Teacher Immediacy and Learning Mathematics:
Effects on Students with Divergent Mathematical Aptitudes

by

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CHAPTER I

INTRODUCTION

Mathematics education has gained increased attention over the past decade. Despite Bureau of Labor statistics estimating the need for more workers in the fields of science, technology, engineering, and mathematics (STEM) (National Science Board, 2006), the proportions of degrees being awarded in these fields is decreasing (Thiel, Peterman, & Brown, 2008). In comparison to other countries, fewer students in the United States pursue fields requiring knowledge of mathematics. The Organisation for Economic Co-operation and Development (2006) found that poor opinions of STEM were linked to negative educational experiences, and that cultivating a positive image of STEM requires skilled teachers. Is it possible that behavior such as smiling and speaking with vocal variety – which are easy for any teacher to incorporate into his lessons – play a role in encouraging positive attitudes toward mathematics? Further, what impact do these communication behaviors have on the learning of mathematics?

The aim of this study is to examine how teacher nonverbal immediacy behaviors, such as smiling and vocal variety, are related to the affective and perceived cognitive learning of students in mathematics classes. Students enter mathematics classes with widely varying levels of aptitude, and it is of particular interest in this study how the effects of nonverbal immediacy on affective and perceived cognitive learning differ with students' mathematical aptitudes.

Chapter II gives a review of the scholarly literature on nonverbal immediacy, affective learning, and perceived cognitive learning. In addition, a brief overview of the

research on immediacy in mathematics courses is provided, along with the rationale for the hypotheses and research questions. In chapter III, a detailed description of the data-gathering process is presented, including sample demographics, the instruments used to measure the variables, and the statistical methods used to test the hypotheses and research questions. Descriptive statistics for the variables, broken down by mathematics course and aptitude level, along with correlations between all variables are provided in chapter IV. Further analysis of the variables is provided in chapter V, and a discussion of the results is given in chapter VI. The final chapter provides suggestions for further research on nonverbal immediacy and mathematics education.

CHAPTER II

LITERATURE REVIEW

Immediacy

Immediacy is defined as behaviors that reduce the physical or psychological distance between communicators (Mehrabian, 1971). Based on the approach-avoidance theory from social psychology, Mehrabian (1971) asserts that people are drawn toward persons or things they like and avoid things they do not prefer. Though Mehrabian (1971) mentions that immediacy has nonverbal and verbal components, the difficulty in measuring verbal immediacy suggests that it may be best to think of immediacy as a nonverbal construct (Richmond, McCroskey, & Johnson, 2003). Nonverbal immediacy behaviors include positive head nods, close physical distances, vocal expressiveness, smiling, eye contact, and relaxed body position (Andersen, Andersen, & Jensen, 1979). The behaviors that make up the immediacy construct “indicate an approach orientation towards others, resulting in interpersonal closeness, sensory stimulation, warmth, and friendliness” (Plax, Kearney, McCroskey, & Richmond, 1986, p. 45). Students view teachers that are more immediate to be more effective; in addition, students with more immediate teachers have greater positive affect toward the instructor and the course (Andersen, Norton, & Nussbaum, 1981). Immediacy has also been associated with college student attendance (Rocca, 2004), increased motivation (Christophel, 1990; Pogue & AhYun, 2006; Richmond, 1990) and in particular end-of-term motivation (McCroskey, Richmond, & Bennett, 2006) as well as student perceptions of teacher power (Plax et al., 1986) and clarity (Chesebro & McCroskey, 2001). The present study

is interested in particular with the relationship between teacher immediacy and students' affective and cognitive learning.

Nonverbal Immediacy and Affective Learning

Affective learning is defined as students' beliefs, attitudes, and values relating to a course, content, and instructor (Bloom, 1956; Bloom, 1976). In the first published research study on nonverbal immediacy and learning, Andersen (1979) asked students to complete survey instruments measuring observed nonverbal immediacy behaviors of instructors, affect for the instructor, and affect for the course material. She found a strong correlation between nonverbal immediacy and affective learning; in particular, approximately 20% of the variance in student affect toward the subject matter and 46% of the variance in affect toward the teacher was predictable from teachers' scores on the nonverbal immediacy instrument.

Many other studies also utilizing a questionnaire-based approach have reproduced similar results to Andersen (Andersen & Andersen, 1982; Andersen et al., 1981; Christophel, 1990; Gorham, 1988; Plax et al., 1987; Richmond, McCroskey, Kearney, & Plax, 1987; Sanders & Wiseman, 1990), confirming that students' affect is primarily a function of perceptions of teacher nonverbal immediacy (Plax et al., 1986). Other immediacy research using experimental designs (Frymier & Houser, 1998; Titsworth, 2001; Witt & Wheelless, 2001) also supported the link between teacher immediacy behaviors and affective learning. The results of Comstock, Rowell, and Bowers (1995) should be particularly noted, as they found that the relationship between immediacy and affect was inverted-U-curvilinear, rather than the often reported linear relationship. This

suggests that excessively high or low immediacy can have negative consequences on learning. Independent of research design, immediacy has consistently increased affect for the teacher and subject matter (McCroskey & Richmond, 1992; Witt, Wheelless, & Allen, 2004).

Nonverbal Immediacy and Cognitive Learning

While it is clear that there is a strong relationship between affective learning and immediacy, the relationship between cognitive learning and immediacy has been disputed in the instructional communication field. Bloom's (1956) taxonomy of educational objectives identifies cognitive learning as the recall, comprehension, application, and synthesis of newly acquired information. Andersen's 1979 study did not find a correlation between students' grades on a multiple choice exam and teacher immediacy. Others also reported low or no relationship between cognitive learning and teacher immediacy (Andersen et al., 1981; McDowell, McDowell, & Hyerdahl, 1980). However, it has been argued that a single grade on a multiple-choice test, Andersen's measurement of cognitive learning, may not accurately reflect cognitive learning; for example, a test might not differentiate between what a student knows and what a student has learned. In addition, course grades do not always accurately reflect cognitive learning, as they can be influenced by student attendance, group projects, and teacher affect toward the student (Richmond et al., 1987). One of the key difficulties in researching immediacy and cognitive learning is the measurement of cognitive learning. Because researchers wanted to investigate a sample representing teachers from a plethora of fields, it would be extraordinarily difficult to measure cognitive learning objectives across disciplines using

standardized tests. This obstacle was avoided in two ways: operationalizing cognitive learning as “learning loss” and using experimental, rather than survey-based, research design.

Richmond, Gorham, and McCroskey (1987) created the learning loss variable in an attempt to further investigate the relationship of teacher immediacy and cognitive learning. In their study, students were asked to respond to the following question: “On a scale from 0-9, how much did you learn in the class, with 0 meaning you learned nothing and 9 meaning you learned more than in any other class you’ve had?” Then, using the same 0-9 scale, students were asked, “How much do you think you could have learned in the class had you had the ideal instructor?” The first value is subtracted from the second to create the learning loss variable. The justification given for using learning loss as a measure of cognitive learning was that college students have many years of experience in learning environments and should be mature enough to accurately assess how much they actually learned in a course. It is further suggested that any measure of cognitive learning is subjective to a certain degree and that the self-reported estimates are likely to be no more superior than subjective grades in terms of validity of cognitive learning (Richmond et al., 1987); in fact, Chesebro and McCroskey (2000) found a moderately strong correlation between learning loss and students’ scores on a multiple-choice recall test. It was expected that a negative correlation between learning loss and teacher immediacy should exist, as high learning loss signifies less effective instruction. Richmond, Gorham, and McCroskey’s results confirmed this hypothesis. In particular, it was found that vocal expressiveness, smiling, and a relaxed body position had the highest positive association with cognitive learning as measured by learning loss (Richmond et al., 1987).

Subsequently, most instructional communication research on immediacy has used learning loss as the indicator for cognitive learning.

Though many researchers have utilized the learning loss instrument as a measure of cognitive learning, it has been argued that learning loss is not cognitive learning as defined by Bloom and should instead be regarded as “perceived learning” (Witt et al., 2004). Skeptics of the learning loss measure suggest that experimental designs, which can control the degree of immediacy and directly test the information taught, may be a better approach. Kelley and Gorham (1988), in an experimental setting, measured cognitive learning via the recall of a series of words and numbers; they found that short-term recall was higher for subjects who had a teacher high in immediacy as determined by physical proximity and eye contact. Witt and Wheelless (2001) reported that a lecturer high in nonverbal immediacy produced greater recall and less learning loss regardless of the amount of verbal immediacy present. Utilizing a video lecture, Titsworth (2001) found that students exposed to the instructor with high immediacy and organizational cues scored lower on an initial recall test but scored higher on a later test, thus retaining more material than students experiencing other combinations. A meta-analysis, investigating over 80 studies that incorporated both research methods, found a meaningful relationship between immediacy and overall learning (Witt et al., 2004).

Different models have been proposed to understand exactly how immediacy increases student learning. The arousal-attention model postulates that immediacy arouses the student, which increases attention, which in turn increases the ability to recall information (Kelley & Gorham, 1988). Another model, the motivation model, theorizes that teacher nonverbal immediacy has an indirect impact on cognitive learning: a

teacher's immediate behaviors affect student state motivation, which increases student affective and cognitive learning (Christophel, 1990; Frymier, 1993; Richmond, 1990). These models were accepted for about a decade, until Rodríguez, Plax, and Kearney (2006) found support for the affective learning model, which posits that student affective learning is the causal mediator between teacher nonverbal immediacy and student cognitive learning. In other words, immediate teachers enhance students' appreciation or value of learning objectives, thereby indirectly influencing students' cognitive learning. While evidence exists to support all three models, the specifics on exactly how immediacy interacts with student learning is still an open question in the field of communication studies (Mottet, Richmond, & McCroskey, 2006).

Teacher Immediacy and Mathematics

The amount of research on the effects of immediacy in specific subjects is minimal. This is likely due to the typical design of immediacy research, developed by Plax et al. (1986). Student questionnaires are distributed in a class (most often a communications course), but in order to obtain information on a variety of instructors and avoid instructor-related bias, students comment on the immediacy behaviors of a teacher from another course. Prior to the development of this popular method, Kearney, Plax, and Wendt-Wasco (1985) investigated teacher immediacy in divergent college classes. Identifying classes as process oriented (P-type) and task oriented (T-type), the study compared the relationship between teacher immediacy, salience of teacher immediacy, and affective learning of business students enrolled in communications (P-type) and accounting (T-type) classes. The results indicated a positive relationship between

students' affective learning and teacher immediacy in both types of courses; however, a strong correlation between saliency of teacher immediacy and affective learning was found only in the P-type classes, suggesting that teacher immediacy in T-type classes such as mathematics may have an impact on affective learning outside of the students' awareness.

Minimal studies have been conducted on the role of immediacy as it applies specifically to mathematics classes. A relationship was found between motivation and immediacy (nonverbal and verbal) in community college mathematics classes (Furlich & Dwyer, 2007). At the secondary level, nonverbal immediacy did not influence affective learning in ninth-grade students; this unusual result may be due to the focus on cognitive learning necessitated by high-stakes testing (Mottet et al., 2008). Moreover, ninth graders perceived math/science teachers as using less immediate behaviors than non-math/science teachers; however, the authors note that the minimal variance attributable to teacher type suggests that these differences may lack meaning (Mottet et al, 2008).

Rationale and Hypotheses/Research Questions

The present study is concerned with the effects of immediacy in mathematics classes. Numerous studies have indicated a positive correlation between nonverbal immediacy and affective learning as well as nonverbal immediacy and perceived cognitive learning. Though the majority of studies on nonverbal immediacy and learning have sampled the reflections of students from a wide range of academic disciplines, the two studies looking specifically at immediacy in math/science classrooms (Mottet et al, 2008) and task-oriented classes (Kearney et al., 1985) found that the positive correlation

between immediacy and learning is present in mathematics courses. It is expected that similar results will be found in this study, and thus the following hypothesis is proposed:

H₁: A positive correlation between immediacy and affective learning and a negative correlation between nonverbal immediacy and perceived cognitive learning will be present for students in mathematics classes.

In particular, the current study is interested in the relationship between nonverbal immediacy and learning with regard to students' mathematical abilities. It is reasonable to assume that the majority of students with low mathematical aptitude do not pursue careers that require advanced proficiency in mathematics. With the expectation that a greater amount of students with medium or high aptitude in mathematics will choose career paths that are more math or science oriented in comparison to students with low mathematical aptitude, it is important to examine why students choose a particular career path and how this may impact the relationship between nonverbal immediacy and learning mathematics.

Many factors influence an individual's career choice. The career choice model developed by Parsons, Adler, and Kaczala (1982) maintains that students make career choices based on "beliefs about themselves and their own abilities and their beliefs about the relative values of different careers" (Dick & Rallis, 1991, p. 283). Men choosing science/engineering careers indicated significantly more often that they took math and science courses because of academic success and affect for the subject (Dick & Rallis, 1991); in addition, female students' interest in science was the most relevant factor in

choosing a science-based career (Jacobs, Finken, Griffin, & Wright, 1998). In addition, the perceived interestingness of a subject is positively related to likelihood of pursuit of a career (Morgan, Isaac, & Sansone, 2001). Assuming that a college student's major is consistent with the desire to pursue a career in a related field, it is likely that lack of affect for mathematics impacts the academic path chosen by non-math/science majors.

Self-efficacy also plays a role in an individual's career choice. Self-efficacy is defined as an individual's belief of how well he or she can successfully enact behavior required to accomplish a task (Bandura, 1977). An individual's past experiences promote self-efficacy in a subject, which increases interest in the subject; further, greater interest motivates students to become more exposed to a topic corresponding to a career choice (Lent, Lopez, & Bieschke, 1991). Low self-efficacy decreases interest in a subject, thereby influencing students who dislike math to choose another career path; for instance, low math self-efficacy among women is one of the major reasons why fewer women select careers in science and engineering (O'Brien, Martinez-Pons, & Kopala, 1999).

Another reason students may choose one particular career or major over another is personal goals. Students perceive careers in math/science to provide less of an opportunity to meet interpersonal goals than the fields of education, social science, or medicine (Morgan et al., 2001).

In studying motivation and immediacy, Frymier (1993) found that students entering a course with low or medium state motivation had increased motivation when taught by an immediate teacher, but students already entering a course with high motivation still maintained high motivation regardless of the teacher's immediacy behaviors. As motivation is a part of the affective domain, it seems logical that this

principle can be applied to affect in general. Students majoring in math/science already have a positive affect for the material; as non-math/science majors generally have lower affect for the subject matter, they have more to gain from an immediate teacher than those already intrinsically valuing the course material. Further, since non-math/science students are more likely than their counterparts to place importance on interpersonal goals, it is reasonable that they will respond more favorably to an immediate teacher they view as also valuing these goals, since one who uses immediate behaviors reduces the physical and psychological distance between people. Anticipating that the students with low mathematical aptitude will consist of mostly non-math/science majors, the following hypothesis is proposed:

H₂: The correlation between nonverbal immediacy and affective learning will be stronger for students with low mathematical aptitude than for students with high or medium mathematical aptitude.

In accordance with the affective learning model developed by Rodríguez et al. (2006), increases in affective learning are the causal mediator between immediacy and cognitive learning. Based off of the previous hypothesis, if the relationship between immediacy and affective learning is stronger for students with low math aptitude then it is reasonable to suggest that this will also affect their perceived cognitive learning more than for students with greater math aptitude.

H₃: The correlation between immediacy and perceived cognitive learning will be stronger for students with low mathematical aptitude than for students with high or medium mathematical aptitude.

Often, in research on immediacy and learning, one of the goals is to obtain a sample that contains a plethora of instructors from a variety of disciplines. An open question in the field of immediacy research is the effects of immediacy in different fields of study (Mottet et al., 2006). The current study aims to fill this gap in the research by investigating the role of nonverbal immediacy in mathematics. Though mathematical ability is expected to have a significant impact on the strength of the relationship between immediacy and learning, is it possible that the strength of the relationship could differ among mathematics courses? While in general the correlation between immediacy and learning is positive, Sanders & Wiseman (1990) discovered that certain immediacy cues are more relevant for students with respect to ethnicity. Perhaps due to the different curricula and rigor of college algebra and calculus, students in these classes will respond differently to various aspects of the immediacy construct. Thus, this research question is posed:

RQ₁: Does the relationship between nonverbal immediacy and learning differ significantly for students in calculus classes as opposed to students in college algebra classes?

Not only has instructor nonverbal immediacy been linked to positive affect for the course material, but it also associated with affect for the instructor (Chesebro & McCroskey, 2001). In addition, Richmond and McCroskey (2000) found that nonverbally immediate instructors were more likely to be positively evaluated by students. Though it is expected that a positive relationship between nonverbal immediacy and affect for the instructor exists in mathematics classes, to what extent does the type of class or the mathematical aptitude of the student have on this relationship? In a cross-cultural comparison of immediacy in American and French classrooms, a significant difference was found between the correlations of nonverbal immediacy and instructor affect between the two countries (Roach, Cornett-DeVito, & DeVito, 2005). The authors of this study explain that the United States is a low uncertainty avoidance culture, and in an educational context this suggests that teachers and students prefer “plain language” and “broad objectives”; conversely, the French are a high uncertainty avoidance culture, and thus teachers and students prefer structured learning with specific objectives.” (Roach et al., 2005, p. 90). It is possible that the “educational culture” of students in college algebra is not the same as that of calculus; further, students with higher mathematical aptitude may enter mathematics classes with different attitudes than those of students with lower mathematical aptitude. Therefore, this research question is posed:

RQ₂: Does the relationship between nonverbal immediacy and affect for the instructor differ significantly for students in different mathematics courses or with divergent mathematical aptitudes?

CHAPTER III

METHODS

Sample Demographics

Survey participants for this study included 543 students at a large public university in the southwest United States. The students were enrolled in 14 college algebra (n=271) or 15 first-year calculus (n=272) courses representing 20 different instructors (12 male, 8 female). The mean ages of the participants were: M=18.65, college algebra; M=18.75, calculus; M=18.71, overall. More information regarding the ages of the participants is given in Figure 1.

Figure 1. Histogram of Ages of Students Sampled

The overall sample included 302 (56.13%) male and 236 (43.87%) female students; 5 students did not report gender. Of the participants enrolled in college algebra, the sample consisted of 85 (31.6%) male students, 184 (68.4%) female students, and 3 did not specify gender; for calculus, 217 (80.67%) male students, 52 (19.33%) female students, and 2 students not reporting gender participated (see Figure 2).

Figure 2. Histogram of Genders of Students Sampled

The breakdown by class year was 426 (80.08%) freshmen, 78 (14.66%) sophomores, 15 (2.82%) juniors, 13 (2.44%) seniors, and 11 either not indicating a particular class or indicating more than one class. A histogram of the data is given in Figure 3.

Figure 3. Histogram of Class Year of Students Sampled

Each student in the study released his or her SAT and/or ACT mathematics subscores for the research. There were 57 students that had an ACT score but no SAT score and 229 students that had an SAT score but no ACT score. In order to compare the students by math aptitude, a concordance table developed by researchers at the University of Austin was used to convert the ACT mathematics scores of the 57 students lacking an SAT score to an approximate SAT quantitative score. A correlation of .86 was found for University of Texas applicants and .89 in a national concordance study; the authors of the University of Texas table suggest that while the scores are not to be considered equal, they are comparable for the purpose of sorting a population of students (Lavergne &

Walker, 2001). In this paper, a student's SAT math subscore will refer to the actual score if available and the score obtained from the concordance table if not available. Using these revised scores, the mean SAT score was $M=578$, $S.D.=76.85$ for the entire sample. The mean SAT scores for the students enrolled in calculus was $M=615.46$, $S.D.=67.32$. For students enrolled in college algebra, the mean SAT score was $M=541$, $S.D.=67.49$. For histograms of the SAT mathematics scores of the entire sample and both courses, see Figures 4-6.

For the purposes of this study, students were divided into three aptitude groupings by SAT math subscore: SATM High, 620-800; SATM Medium, 550-610; SATM Low, 250-450. The number of students in each aptitude grouping is approximately proportional to the number of students in the university's freshman class that fall into each category.

Figure 4. Histogram of SAT Mathematics Scores for All Students Sampled

Figure 5. Histogram of SAT Mathematics Scores for Calculus Students Sampled

Figure 6. Histogram of SAT Mathematics Scores for College Algebra Students Sampled

Procedures

The survey included measures of affective learning, teacher nonverbal immediacy, and learning loss. After receiving permission from the university's institutional review board, the researcher contacted the instructors of college algebra and first-year calculus courses. In order to maximize the amount of instructors in the sample, 14 college algebra and 15 calculus courses were chosen, representing 20 different instructors. The researcher distributed surveys and read scripted instructions at the end of the class period after the instructor had left the room. Students were instructed to complete the surveys at home and return them at the beginning of the next class period; however, some students voluntarily returned the surveys on the day of distribution. The surveys were distributed during the 13th, 14th, and 15th weeks of a 16-week semester. A total of 654 surveys were collected; however, due to incomplete surveys or lack of test scores, 111 of the surveys were not included in the sample.

Instrumentation

Teacher nonverbal immediacy

Student perceptions of the instructor's nonverbal immediacy (NVI) behaviors were measured by the Nonverbal Immediacy Scale – Observer Report (NIS-O) developed by Richmond, McCroskey, and Johnson (2003). The NIS-O consists of 26 items, half of which are positively worded and the other half negatively worded. The items were presented with a 5-point Likert-type response format and students were to rate the frequency of certain immediacy behaviors exhibited by the instructor (1=never, 5=very often). The scale has a range from 26 to 130, with higher scores indicating stronger

degrees of nonverbal immediacy. The alpha reliability for the NIS-O in the present study was 0.90 ($M=91.46$, $S.D.=13.81$); this is consistent with previously reported reliability estimates of around 0.90 (Mottet et al., 2006).

Affective Learning

The affective learning instrument was developed by McCroskey (1994) to measure affect for the content of a course. The instrument consists of two measures each with four bipolar scales from 1-7, which gives the scale a range of 8-56. The first measure (ALS) represents students' feelings on the content of the course (bad/good, valuable/worthless, unfair/fair, positive/negative) and the second measure (ALFS) represents students' feelings on taking future courses in mathematics (unlikely/likely, possible/impossible, improbable/probable, would/would not). The scale is coded so that higher scores reflect positive feelings toward the subject. The alpha reliability of the instrument in the current study was .89 ($M=43.55$, $S.D.=10.14$); this is consistent with prior studies, which have had alpha reliabilities of .90 or above (McCroskey, 1994).

Perceived Cognitive Learning

The learning loss (LL) variable was created by Richmond, Gorham, and McCroskey (1987) in order to measure cognitive learning in the absence of a solid, objective measure; this was necessary due to the obvious difficulty in creating standardized tests for the amount of courses surveyed in their research. The instrument consists of two questions: "How much did you learn in this class?" and "How much do you think you could have learned in this class had you had the ideal instructor?" Subjects

are to respond using a scale from 0 to 9, with 0 indicating that he/she learned nothing and 9 indicating that he/she had learned more than in any other class. The first response is subtracted from the second and used as the learning loss variable. This results in a range of -9 to 9 for the learning loss variable, though it is hard to determine how to interpret a negative score as this implies that the subject thought he or she would learn less from an ideal instructor than from the teacher in question! It was expected that all the learning loss scores would be greater than zero, however 24 respondents had a negative learning loss score.

Instructor Affect

Instructor affect was measured using two items from the Instructional Affect Assessment Instrument, developed by McCroskey (1994) to measure affect for the instructor of a course. The instrument consists of two measures each with four bipolar scales from 1-7, which gives the scale a range of 8-56. The first measure (IA) represents students' feelings on the instructor of the course (bad/good, valuable/worthless, unfair/fair, positive/negative) and the second measure (IAF) represents students' feelings on taking future courses with this instructor if possible (unlikely/likely, possible/impossible, improbable/probable, would/would not). The scale is coded so that higher scores reflect more positive feelings toward the instructor. Reported alpha reliabilities for this instrument are over .90 (McCroskey, 1994); the alpha reliability of the instrument in the current study was .94 (M=42.73, S.D.=12.14).

Data Analysis

For each of the hypotheses and the research question, Pearson product-moment correlations were computed to determine the linear dependence between variables. Correlation coefficients closer to -1 or 1 indicate stronger relationships between the variables, while coefficients closer to 0 represent weaker relationships between the variables. In order to test H_1 , Pearson product-moment correlations were computed between nonverbal immediacy and affective learning, nonverbal immediacy and learning loss, and affective learning and learning loss for the entire sample. For H_2 , a Pearson correlation was computed between nonverbal immediacy and affective learning for each of the three aptitude groups. H_3 was tested by computing Pearson correlations between nonverbal immediacy and learning loss for each aptitude group. In the case of RQ_1 , Pearson correlations between nonverbal immediacy and affective learning, nonverbal immediacy and learning loss, and affective learning and learning loss were calculated separately for college algebra students and calculus students. Pearson product-moment correlations between nonverbal immediacy and instructor affect were computed for the entire sample, both mathematics courses, and the three aptitude levels in order to answer RQ_2 .

CHAPTER IV

RESULTS

Teacher nonverbal immediacy

The Nonverbal Immediacy Scale – Observer Report (NIS-O), the instrument used to measure teacher nonverbal immediacy, has a range of 26-130. Higher values represent a greater amount of observed immediacy behaviors. For the present study, the range for the entire sample was 30-129. Richmond, McCroskey, and Johnson (2003) report normal means of 94.2 with standard deviation 15.6 for the instrument. For the entire sample in this study, the mean was 91.46 with standard deviation 13.81. A histogram is given in Figure 7.

Figure 7. Histogram of Nonverbal Immediacy Scores for Entire Sample

The mean of the nonverbal immediacy scores for the calculus students was $M=95.15$, $S.D.=13.19$. For students in college algebra, the nonverbal immediacy scores had mean $M=87.78$, $S.D.=13.46$. Histograms of the scores for each are given in Figures 8-9.

Figure 8. Histogram of Nonverbal Immediacy Scores for Calculus Students

Figure 9. Histogram of Nonverbal Immediacy Scores for College Algebra Students

Mean nonverbal immediacy scores for students in each of the three math aptitude groupings were: high math aptitude, $M=94.02$, $S.D.=11.80$; medium math aptitude, $M=91.97$, $S.D.=13.86$; low math aptitude, $M=88.23$, $S.D.=15.09$. Histograms of the data for each aptitude group are given in Figures 10-12.

Figure 10. Histogram of Nonverbal Immediacy Scores for SATM High Group

Figure 11. Histogram of Nonverbal Immediacy Scores for SATM Medium Group

Figure 12. Histogram of Nonverbal Immediacy Scores for SATM Low Group

Affective Learning

The possible range for the affective learning instrument is 8-56; in the current study, the lowest and highest affective learning scores were 10 and 56, respectively. For this instrument, higher scores represent more affective learning. The mean for the entire sample was $M=43.55$, $S.D.=10.14$. The calculus students had a mean affective learning score $M=48.14$, $S.D.=8.20$ while students enrolled in college algebra had a mean affective learning score of $M=38.97$, $S.D.=9.81$. Histograms of the affective learning scores for the entire sample and both courses are given in Figures 13-15.

Figure 13. Histogram of Affective Learning Scores for Entire Sample

Figure 14. Histogram of Affective Learning Scores for Calculus Students

Figure 15. Histogram of Affective Learning Scores for College Algebra Students

The mean affective learning scores for students in the three mathematical aptitude groups were as follows: high mathematical aptitude, $M=47.06$, $S.D.=8.46$; medium mathematical aptitude, $M=44.58$, $S.D.=9.85$; low mathematical aptitude, $M=38.74$, $S.D.=10.26$. Histograms for each group are given in Figures 16-18.

Figure 16. Histogram of Affective Learning Scores for SATM High Group

Figure 17. Histogram of Affective Learning Scores for SATM Medium Group

Figure 18. Histogram of Affective Learning Scores for SATM Low Group

Perceived Cognitive Learning

Perceived cognitive learning was measured via the learning loss variable.

Learning loss is calculated by taking the difference of two ratings: how much the student believes he or she would have learned from an ideal instructor and how much he or she felt was learned from the instructor in question. The possible range for learning loss scores is -9 to 9 . A learning loss score of 0 implies that the student felt that he or she would not have learned any more in the course from an ideal instructor than the actual instructor; another interpretation is that the student may have felt that she or he had an ideal instructor. The mean learning loss reported for the entire sample was $M=1.23$, $S.D.=1.84$. The mode for the sample was zero; over a third of respondents felt that he or

she would not have learned more from the ideal instructor. The mean learning loss score for calculus students was $M=0.85$, $S.D.=1.56$; college algebra students had a mean of $M=1.61$, $S.D.=2.01$ for learning loss. Histograms of perceived cognitive learning scores are given for the entire sample and each course (see Figures 19-21).

Figure 19. Histogram of Perceived Cognitive Learning Scores for Entire Sample

Figure 20. Histogram of Perceived Cognitive Learning Scores for Calculus Students

Figure 21. Histogram of Perceived Cognitive Learning Scores for College Algebra Students

The mathematical aptitude subgroups had the following mean scores for perceived cognitive learning: high mathematical aptitude, $M=0.73$, $S.D.=1.69$; medium mathematical aptitude group, $M=1.24$, $S.D.=1.83$; low mathematical aptitude group, $M=1.73$, $S.D.=1.85$. Histograms of the perceived cognitive learning scores for each aptitude group are given in Figures 22-24.

Figure 22. Histogram of Perceived Cognitive Learning Scores for SATM High Group

Figure 23. Histogram of Perceived Cognitive Learning Scores for SATM Medium Group

Figure 24. Histogram of Perceived Cognitive Learning Scores for SATM Low Group

Instructor Affect

The possible range for instructor affect is 8-56; this was also the range for the data observed in the current study. For this instrument, higher scores represent more affect for the instructor of the course. The mean instructor affect score for the entire sample was $M=42.73$, $S.D.=12.14$, while the mean instructor affect score for was $M=46.72$, $S.D.=10.57$ for calculus students and $M=38.75$, $S.D.=12.32$ for college algebra students. Histograms of the instructor affect scores for the entire sample and both courses are below (Figures 25-27).

Figure 25. Histogram of Instructor Affect Scores for Entire Sample

Figure 26. Histogram of Instructor Affect Scores for Calculus Students

The mean instructor affect scores for the mathematical aptitude groups were: high mathematical aptitude, $M=45.96$, $S.D.=10.27$; medium aptitude group, $M=42.99$, $S.D.=12.29$; low aptitude group, $M=39.08$, $S.D.=12.82$. Histograms of the instructor affect scores for each aptitude group are given in figures 28-30.

Figure 28. Histogram of Instructor Affect Scores for SATM High Group

Figure 29. Histogram of Instructor Affect Scores for SATM Medium Group

Figure 30. Histogram of Instructor Affect Scores for SATM Low Group

Correlations

Pearson product-moment correlations were calculated between all possible pairings of the following variables: nonverbal immediacy (NVI), affective learning (AL), learning loss (LL), and instructor affect (IA). Separate correlations were computed for the entire population (Table 1), both mathematics courses (Tables 2-3), and the three mathematical aptitude groups (Tables 4-6). All correlations are significant for $p < 0.0001$ unless otherwise noted.

Table 1. Pearson Correlations for All Variables (Entire Sample)

	NVI	AL	LL	IA
NVI	1	0.40649	-0.45086	0.61807
AL		1	-0.40274	0.59372
LL			1	-0.63844
IA				1

Table 2. Pearson Correlations for All Variables (Calculus)

	NVI	AL	LL	IA
NVI	1	0.38248	-0.40715	0.57771
AL		1	-0.41502	0.62706
LL			1	-0.59815
IA				1

Table 3. Pearson Correlations for All Variables (College Algebra)

	NVI	AL	LL	IA
NVI	1	0.29343	-0.43419	0.58918
AL		1	-0.31592	0.45797
LL			1	-0.63154
IA				1

Table 4. Pearson Correlations for All Variables (SATM High)

	<i>NVI</i>	<i>AL</i>	<i>LL</i>	<i>IA</i>
<i>NVI</i>	1	0.24945*	-0.36437	0.61015
<i>AL</i>		1	-0.28021	0.51572
<i>LL</i>			1	-0.51884
<i>IA</i>				1

*p=0.0008

Table 5. Pearson Correlations for All Variables (SATM Medium)

	<i>NVI</i>	<i>AL</i>	<i>LL</i>	<i>IA</i>
<i>NVI</i>	1	0.47771	-0.51522	0.60651
<i>AL</i>		1	-0.47774	0.62054
<i>LL</i>			1	0.66452
<i>IA</i>				1

Table 6. Pearson Correlations for All Variables (SATM Low)

	<i>NVI</i>	<i>AL</i>	<i>LL</i>	<i>IA</i>
<i>NVI</i>	1	0.36140	-0.39640	0.59726
<i>AL</i>		1	-0.29949	0.54108
<i>LL</i>			1	-0.65137
<i>IA</i>				1

Pearson product-moment correlations were also calculated between all possible pairings of the following variables: nonverbal immediacy (NVI), affect for mathematical learning (ALS), affect for future mathematical learning (ALFS), instructor affect (IA), and future instructor affect (IAF). These correlations were computed for the entire sample (Table 7) as well as all five subgroups (Tables 8-12).

Table 7. Correlations for NVI and Affective Learning Variables (Entire Sample)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.47136	0.28474	0.62680	0.56420
<i>ALS</i>		1	0.51055	0.68300	0.57033
<i>ALFS</i>			1	0.40666	0.43087
<i>IA</i>				1	0.79826
<i>IAF</i>					1

Table 8. Correlations for NVI and Affective Learning Variables (Calculus)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.44517	0.24015	0.59041	0.52715
<i>ALS</i>		1	0.44594	0.68967	0.60135
<i>ALFS</i>			1	0.43853	0.40969
<i>IA</i>				1	0.81839
<i>IAF</i>					1

Table 9. Correlations for NVI and Affective Learning Variables (College Algebra)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.41021	0.15163	0.60569	0.52237
<i>ALS</i>		1	0.44136	0.62889	0.46625
<i>ALFS</i>			1	0.25581	0.27732
<i>IA</i>				1	0.75323
<i>IAF</i>					1

Table 10. Correlations for NVI and Affective Learning Variables (SATM High)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.37265	0.10715	0.60573	0.56943
<i>ALS</i>		1	0.33660	0.60240	0.52091
<i>ALFS</i>			1	0.30674	0.33282
<i>IA</i>				1	0.81447
<i>IAF</i>					1

Table 11. Correlations for NVI and Affective Learning Variables (SATM Medium)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.51927	0.35799	0.60013	0.56675
<i>ALS</i>		1	0.55037	0.70033	0.61764
<i>ALFS</i>			1	0.41328	0.45792
<i>IA</i>				1	0.81299
<i>IAF</i>					1

Table 12. Correlations for NVI and Affective Learning Variables (SATM Low)

	<i>NVI</i>	<i>ALS</i>	<i>ALFS</i>	<i>IA</i>	<i>IAF</i>
<i>NVI</i>	1	0.43184	0.24117	0.63040	0.51716
<i>ALS</i>		1	0.48765	0.67334	0.49280
<i>ALFS</i>			1	0.36133	0.37067
<i>IA</i>				1	0.75252
<i>IAF</i>					1

CHAPTER V

ANALYSIS OF VARIABLES

Teacher Nonverbal Immediacy

A post-hoc analysis of the data indicated that as the ability level of the groups increased, so did the mean nonverbal immediacy: the high SATM group had a mean of 94.02, the medium SATM group had a mean of 91.97, and the low SATM group's mean was 88.2. In addition, as the aptitude of the group decreased, the variance of the nonverbal immediacy scores increased: standard deviations for the high, medium, and low aptitude groups were 11.80, 13.86, and 15.09, respectively.

Affective Learning

Similar to the results for nonverbal immediacy, the calculus students in the sample had a higher mean for affective learning than did their peers taking college algebra. As many of the students taking calculus are engineering majors, and one of the measures of affective learning is concerned with enrolling in more mathematics courses in the future, this result was expected. It was also not surprising to find that students enrolled in college algebra courses had lower affective learning scores ($M=38.97$) than their peers in calculus ($M=43.55$). It should be noted that the mean score for college algebra students is significantly higher than a "neutral" affective learning score of 24. Though it is often the case that many students in lower level courses often state a dislike of mathematics, it appears that students still feel that the course material has some value.

When the sample is grouped according to mathematical ability, a trend similar to the results for nonverbal immediacy may be observed. The group with the highest SAT math scores also had a higher mean affective learning score ($M=47.06$, $S.D.=8.46$) than the middle ($M=47.06$, $S.D.=8.46$) or low ($M=44.58$, $S.D.=9.85$) achievement groups; further, the data became more dispersed as ability level decreased. Also of note is that for the entire sample the mode of the scores, achieved by 50 students, was the maximum possible affective learning score.

Perceived Cognitive Learning

Consistent with the results for nonverbal immediacy and affective learning, differences may be observed when the data is divided by course enrollment. The mean learning loss score for calculus students ($M=0.85$, $S.D.=1.56$) is lower than that of college algebra students ($M=1.61$, $S.D.=2.01$). Nearly half of the calculus students, as indicated by a learning loss score of zero, felt that they would not have learned any more from an ideal calculus instructor; in comparison, only 30% of college algebra students shared that opinion. In addition, the data for college algebra students is bimodal, with 0 and 2 being the learning loss scores with the greatest frequency.

In analyzing differences among ability groups, it was found that as mathematical aptitude levels decreased, the mean learning loss scores increased. Since learning loss is a negative measure (lower learning loss scores indicate that more was learned from the instructor), this indicates a trend similar to that observed for nonverbal immediacy and affective learning. The highest mathematical aptitude group had a mean learning loss score of 0.73 (standard deviation 1.69), with almost half of the respondents having no

learning loss. Students in the medium aptitude designation had a mean learning loss score of 1.24 (standard deviation 1.83), with nearly 40% of students indicating no learning loss. However, nearly 70% of the respondents in the lowest aptitude category indicated they would have learned more with an ideal instructor. Though the mean for the low aptitude group (1.73) was the highest of the three groups, the standard deviation (1.85) was very close to that of the medium achievement group. Moreover, the data for the students in the low aptitude group is bimodal in a manner similar to that of the college algebra students.

Instructor Affect

As was the case with affective learning, it was found that students in college algebra classes had less affect for the instructor than did their peers taking calculus: the mean instructor affect for college algebra students (38.75) was lower than for calculus students (46.72). Approximately 22% of students surveyed in the calculus courses had the highest possible instructor affect score, but only 12% of students in college algebra reported the highest possible instructor affect.

When instructor affect means were compared among the three aptitude groupings, the same pattern observed with the previous variables emerged: as the aptitude of the group decreased, so did the mean instructor affect score. The high aptitude students had a mean of 45.96, the medium aptitude students had a mean of 42.99, and the low aptitude students had a mean of 39.08. Though the highest aptitude group had the highest mean instructor affect, it is interesting to note that the medium aptitude group had nearly 20% of respondents with the highest possible affect for the

instructor, in comparison to students in the high (18%) and low (12%) aptitude categories.

Hypotheses and Research Questions

H₁ predicted that for the overall sample, the relationship between NVI and AL would be positive and the relationship between NVI and LL would be negative. The results support this hypothesis. A moderate correlation, $r(543)=.41$, $p<0.0001$ was found for teachers' nonverbal immediacy behaviors and students' affective learning. It should also be noted that when the affective learning measure was restricted to only the four items addressing the content of the class and omitting those regarding the likelihood of taking future courses, the correlation between nonverbal immediacy and this modified affective learning was greater, $r(543)=.47$, $p<0.0001$. In addition, a moderate negative correlation, $r(543)=-0.45$, $p<0.0001$, was reported for nonverbal immediacy and learning loss.

H₂ predicted that there would be a positive relationship between NVI and AL for all students, but that the correlation would be stronger for students with lower math aptitude. This hypothesis was partially confirmed by the results. The correlations for the three SAT divisions were: High, $r(179)=.25$ $p = 0.0008$; Medium: $r(192)=.48$, $p<0.0001$; Low: $r(172)=.36$, $p<0.0001$. When affective learning was restricted to subject affective learning, the results were High, $r(179)=.37$, $p<0.0001$; Medium, $r(192)=.52$, $p<0.0001$; Low, $r(172)=.43$, $p<0.0001$.

It was hypothesized in H₃ that there would be a negative relationship between NVI and LL for all students, but that the correlation would be stronger for students with

lower math aptitude. This hypothesis was partially confirmed by the results. The correlations for the three SAT divisions were: High: $r(179) = -0.36$, $p < 0.0001$; Medium: $r(192) = -0.52$, $p < 0.0001$; Low: $r(172) = -0.40$, $p < 0.0001$.

The first research question (RQ₁) was concerned with any differences in correlation between nonverbal immediacy and learning (affective and perceived cognitive) with respect to course type. For calculus students, the correlation between nonverbal immediacy and affective learning was $r(271) = .38$, $p < 0.0001$; for students in college algebra, a correlation of $r(272) = 0.29$, $p < 0.0001$ was found. Both of these individual correlations were weaker than the correlation between nonverbal immediacy and affective learning observed for the entire sample. In looking at the correlation between nonverbal immediacy and affect for the subject matter, similar correlations were found for calculus ($r(271) = .44$, $p < 0.0001$) and college algebra ($r(272) = .41$, $p < 0.0001$) students. Correlations between nonverbal immediacy and learning loss were also similar between the two courses, with calculus students having a correlation coefficient of $r(271) = -0.40$, $p < 0.0001$ and college algebra students having a correlation coefficient of $r(272) = -0.43$, $p < 0.0001$.

The second research question (RQ₂) asked what observations could be made regarding nonverbal immediacy and affect for the instructor. A strong positive correlation, $r(543) = 0.62$, $p < 0.0001$, was found between nonverbal immediacy and instructor affect for the entire sample. In fact, this correlation was stronger than nonverbal immediacy's correlation with affective learning (0.41) or learning loss (-0.45). The correlation between nonverbal immediacy and instructor affect was almost the same for college algebra students, $r(272) = 0.59$, $p < 0.0001$, as it was for calculus students,

$r(271)=0.58, p<0.0001$. Correlations between nonverbal immediacy and instructor affect were nearly identical when the sample was broken down into mathematical aptitude groups: the high aptitude grouping had a correlation of $r(179)=0.61, p<0.0001$; the medium aptitude grouping had a correlation of $r(192)=0.61, p<0.0001$; the low aptitude grouping had a correlation of $r(172)=0.60, p<0.0001$.

CHAPTER VI

DISCUSSION

The primary goal of this study was to determine how the nonverbal immediacy behaviors of mathematics instructors relate to the affective and perceived cognitive learning of students. More specifically, the study explored the relationship between nonverbal immediacy and learning with respect to the mathematical aptitude of students in calculus and college algebra courses.

First, it was predicted that for students in mathematics courses, nonverbal immediacy would correlate positively with affective learning and negatively with learning loss. The data supported this prediction. Furthermore, it should be noted that the findings in the present study are consistent with previous studies conducted in the instructional communication community (Andersen, 1979; Chesebro & McCroskey, 2001; Christophel, 1990; Gorham, 1988; Mottet & Beebe, 2002; Plax et al., 1986; Richmond, 1990; Witt et al., 2004) which sampled the opinions of students taking courses in a variety of disciplines. Only two previous studies examined immediacy and learning as it pertains to specific courses; similarities may be found when comparing these to the present study. Mottet et al. (2008) reported a correlation of .37 for immediacy and affective learning for ninth graders in math/science courses, where affective learning is measured regarding attitudes about the subject matter. The present study found a stronger correlation (.47), perhaps because college students are more mature than high school students and the caliber of students in college is higher than that of the general high school population. Mottet et al. (2008) also report a correlation of .20

for immediacy and affective learning, where affective learning measures attitudes toward the course material and likelihood of using mathematics/science in high school, college, and career. The current study found a correlation of .28 between nonverbal immediacy and affective learning as it pertains to future mathematics courses. Both studies found that the correlation between nonverbal immediacy and affective learning is weaker when affect is identified as taking future courses in mathematics; however, as college students are probably better equipped than high school freshmen to determine the likelihood of using mathematics in the future, it is not surprising that the current study had a higher correlation between immediacy and affect for future mathematics learning. Kearney, Plax, and Wendt-Wasco (1985) looked at the relationship between immediacy and affective learning for T-type (task-oriented) classes, such as mathematics. They found a correlation of .43 between immediacy and affect for course content, while the correlation between immediacy and enrolling in another course was .16; these results are supported by the data in the current report. In regards to the correlation between nonverbal immediacy and perceived cognitive learning, results in the present study were consistent with many previous studies (Chesebro & McCroskey, 2001; Christophel, 1990; Gorham, 1988; Mottet & Beebe, 2002; Richmond et al., 1987; Richmond, 1990; Witt & Wheelless, 2001; Witt et al., 2004).

The second prediction, that students with lower math aptitude would have a higher correlation between immediacy and affective learning than those with medium or high math aptitude, was partially supported by the data. It was found that the lower SATM group did have a higher correlation with affective learning than the highest SATM group; however, the middle SATM group had the strongest correlation.

The third hypothesis posited that students with lower math aptitude would have a stronger correlation between nonverbal immediacy and perceived cognitive learning than the other two aptitude categories. The data revealed minimal differences in the correlations between nonverbal immediacy and perceived cognitive learning in the lower and high mathematical aptitude groups. Despite this finding, almost 70% of the students in the low aptitude group, versus 50% of students in the high aptitude group, felt that they would have learned more from an ideal instructor. The middle aptitude group again had the strongest correlation with nonverbal immediacy.

Research on immediacy and motivation may shed some light on the results of the second and third hypotheses. Frymier (1993) found that students who were highly motivated at the beginning of a course remained highly motivated at the end of the course regardless of the immediacy behaviors of the instructor. Perhaps it is the case that students with high mathematical aptitude already have firm attitudes toward learning mathematics and that positive (or negative) immediacy behaviors do not affect their beliefs. Similarly, students with high math aptitude are likely to be less reliant on the instructor in their learning of mathematics, thus immediacy may not have a profound impact on perceived learning.

The first research question asked if there were differences in the correlations between nonverbal immediacy and learning with regard to the type of mathematics course. The data indicated that students enrolled in calculus had a stronger correlation (.38) for nonverbal immediacy and overall affective learning than did student taking college algebra (.29). Since overall affective learning accounts for the desire to study mathematics in the future, it follows that the correlation between immediacy and affect is

higher for students in calculus. Many of the students enrolled in calculus are required to take a sequence of calculus courses as a requirement for their major; conversely, most students in college algebra are in a field of study that does not require them to take another mathematics course. Therefore, when comparing the two courses, it may be more appropriate to examine the correlation between nonverbal immediacy and affect for subject matter. Indeed, when specifically looking at the correlation between nonverbal immediacy and affect for subject matter, the differences between calculus (.45) and college algebra (.41) are diminished. The correlation between nonverbal immediacy and perceived cognitive learning was nearly the same for calculus students (-0.41) as it was for college algebra students (-0.43), despite the fact that college algebra students had a greater variance in learning loss scores.

The second research question was concerned with exploring the relationship between nonverbal immediacy and instructor affect, and a moderately strong positive correlation was observed between these variables (.62) for the entire sample. However, unlike the correlations between nonverbal immediacy and the other variables observed, disaggregating the data by course or mathematical aptitude did not reveal significant changes in the correlations. McCroskey, Richmond, and McCroskey (2002) found that teachers exhibiting nonverbal immediacy behaviors are seen as “more caring, clearer, and overall better teachers than less immediate teachers” (p. 387). The results of the present study support this assertion, despite the mathematical ability of the student or the subject matter of the course.

CHAPTER VII

CONCLUSION

The effects of teacher immediacy on student learning have been researched in detail over the past several decades; however, the extent to which immediacy is differentially effective for different subject matters is not fully known. The present study assists in furthering the knowledge base of immediacy research as it pertains to mathematics: a relationship was found between teacher nonverbal immediacy and students' affective and perceived cognitive learning. In addition, a new research direction was explored in the study: to what extent are different levels of immediacy differentially effective for students with different levels of math aptitude? It was found that while a moderate correlation between nonverbal immediacy and students' affective and perceived cognitive learning existed for students with high, medium, and low math aptitudes, the relationship was slightly stronger for students with medium mathematical aptitude.

When interpreting the results of this study, it is important to note that the research had some limitations. The sample population for this study consisted of college students from a single university; further, the majority of students in the sample were freshmen. Also, since the surveys were distributed at a class session, it might be the case that students with sporadic attendance may be underrepresented in the study: out of 1140 possible students enrolled in the courses surveyed, only 654 surveys (of which 543 were valid) were collected. One should be cautious in generalizing the results of the study to the general college population.

A concern from the outset of the study was the measurement of perceived cognitive learning via the learning loss variable. When recording the data, the researcher noted that several students wrote unsolicited comments when answering the learning loss items. Most often, these comments were made when a student recorded a low score for the question “How much did you learn in this course,” and the typical reason given for the score was that he or she had already learned much of the material in a previous course. It seemed that many of the students did not want the researcher to believe that lack of learning was a result of an inadequate instructor, but due to previously mastering the objectives of the course. To a certain degree, the learning loss variable takes into account this perception, as the student would often give the instructor the same score on the next question, “If you had the ideal instructor, how much would you have learned.” However, the students making these comments bring to light a limitation of the study: how does prior subject knowledge interact with the relationship between nonverbal immediacy and perceived cognitive learning? Students enter the classroom with widely varying levels of prior knowledge. Even though a student might have an instructor with high immediacy, he or she might still perceive that more learning could have been obtained from a better instructor; it remains to be determined if this assumption is due to immediacy behaviors, the student’s definition of an “ideal” teacher, or other factors.

Future research on immediacy in mathematics classes should be conducted using a measure of learning that is not dependent upon students’ self-assessment. For instance, students could be given a standardized pre-test at the beginning of the course to determine how much of the material has already been mastered. Then, at the end of the course, a post-test would be administered to assess the material learned during the course.

In this manner, it would be possible to have a better representation of the learning gains achieved by the student for the duration of the course; further, this measure could be used in conjunction with the learning loss variable to compare standardized-test-based learning with perceived cognitive learning.

In summary, a link was found between student affective and perceived cognitive learning and teacher nonverbal immediacy in mathematics classes. Though the strength of the relationship between immediacy and learning may have varied slightly depending on what course students were enrolled or the mathematical aptitude of the students, it is clear that teachers engaging in nonverbal immediacy behaviors had more students with positive affect towards mathematics and greater perceived learning. Teaching mathematics educators about the importance of nonverbal immediacy and how to incorporate these behaviors in the classroom could improve student attitudes toward math and thus increase the number of students choosing to pursue careers utilizing mathematics. Moreover, if something so simple as a smile could be a factor in helping students achieve mathematical excellence, it is imperative to enlighten educators about the benefits of nonverbal immediacy in the classroom: our future may depend on it.

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APPENDIX A
STUDENT SURVEY

DIRECTIONS: Please complete the following demographic information.

Age:

Gender:

Class (circle one): Freshman, Sophomore, Junior, Senior

Major:

DIRECTIONS: Please circle the number that best represents your feelings. The closer a number is to the item/adjective, the more you feel that way.

I feel the class' content is:

Bad	1	2	3	4	5	6	7	Good
Valuable	1	2	3	4	5	6	7	Worthless
Unfair	1	2	3	4	5	6	7	Fair
Positive	1	2	3	4	5	6	7	Negative

My likelihood of taking future courses in this content area is:

Unlikely	1	2	3	4	5	6	7	Likely
Possible	1	2	3	4	5	6	7	Impossible
Improbable	1	2	3	4	5	6	7	Probable
Would	1	2	3	4	5	6	7	Would not

Overall, the instructor I have in the class is:

Bad	1	2	3	4	5	6	7	Good
Valuable	1	2	3	4	5	6	7	Worthless
Unfair	1	2	3	4	5	6	7	Fair
Positive	1	2	3	4	5	6	7	Negative

Were I to have the opportunity, my likelihood of taking future courses with this specific teacher would be:

Unlikely	1	2	3	4	5	6	7	Likely
Possible	1	2	3	4	5	6	7	Impossible
Improbable	1	2	3	4	5	6	7	Probable
Would	1	2	3	4	5	6	7	Would not

DIRECTIONS: The following statements describe the ways some people behave while talking with or to others. Please indicate in the space at the left of each item the degree to which you believe the statement applies to the instructor of this course. Please use the following 5-point scale:

1 = Never 2 = Rarely 3 = Occasionally 4 = Often 5 = Very Often

- _____ 1. He/she uses her/his hands and arms to gesture while talking to people.
- _____ 2. He/she touches others on the shoulder or arm while talking to them.
- _____ 3. He/she uses a monotone or dull voice while talking to people.
- _____ 4. He/she looks over or away from others while talking to them.
- _____ 5. He/she moves away from others when they touch her/him while they are talking.
- _____ 6. He/she has a relaxed body position when he/she talks to people.
- _____ 7. He/she frowns while talking to people.
- _____ 8. He/she avoids eye contact while talking to people.
- _____ 9. He/she has a tense body position while talking to people.
- _____ 10. He/she sits close or stands close to people while talking with them.
- _____ 11. Her/his voice is monotonous or dull when he/she talks to people.
- _____ 12. He/she uses a variety of vocal expressions when he/she talks to people.
- _____ 13. He/she gestures when he/she talks to people.
- _____ 14. He/she is animated when he/she talk to people.
- _____ 15. He/she has a bland facial expression when he/she talks to people.
- _____ 16. He/she moves closer to people when he/she talks to them.
- _____ 17. He/she looks directly at people while talking to them.
- _____ 18. He/she is stiff when he/she talks to people.
- _____ 19. He/she has a lot of vocal variety when he/she talks to people.

DIRECTIONS: The following statements describe the ways some people behave while talking with or to others. Please indicate in the space at the left of each item the degree to which you believe the statement applies to the instructor of this course. Please use the following 5-point scale:

- _____ 20. He/she avoids gesturing while he/she is talking to people.
 - _____ 21. He/she leans toward people when he/she talks to them.
 - _____ 22. He/she maintains eye contact with people when he/she talks to them.
 - _____ 23. He/she tries not to sit or stand close to people when he/she talks with them.
 - _____ 24. He/she leans away from people when he/she talks to them.
 - _____ 25. He/she smiles when he/she talks to people.
 - _____ 26. He/she avoids touching people when he/she talks to them.
-

DIRECTIONS: Please answer the following two questions. Please place your response in the space provided.

_____ On a scale of 0-9, how much did you learn in this class, with 0 meaning you learned nothing and 9 meaning you learned more than in any other class you've had.

_____ How much do you think you could have learned in this class had you had the ideal instructor? (Use the same 0-9 scale).

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____Ryan Q. McCluskey_____

Student Signature

____14 March 2009_____

Date