found that African American students, males in particular, had not benefited to the same degree as students from other groups from their otherwise successful implementation of reforms. Department leaders reached out to the research community for help understanding and addressing the observed achievement inequity. The paper reported here is part of this larger project. This department provides an unusual opportunity to examine factors that contribute to inequity in a context that differs from that of more commonly documented under-resourced schools, where there is often a lack of will or skills to address the challenges of promoting equity.

The initial focus of the research was to understand the school and the math classrooms as social spaces (300 hours of observations were conducted). Interviews explored students' views of themselves, their school, their attitudes toward math, and their experiences in the math classroom (N = 60; African American N = 45). This qualitative research had several important findings. Literally, all the African American students interviewed reported caring about their grades and viewing math as important for their lives (Davis, 2008). (Consensus on the importance of math may be related to departmental norms regarding communicating math's value to the students.) Additionally, students uniformly showed disappointment or dejection with low marks and protested when they thought they deserved higher grades. Despite their commitment to achievement the students frequently did not engage in mathematical activities as expected by their teachers. Many students reported and were observed experiencing and expressing intense negative emotion during math class, including physical rage and crying.

Anger and frustration frequently emerged when students confronted assignments they could not understand. Also, many students spoke about fear of exposing incompetence. These reports fit with observational data. Students were often reluctant to share their approach to a problem unless they were confident it was correct and became agitated when pressed. Importantly, some factors seemed to be associated with less intense negative emotions. Students who understood and endorsed group-learning practices and had stronger relationships with teachers appeared to experience less negative emotion and engaged more frequently in group work activities as expected by their teachers. For example, one such African American student commented that he volunteered to present his work on problems when he was confused because he knew that he would get the support of his classmates in understanding the problem.

Our qualitative data (referred to above) focused heavily on African American students. It seemed that similar issues were playing out for students across racial/ethnic groups. However, it also appeared that that African American students more frequently confronted the types of negative emotions described above. Moreover, we suspected that these emotional experiences might contribute to disparities in math achievement and be alleviated by particular pedagogical approaches. Therefore, we investigated the role of negative emotions in student achievement across racial/ethnic groups and the degree to which students' perceptions of group work, personal connections to teachers, and mathematical identities were related to these negative emotions. We also examined how these relationships varied across racial/ethnic groups.

#### Literature Review and Theoretical Perspectives

The focus of this study cuts across several different bodies of research. As is often the case with exploratory research, there is not an established body of directly relevant research. This review considers relevant studies on affect in mathematics, stereotype threat, and reform math. It concludes with some theoretical considerations about emotion and cognition.

Research on affect in mathematics education has focused primarily on beliefs and attitudes and has not attended as much to more "hot" emotions, such as anger, fear, and shame (McLeod, 1994). Studies that do consider emotion have been mostly limited to the investigation of math anxiety. Although these studies have consistently found significant

relationships between levels of anxiety and performance, they have either not considered race or found no differences between racial/ethnic groups (Ma, 1999). Mcleod (1994) argues that researchers in this field have not attended sufficiently to the characteristics and experiences of their subjects. This limitation, in conjunction with investigating an insufficiently broad range of emotions may have contributed to finding no differences across racial/ethnic groups.

Other research suggests that there may be interactions between race, context, emotion, and cognitive performance. Stereotype threat research has shown that increasing the salience of an identity that is stigmatized in the domain tested can have detrimental effects (Aronson & Steele, 2005), including African Americans in mathematics (Steele & Aronson, 1995). Although research on causal mechanisms for these findings, has been inconsistent, anxiety-related emotions appear to be a contributor (Smith, 2004). However, stereotype threat findings are limited to specific populations and conditions, namely domain-identified individuals being tested in controlled settings on material that is at the edge of their skill level. In contrast, this study considers students' experiences in natural learning environments. Further, it explores how negative emotions operate in classrooms where race is salient on a day-to-day basis. Moreover, it looks at reform math classroom that are highly social in nature where issues of identity, racial/ethnic identities included, are pushed to the forefront.

The public and social nature of mathematical activity in reform-based courses makes them interesting contexts to consider affect. Some researchers studying reform math have found that these curricula foster achievement supporting affective changes. (Boaler, 2002; Nichols et al., 1990; Stipek et al., 1998). However, these studies did not conduct analyses by race/ethnicity. Other researchers (Lubienski, 2007) have argued that issues of diversity have not been adequately addressed in the implementation of reform curricula. More specifically, some studies have found that teachers of African American students have difficulty establishing the desired discourse norms for these courses (Martin, 2000; Murrell, 1994). It is unclear what role negative emotions might have in the challenges observed.

There are several aspects of reform curricula that may make considerations of affect important for addressing equity concerns. First, these curricula employ problems that lower-achieving students have had more challenges with (Jordan, Kaplan, Nabors Olah, & Locuniak, 2006). Models of affect suggest that past experiences cumulatively precipitate relatively stable beliefs and attitudes that come to shape perception and behavior (Marshall, 1989; Schumann, 1994). Thus, students with histories of low achievement in mathematics (and by extension those students from under-served social groups) may have negative affective responses to the types of problems that are the focus in reform math. Also, these curricula focus on types of math most associated with math anxiety (Hembree, 1990). Finally, students are expected to share answers and justifications, which increases opportunities to expose not only miscalculations, but also misconceptions. Students who view these experiences as creating risks of appearing incompetent may avoid participating in ways that could help them learn (Covington, 1992). Negative emotions may also lead to prolonged deficits in the ability to complete assignments even when students re-engage (Carver & Scheier, 2005)

Studying the role of affect in learning, particularly emotion, presents methodological

challenges. However, isolating affect from intellect is of questionable utility for developing an understanding of human behavior (Eder et al, 2007). Vygotsky wrote “Their separation as subjects of study is a major weakness of traditional psychology.” (1986. p10). More recently other scholars have pointed out that education research in particular tends to treat affect as separate from cognition, which has limited a thorough understanding of affect (Malmivuori, 2006) We can make theoretical distinctions between cognition and emotion but the boundaries between them are not clear (Schoenfeld, 1994). Even while engaged in purely analytical processes our thoughts have an emotional valence (Schumann, 1994). These feelings influence our behavior and thinking and are connected to our identities and beliefs. We advocate a distinctly sociocultural view of emotion that seeks to understand how beliefs and identities are interrelated with affect and participation (see Evans, Morgan, and Tsataroni, 2006 for a related approach). Our model moves beyond looking at affect as an aspect of personality and the subject experiencing the emotion as the prime cause of that experience. Instead, it considers the ways contexts afford and support different beliefs and identities (Greeno, 1994) and how these are related to emotions.

#### Research Questions

1. Are there differences across racial/ethnic groups in the frequency of negative emotion during math class?
2. What is the relationship between negative emotion and math achievement? Are there differences across racial/ethnic groups?
3. Are students’ positive perceptions of group work, stronger connections with teachers, and identification with math associated with less frequent negative emotion during math class? Are there differences across racial/ethnic groups?

#### Methodology

We investigated these questions through a survey that allowed us to make comparisons across broad segments of the population (N = 515; African American N = 115). The survey was administered to all students taking math during a single semester. Participation in many classrooms was 100%. The survey contained four Likert questions about emotion that asked students to rate the frequency that they experienced the following during math: worry about looking stupid, anger when confused, frustration when confused, and headache or stomach aches due to difficulty in math. The content of these items was derived from interview transcripts and observation notes. Other scales included mathematical identity, which asked students about their commitment to the subject and sense of skill in it, and interpersonal connections with teachers, which asked about care and respect in student-teacher relationships (Marks 2000). In addition, we asked students to provide five reasons why their teachers ask them to work in groups. Answers were coded into three categories: providing instrumental support for learning mathematics (IM), providing instrumental support for social learning (SL), and negative comments about group work (N). An additional pair of Likert questions asked students to report the degree to which the found working in groups helped them learn math.

#### Results

Swars, S. L., Stinson, D. W., & Lemons-Smith, S. (Eds.). (2009). Proceedings of the 31<sup>st</sup> annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Atlanta, GA: Georgia State University.

## Question 1

Our results indicated that students from all racial/ethnic groups experience some negative emotions during math class. There were no statistically significant differences in the levels of negative emotion reported between racial/ethnic groups

## Question 2

Correlations between negative emotion and math grades for the entire sample were significant  $r(470) = -.215^{**}$ . African American females showed no correlation between negative emotion and math grades,  $r(56) = .015$ , while African American males showed a significant correlation,  $r(50) = -.345^*$ .

Breaking down the negative emotion variable into individual survey items we found two items contributed more strongly to the significant correlations for African American males, fear of looking stupid in math class,  $r(51) = -.478^{**}$  and frustration when unsure of what to do,  $r(51) = -.345^*$ . White females ( $N = 20$ ) were the only other group with significant correlations on both of these variables.

To investigate whether the relationship between math grades and 'fear of looking stupid' for African-American students was significantly different from that found for the general population we tested the slopes of the regression lines for parallelism for math grades on 'fear of looking stupid' and found that the slope for African Americans was significantly steeper ( $t = -2.752, p = .003$ ). To ensure that this significant finding was not confounded by gender differences, we also compared the slopes of the regression lines for African American males to the slope for all other males for these same variables. The difference between these slopes was also significant ( $t = -2.149, p = .033$ ).

## Question 3

Turning to the relationship between negative emotions during math class and perceptions of group work learning exercises, we did not find significant correlations when examining the sample as a whole. However, analyzed by race/ethnicity, African Americans were the only group that displayed significant correlations between two of these variables, instrumental social (IS)  $r(103) = -.235^*$  and negative comments (N)  $r(103) = .267^{**}$ . These findings indicate that for African American students the awareness of teachers' intention to promote social learning through group learning activities was associated with less negative emotion and critical views of group work were associated with higher levels of negative emotion. A test for the parallelism of the slopes of the regression lines for African American students and non-African Americans students for negative emotion on IS found a nearly significant difference, with the regression line for African Americans having a steeper slope ( $t = -1.853, p = .064$ ).

In the general population, higher levels of math identity (MI) were associated with lower levels of negative emotion (MI  $r(513) = -.251^{**}$ ). Analyzed by race/ethnicity students from all groups displayed significant correlations between these variables, such that less negative emotion was experienced by more domain-identified students.

In the general population, there was a weak but significant negative correlation between interpersonal connection (IC) and negative emotion,  $r(513) = -.108^*$ . Analyzed by racial/ethnic groups, only African American students showed a significant correlation between IC and negative emotion  $r(106) = -.269^{**}$ . Analyzed by gender and race/ethnicity we find only African American and Latino male students showed significant correlations between these variables, but results for African American females

were approaching significance (AAM:  $r[50] = .335^*$ ; LM:  $r[83] = -.244^*$ ; AAF  $r[56] = .252$ ,  $p = .069$ ). A test for parallelism of slopes for African-American students and non-African American students for the regression of negative emotion on interpersonal connection was approaching significance ( $t = -1.846$ ,  $p = .065$ ).

Group work support and interpersonal connection were both associated with lower levels of negative emotion for African American students. We also found that African American males showed the strongest correlations between these variables. Comparisons of the slopes for African American males and all other students for the regression of group work support on interpersonal connection found that African American males showed a steeper slope ( $t = 3.034$ ,  $p = .002$ ).

### Discussion

Not surprisingly, students from all racial/ethnic groups reported experiencing negative emotions in math class. Although there were no significant differences in the amounts of negative emotion reported, there was divergence in how negative emotions were related to achievement across racial/ethnic groups. It is unclear if differences between groups are related to variation in how readily students acknowledge social anxiety, how they define negative emotions as expressed in the survey, and/or different responses to these emotions (or some combination). For example, fear of looking stupid can be experienced as a gripping anxiety or merely as something unpleasant to avoid. Also, some students may manage this anxiety (whatever its strength) by trying to take good notes and ask questions so as to insure that they master the material, whereas others may be motivated by this emotion to attempt to get recognized for some socially valued identity, such as class clown. In addition, we suspect that prior histories of difficulty with mathematics may be related to the strength of negative emotion experienced and how it is responded to. Longitudinal research that can disaggregate the role of factors related to race/ethnicity from achievement history is needed.

African American students showed a stronger relationship between negative emotions and perceptions of group work than students from other groups. Due to the prevalence of stereotypes about African Americans and intelligence (Steele, 1997) and students' awareness of the social consequences of school failure (van Laar, 2000) there may be more at stake and thus more negative emotions for African American students in school contexts where race is salient and emotional safety is lacking. Therefore, perceptions of learning exercises and their purpose may have a greater influence on African American students' emotions. That is, believing that teachers assign group work to promote learning or social development may help students view risk exposure as having an instrumental value, which in turn may lead to experiencing lower levels of negative emotion. Endorsing the learning practices may provide a much-needed proximal reason for engagement for those students who lack certainty about the distal value or likelihood of school achievement. Seeing group work as instrumentally valuable may help also students cognitively restructure interpretations of events in ways that down-regulate negative emotions when they emerge (Gross, 2002). Domain identification with mathematics and interpersonal connections with teachers may help students in similar ways. For example, believing that your teacher respects you and is committed to your

learning may provide ways of framing struggle that decreases arousal and supports engagement and persistence.

Findings indicated that higher levels of math identification were associated with lower levels of negative emotion. These results contrast with stereotype threat research that finds that only domain-identified individuals are subject to the performance-reducing effects of racial priming. This contrast suggests that perhaps the kinds of negative emotion measured in this study are not related to stereotype threat effects. Alternatively, these effects may play out differently *in situ*.

### Conclusion

This study suggests that negative emotions may play a role in achievement inequity in high school mathematics. It also offers promising results. More specifically, this study suggests that when students view the learning practices as having instrumental value and have interpersonal connections with teachers, they may experience less negative emotion. Further research is needed to develop validated measures for the kinds of emotions investigated in this study and to better understand the variability observed in the relationship between negative emotions and achievement across racial/ethnic groups. Additional qualitative research that adds needed complexity to the limited fixed categories of racial/ethnic identities used in these analyses is called for. It will be valuable to examine the different ways racial/ethnic identity is constructed and how these variations relate to the ways emotion influences participation in mathematics.

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