American Educational Research Journal
March 2009, Vol. 46, No. 1, pp. 275–314
DOI: 10.3102/0002831208324517

Sources of Middle School Students' Self-Efficacy in Mathematics: A Qualitative Investigation

Ellen L. Usher
University of Kentucky

According to A. Bandura's (1986) social cognitive theory, individuals form their self-efficacy beliefs by interpreting information from four sources: mastery experience, vicarious experience, social persuasions, and physiological or affective states. The purpose of this study was to examine the heuristics students use as they form their mathematics self-efficacy from these and other sources. Semistructured interviews were conducted with eight middle school students who reported either high or low self-efficacy and with students' parents and mathematics teachers. Students relied on information from all four hypothesized sources, which were combined according to various heuristics. Teaching structures, course placement, and students' self-regulated learning also emerged as important factors related to self-efficacy. Results refine and extend the tenets of social cognitive theory.

KEYWORDS: motivation, mathematics education, self-efficacy, sources of self-efficacy

As a fundamental part of his social cognitive theory, Bandura (1986) posited that unless people believe they can produce desired outcomes, they have little incentive to act. Although ample research attests to the predictive power of academic self-efficacy—the beliefs students hold about their academic capabilities—on academic achievement, there have been few efforts to investigate the sources underlying these self-beliefs (Pajares & Urdan, 2006). In the social cognitive theoretical framework, human functioning is viewed as the product of the reciprocal influences of personal, behavioral, and environmental determinants (Bandura, 1986). Humans rely on cognitive, vicarious, self-regulatory, and self-reflective processes, all of which

---

ELLEN L. USHER is an assistant professor of educational psychology in the Department of Educational and Counseling Psychology at the University of Kentucky, 249 Dickey Hall, Lexington, KY 40506-0017; e-mail: *Ellen.Usher@uky.edu*. Her research focuses on clarifying the origins and correlates of academic self-efficacy.

play a central role in people's adaptation and change. Self-efficacy beliefs develop as the result of emotional, cognitive, or motivational processes; behavioral indicants; or the social environments in which people live and work. In school, for example, students' self-efficacy beliefs can be enhanced when students alter their emotions and thoughts (personal factors), when their teachers use effective classroom structures (environmental factors), and when students improve their self-regulatory practices (behavior).

Bandura (1997) hypothesized that students form their self-efficacy by selecting and interpreting information from four primary sources, the most powerful of which is the result of their own previous performance, or *mastery experience*. Students also build their self-efficacy beliefs through the *vicarious experience* of observing the actions of others. It is for this reason that models can play a powerful role in the development of self-efficacy. The third source of self-efficacy information comes from the *social persuasions* that individuals receive from others. Students often depend on parents, teachers, and peers to provide evaluative feedback, judgments, and appraisals about their academic performance. Finally, self-efficacy beliefs are informed by *emotional and physiological states* such as arousal, anxiety, mood, and fatigue.

The bulk of the research that has addressed the hypothesized sources of self-efficacy has been quantitative in nature and has targeted the self-efficacy beliefs of high school and college-aged students in predominantly White settings (e.g., Hampton & Mason, 2003; Lent, Lopez, & Bieschke, 1991; Lent, Lopez, Brown, & Gore, 1996). Researchers have typically investigated the sources by seeking students' responses to four self-report measures, each presumably tapping a source of self-efficacy, and subjecting them to correlational analyses (Usher & Pajares, in press). Empirical evidence supports Bandura's (1997) contention that mastery experience is the most influential source of efficacy information, but the predictive value of the other sources has been inconsistent, likely because of methodological limitations. For example, items from quantitative measures designed to assess vicarious experience have consistently shown poor internal consistency, obscuring the relationship between this source and self-efficacy (Usher & Pajares, in press). Likewise, the use of anxiety measures as a proxy for students' physiological arousal fails to capture other forms of physiological or affective arousal that may affect self-efficacy.

Contextual and demographic factors may also have played a role in research outcomes in this area. Researchers investigating the sources of middle and high school students' self-efficacy beliefs have reported that students may rely differently on the sources of self-efficacy as a function of their gender, ethnic background, and learning domain. For example, boys report stronger mastery experiences and lower anxiety in the area of mathematics (Lent et al., 1996) and science (Britner & Pajares, 2006), but girls report greater mastery experiences and lower anxiety in writing (Pajares, Johnson, & Usher, 2007). Researchers have also detected mean differences favoring girls on social persuasions and vicarious experiences in mathematics (Lopez,

Lent, Brown, & Gore, 1997). Others have found that social persuasions accounted for 4 times more variance than did mastery experience in middle school girls' academic self-efficacy, suggesting that girls rely more on information gained from their relationships with others than on their own accomplishments (Usher & Pajares, 2006).

Researchers have also examined whether the formation of self-efficacy differs for students of diverse ethnicity. For example, Usher and Pajares (2006) found that only mastery experience and social persuasions predicted the academic self-efficacy beliefs of African American middle school students, whereas all four hypothesized sources predicted the self-efficacy of White students. African American students also reported greater physiological arousal than did their White peers. In another study, Indo Canadian immigrant middle school students reported receiving more information from vicarious influences and social persuasions than did their Anglo Canadian peers, which may have reflected a cultural emphasis on *other-oriented* rather than on *self-oriented* messages as indicative of one's capabilities (Klassen, 2004).

Comparatively few qualitative investigations of the sources have been undertaken, and all of the existing studies have been conducted with college students and adults. Zeldin and Pajares (2000) asked women who excelled at careers in mathematics, science, and technology to describe the people, events, and situations that influenced their career paths. Vicarious experience and social persuasions powerfully influenced women's confidence in these male-dominated fields. The messages women received from those whose opinions they held in high regard served as important contributors to women's personal efficacy beliefs. In a follow-up investigation, Zeldin, Britner, and Pajares (2007) investigated the sources of men's self-efficacy beliefs in these domains and found that men tended to rely on their personal accomplishments when describing the basis for their confidence in mathematics, science, and technology. In particular, they spoke of their natural abilities, inclinations, or talents in these domains. The modeling experiences men reported were informative to their careers but were not as persuasive as they had been for women interviewed earlier (i.e., Zeldin & Pajares, 2000). Although vicarious experiences helped show men *how* to approach mathematics-related careers, these experiences did little to convince men of their capabilities to succeed. Men also recalled passing moments when they received support from significant others, but these persuasions were less influential for the self-efficacy beliefs of men. Participants in both studies, however, referenced experiences that took place during their adolescence as having had a profound effect on their self-efficacy.

Other researchers have examined the sources of self-efficacy qualitatively by asking college students to list what makes them feel confident in their coursework. One group of researchers asked undergraduate engineering students to list and rank the factors that influenced their confidence that they would be successful in an introductory course (Hutchison, Follman, Sumpter, & Bodner, 2006). Students generally reported that mastering course content increased their confidence, though women were more likely than

men to report that availability of help in the class made them more confident. Lent, Brown, Gover, and Nijjer (1996) reported similar findings from college undergraduates whom they asked to list what affected their mathematics self-efficacy. Students in these studies primarily listed mastery experiences and rarely vicarious experiences, social persuasions, or physiological arousal as central to their self-efficacy, which may have been a function of the open-ended nature of the measures used.

Qualitative inquiry can provide a better understanding of the genesis of self-efficacy beliefs by revealing the heuristic techniques younger students use to evaluate their academic capabilities (see Pajares & Schunk, 2005). In particular, an interview approach offers a phenomenological lens through which the development of efficacy beliefs can be viewed and enables researchers to examine the different conditions under which students process and appraise their experiences at particular junctures in their schooling.

This study features eighth-grade students who, at the cusp of their transition to high school, have already accumulated a rich history of academic performance and feedback. Researchers have documented that students often experience a decline in academic motivation and self-efficacy during important school transitions (e.g., Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991). Most have pointed to a mismatch between adolescents' changing developmental needs and the school environment as a likely cause (Eccles, 2004; Eccles & Midgley, 1989). Giving voice to middle school students who are old enough to reflect articulately on their own learning could provide new insights about how self-efficacy develops.

The purpose of this study was to use qualitative methods to investigate the rules or heuristics these students use to select and interpret information related to their mathematics self-efficacy. I also sought to examine whether other factors might be related to students' self-efficacy in mathematics. Of particular interest was students' *self-regulation*, which refers to "the self-directive process by which learners transform their mental abilities into academic skills" (Zimmerman, 2002, p. 65). Bandura (1986) hypothesized a reciprocal relationship between self-regulation and self-efficacy, both of which are driven by individuals' capacity to self-reflect. This reciprocity has also been empirically documented (Zimmerman & Schunk, 2008). Students who view themselves as capable tend to set higher learning goals for themselves and to plan their work and monitor their progress more effectively (see Schunk & Ertmer, 2000, for a review). Likewise, when students increase their repertoire of self-regulated learning skills, their academic self-efficacy is enhanced (e.g., Zimmerman & Bandura, 1994; Zimmerman & Kitsantas, 1999). Hence, I aimed to see whether and how participants discussed self-regulation within the context of the sources of mathematics self-efficacy. Of course, I remained open to the possibility that participants would describe other sources as well.

Three questions guided the investigation: (a) How do students with high or low mathematics self-efficacy interpret and weigh efficacy-relevant information, and do these interpretations seem to differ for boys and girls or for

African American and White students? (b) What insights can teachers and parents provide about the sources of their students' and children's mathematics self-efficacy beliefs? (c) What additional factors, such as self-regulated learning, might be related to the development of students' mathematics self-efficacy beliefs?

Method

Participants and Setting

Interviews were conducted in March and April of 2006 with eight students selected from a group of public middle school (Grades 6–8) students who had participated in a larger quantitative study in February of 2006 (N = 824). All participants were attending Grade 8 of their middle-class, suburban school located in the southeastern United States. The school student body was 66% White, 21% African American, 6% Hispanic, 4% Asian, and 3% mixed ethnic origin.

Interviewees were selected from four subgroups of interest: African American girls, White girls, African American boys, and White boys. Students in each subgroup were first rank ordered by their mean response scores on four quantitative self-efficacy measures that they had completed several weeks earlier. Following the guidelines set forth by Bandura (2006), these measures assessed self-efficacy at four levels, ranging from most to least specific: mathematics skills self-efficacy (e.g., I can successfully solve math exercises involving inequalities), self-efficacy for self-regulated learning in mathematics (e.g., How well can you organize your math work?), grade self-efficacy (e.g., How confident are you that you will pass math with a grade higher than 70%?), and self-efficacy to complete a variety of mathematics-related courses (e.g., I am confident that I will make a final grade of A or B in geometry). Mean scores reflected the six points of the Likert-type response scale and ranged from 1 (lowest self-efficacy level) to 6 (highest self-efficacy level). Two participants, one ranked highest in self-efficacy and one ranked lowest in self-efficacy, were then selected from each of the four subgroups of interest. In cases in which a student declined or was not permitted to participate, "runners-up" were invited. Three such cases occurred, but this did not in any way compromise the aim of selecting students with either low or high self-efficacy, as all participants met this criterion. Interviews took place during noncore instructional hours in the school's media center.

At the beginning of the school year, students had been placed in one of four mathematics courses according to their achievement, ability, and preference: prealgebra, on-level algebra, advanced algebra, or honors geometry. In this particular setting, placement and performance in one's eighth-grade mathematics course is considered "high stakes" because it largely determines the mathematics track a student will follow in high school, which in turn has important implications for the student's admission to college. Table 1 provides general information about participants, including each student's mathematics course placement.

Table 1

Description of Phase 3 Study Participants[a]

Student's Name	Gender Age	Ethnicity	Self-Efficacy Mean Score[b]	Math Teacher Math Course	Mother's Occupation (M) Father's Occupation (F)
Students with high self-efficacy					
Brandy Palmer	Female 14	African American	5.83	Ms. Wheeler Algebra	M: shipping agent for computer company F: police investigator
Hannah Murphy	Female 13	White	5.98	Ms. Barkley Honors Geometry	M: high school math teacher F: lawyer
Jamaal Haines	Male 14	African American	5.12	Ms. Barkley Honors Geometry	M: hospital bill collector F: military contractor
Zach Bettino[c]	Male 13	White	5.90	Ms. Barkley Honors Geometry	M: certified public accountant F: criminal defense investigator
Students with low self-efficacy					
Tanisha Jones[c]	Female 13	African American	2.57	Ms. Matthews Prealgebra	M: housekeeping manager for a governmental agency
Arden Cramer	Female 14	White	2.12	Ms. Matthews Algebra	M: part-time emergency room nurse F: corporate employee for beverage company
Xavier Relaford	Male 14	African American	3.66	Ms. Matthews Prealgebra	M: disabled
Chris Simmons	Male 14	White	2.20	Ms. Matthews Algebra	M: homemaker F: commercial construction owner

[a]Participants were given the option of selecting a pseudonym to be used to identify them in the study. If no selection was made, a pseudonym was assigned in an effort to preserve the ethnic and semantic origin of each participant's given name and surname.
[b]Mean score obtained by students' responses on a 6-point Likert-type scale.
[c]Zach's and Tanisha's mothers have different surnames because of remarriage: Ms. Kaiser and Ms. Wilson, respectively.

Interviews were subsequently conducted with the mathematics teachers of each student participant and with one of the student's parents. In all cases, the parent who volunteered to be interviewed was the mother. The eight teacher interviews took place during planning periods in teachers' classrooms. The parent interviews took place at a location specified by the parent so as to ensure each participant's comfort and convenience. One parent (Brandy's mother) who had agreed to participate in the study later withdrew because of a family emergency. Participants were given the option of selecting a pseudonym to be used to identify them in the study. If no selection was made, a pseudonym was assigned in an effort to preserve the ethnic and semantic origin of each participant's given name and surname. All interviews were conducted and transcribed by the author, who had no prior relationship with any of the study participants apart from having previously administered a survey in students' mathematics class.

Interview Protocol

A semistructured interview protocol adapted for middle school students from Zeldin and Pajares (2000) was used to gain information about the four sources of efficacy information believed to underlie students' self-efficacy beliefs in mathematics. A semistructured interview format does not lend itself to a one-to-one matchup between theoretical constructs and the interview questions asked. As Merriam (1998) pointed out, this format "allows the researcher to respond to the situation at hand, to the emerging worldview of the respondent, and to new ideas on the topic" (p. 74). For this reason, I crafted questions general enough to allow participants the freedom to answer in whatever direction they chose, and I used probes to seek more detail, clarification, or examples (Merriam, 1998). Global questions (e.g., "Tell me about yourself as a math student") permitted lengthy or complex responses that often demonstrated the dynamic processes through which self-efficacy beliefs are modified. These methods also enabled me to gather information related to other factors potentially associated with students' self-efficacy.

Table 2 provides the semistructured interview protocol used with students. Parent and teacher protocols were similarly structured but crafted with the goal of probing how students appraise efficacy-relevant information (e.g., "Tell me about how Hannah views herself as a math student"). Questions on the protocol are organized categorically, but changes in ordering during the interview helped to maintain conversational flow. An interview checklist utilized during each interview ensured that all theoretical constructs were addressed. I concluded each student interview with a question explicitly targeting sources of self-efficacy in mathematics (e.g., "What could make you feel more confident about yourself in mathematics?"). This question prompted students to state, emphasize, or reiterate what they believed were the sources of their confidence.

Each interview was scheduled to last approximately 45 minutes. Interviews were digitally recorded and were transcribed by the author. To

Table 2
Student Interview Protocol

Background

1. Tell me about where you have previously gone to school.
2. Tell me a little bit about your family.
3. Tell me little bit about yourself.
   a. What sort of personality do you have?
   b. What sorts of things do you enjoy doing outside of school?
   c. Tell me about your friends.
   d. Tell me about the people you most admire.
4. Describe yourself as a student.
   a. What would you say is your best subject in school? Why? What is your favorite subject? Why?
   b. What subject do you feel is your weakest? Why? Which subject is your least favorite? Why?
   c. Tell me about the grades you typically make in school. Do you agree with the grades you are given?

Mathematics experiences and self-efficacy

5. I am going to ask you several questions about a specific subject you study in school. I want you to think hard about all the math classes you've ever taken as well as other experiences you've had involving math. First, tell me about yourself as a math student.
   a. What sort of work habits do you have in math?
   b. If you were asked to rate your ability in math on a scale of 1 (lowest) to 10 (highest), where would you be? Why? How would you rate your confidence that you will do well on the upcoming state math test?
   c. What do you like to do related to math outside of school? [mastery experiences]
   d. Tell me about a time you experienced a setback in math. How did you deal with it?
6. Tell me a story that explains to me something about the type of student you are in math. In other words, share with me something that happened to you that involves this subject and perhaps your parents, teachers, or friends.

Mathematics learning environment

7. Tell me about the math class you are in.
   a. Does your school group students according to their abilities in math? If so, which group are you in?
   b. How would you say you compare to the rest of your classmates in your math abilities? How about to the rest of the students in your grade?
8. Tell me about the math teachers you've had.
   a. What sorts of things do your teachers tell you about your performance in math?
   b. What do you think your teacher(s) would tell your parents about how you do in math?
   c. How does your teacher make you feel about your ability in math?
   d. Describe the best teacher you've had in math. What made her (or him) so good?
   e. What could your teachers do to help you feel more confident in your math abilities?
9. Under what conditions do you perform well in math? Under what conditions do you perform less well? Why?

(continued)

Table 2 **(continued)**

Mathematics and others

10. Have you ever been recognized for your ability in math? Explain.
11. Tell me about your family and math.
    a. What do members of your family do that involves math?
    b. What do your parents tell you about math?
    c. How are your siblings in math?
    d. What would you parents tell your teachers about you as a math student?
12. Tell me about your friends (not necessarily your classmates) and math.
    a. Describe how most of your friends do in math.
    b. What do your friends say about math? What do they say about those who do well?
    c. How do you think your friends would describe you in math?
13. Do you think the people you admire would be good at math? Why?

Affective and physiological response to mathematics

14. I want to ask you to think about how math makes you feel. You probably haven't been asked to think about that before. When you are given a math test, how does that make you feel? How do you feel when you are given a math assignment?

Sources of self-efficacy in mathematics

15. Earlier you rated your math ability on a scale of 1 to 10. How would you rate your *confidence*? Why? What could make you feel more confident about yourself in math?

mirror the informality of discussions with students, teachers, and parents, the terms *math* and *mathematics* are used interchangeably.

Analysis

Interview data were transcribed, coded, and analyzed according to the guidelines set forth by Miles and Huberman (1994) and using the NVivo 7.0 software program. A start list of codes was developed to mirror the study's theoretical framework and guiding questions, and first-level codes were added for other variables that emerged from the data as warranted. For example, first-level codes were created to represent *curiosity*, *teaching structures*, and *readiness* as factors that may be related to students' self-efficacy. Because of the semistructured protocol design, some questions (e.g., "Tell me a story that explains to me something about the type of student you are in math") elicited a response that lasted several minutes and addressed several constructs. As a result, responses often required multiple codes.

Reliability checks (described below) were conducted on first-level codes. Revisions to these codes were made as needed so as to reflect the data accurately. Ancillary annotations were added to data that were ill-fitting to the original codes assigned. This helped to capture surprising patterns that emerged that were not easily tapped by a single code.

After assigning first-level codes to all transcripts, I listened to each interview again while reviewing individual transcripts and codes. This process enabled me to verify the accuracy and internal consistency of the coding

system, to combine similar codes when redundancies occurred (e.g., *self-talk* with *self-modeling*), to reduce the number of first-level codes by collapsing related categories, and to remove codes assigned to passages that were tangential to the study. Next I combined categories with similar codes in a higher-level, "tree-node" format. This permitted me to sort through larger chunks of information more efficiently and to see general trends and patterns in the data, both within and between participants. For example, the first-level codes for *vicarious experiences from peers*, *vicarious experiences from adults*, and *self-modeled experiences* were combined in a higher-level node labeled *vicarious experience*.

The data were next organized on four conceptually clustered matrices. On each matrix, rows were labeled with the codes reflecting the various sources of self-efficacy (e.g., mastery experience). Columns on the first matrix were labeled *High Self-Efficacy* and *Low Self-Efficacy*. Cells on that matrix represented the intersection of mathematics efficacy information and self-efficacy level (e.g., mastery experiences for students with high self-efficacy; failure experiences for students with low self-efficacy). Subsequent matrices were created by gender, ethnicity, and participant type (i.e., student, parent, or teacher), respectively. Investigating the data in this basic way helped identify cross-case and intergroup patterns and differences.

Reliability and Validity

Merriam (1998) outlined several means by which researchers can establish reliability and show that results drawn from qualitative data analysis are consistent. This study's design enabled me to compare the self-efficacy judgments students made on earlier quantitative measures at the time of our interview. Although interview questions were kept general enough to invite students to express their perceived mathematics capabilities however they might view them, students' responses reflected both task- and domain-specific efficacy beliefs in a manner congruent with their responses to quantitative measures. For example, Chris noted that "when it comes to like percents and stuff, I can't do it. And fractions. But like equations and like geometry, like, I can do that well." As illustrated in Table 1, his quantitative self-efficacy scores mirrored this modest belief in his capabilities. This symmetry offers evidence for the internal validity of students' self-efficacy reports and demonstrates that students' quantitative and qualitative self-efficacy judgments, though not identical, were generally consistent.

Data collected from parents and teachers in response to similar questions (e.g., "Tell me about how [child's name] views himself/herself as a math student") were used to complement students' views of their own mathematics capabilities and thereby offered triangulation of the data that also enhanced internal validity. Member checks were conducted with participants to give them an opportunity to modify, clarify, or expand information they shared during the initial interview. Such checks help ensure that the study's

results are an accurate reflection of participants' beliefs at the time of the interview (Merriam, 1998).

According to Miles and Huberman (1994), working toward a high degree of intercoder reliability permits researchers to present "an unequivocal, common vision of what the codes mean" (p. 64). Although I coded all transcripts independently, it was important to verify that the codes assigned were meaningful, logical, and consistent with those that other readers would assign. To this end, two graduate students familiar with social cognitive theory and self-efficacy were asked to code three complete interview transcripts comprising 44 pages (14% of total transcript pages). Coding cross-checks were conducted by tallying the number of agreements and disagreements between the graduate students and the researcher. The ratio of the number of agreements to the number of agreements plus disagreements was used as a measure of intercoder reliability (Miles & Huberman, 1994). We obtained an intercoder reliability of 93%. Disagreements in coding were resolved by returning to Bandura's (1997) theoretical description of the sources of self-efficacy for clarification. I also invited an expert in social cognitive theory to code an additional (unique) 10-page section of an interview transcript. Interrater reliability for this cross-check was 96%.

An audit trail was created by maintaining a detailed record of how and when data were collected and by labeling the data gathered and the revisions made during each step of the analysis. The NVivo software program enables researchers to create and maintain a digital filing system that hyperlinks all relevant materials—in this case audio files, coded interview transcripts, journal notes made at each interview site, annotations made during coding, coding lists, and data matrices and queries. This careful system of organization increased the likelihood that the conclusions drawn here would match those drawn by researchers following the same methodology.

The use of a research methodology previously designed for use in an empirical investigation of the sources of self-efficacy (i.e., Zeldin & Pajares, 2000) enhances the contribution this work makes to existing qualitative findings on the sources. External validity is further enhanced when participants and settings are described with sufficient detail to enable readers to assess similarities among study participants and people learning in other contexts (Miles & Huberman, 1994). Working within the well-defined theoretical framework of social cognitive theory also permits me to look for connections between participants' responses and theoretical constructs.

Results and Discussion

In this section, I begin by offering background information about the eight students who participated in the study, their interests, and their academic record in mathematics (see Figures 1–3). Next I present students' interpretations of information related to their mathematics self-efficacy that appears to be related to the four sources hypothesized by Bandura (1997). I then turn to students' descriptions of their self-regulatory skills, a factor they

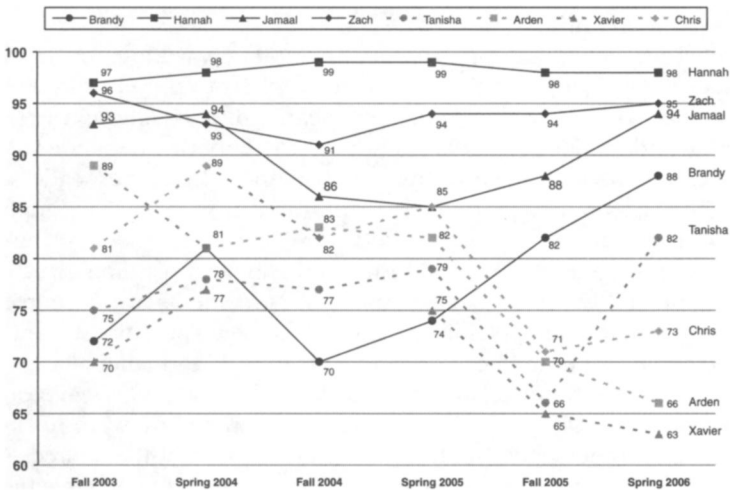

Figure 1. **Student grade point averages in middle school mathematics: Grades 6–8.**
Note. Grade point averages can range from 0 to 100. Scores for students with low self-efficacy are plotted along dotted lines.

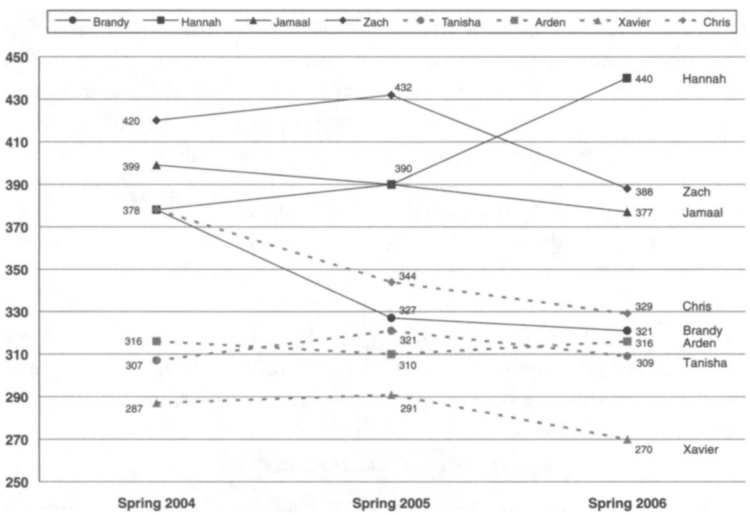

Figure 2. **Student scores on state criterion-referenced competency tests, 2004–2006: Mathematics Total.**
Note. Scores on this measure can range from 150 to 450. Scores for students with low self-efficacy are plotted along dotted lines.

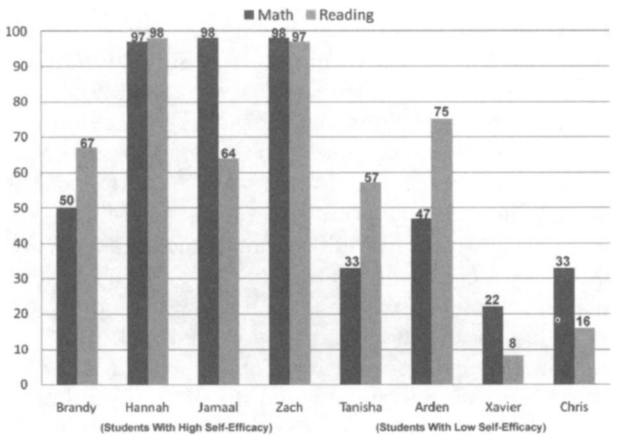

Figure 3. **Student scores on the Grade 8 (fall 2005) Iowa Test of Basic Skills: Mathematics and Reading.**
Note. Scores on this measure are reported as percentiles and are norm referenced.

often mentioned with regard to their competence in mathematics. Parent and teacher perspectives provide additional context for students' remarks. Throughout this section I first present results for students who reported high mathematics self-efficacy and then for those with low self-efficacy because the stories that emerged from these two groups differed most dramatically. I follow each section with a summary and a brief discussion of general trends and other group differences.

Background of Participants

Students With High Self-Efficacy

Brandy described herself as an aspiring Alvin Ailey professional dancer who loves music, is outgoing, and, in math class, tends to be a "loud mouth." Through her calm, cool demeanor and reflective disposition, Brandy explained that she planned to move in with her grandmother for ninth grade to attend a special high school of the arts in an inner-city district. Her grandmother, she beamed, was one of the first African American women to work in a barber shop and was someone Brandy admired for being a steady figure in times of stress. Brandy has two older siblings—a sister who did not finish high school and a brother who worked as a disc jockey in a local club. She described mathematics as her best subject and largely attributed this to the teachers she had who made math interesting and fun.

Usher

Hannah arrived promptly and eagerly for her interview and carefully placed on the table before her a neatly organized binder notebook with color-coded tabs for each subject area. In a frenetic cadence, the curly haired adolescent managed to explain within the first several minutes of our talk that she held a long and shining record as an exceptional math student, belonged to the Jewish faith, enjoyed reading and playing the flute more than doing things her younger sister liked (such as soccer or partying), and was "sort of obsessive about school."

Described by his teacher as one of the most well-liked boys at school, *Jamaal*, who characterized himself as "real laid back," wore a glowing smile and spoke in a calm and mature manner. With handsome features and self-declared athletic prowess, Jamaal drew frequently on his opportunity as a middle school student to play cornerback for the high school football team when describing the competitive edge he felt in math class. Jamaal was the oldest man in his household since his father, to whom he talked on the phone daily, had left to work for a year as a contractor in the Middle East.

Zach, a tidy, thin student who spoke in a quick and to-the-point manner, expressed his affinity for golf, tennis, baseball, and video games. Zach's mother portrayed her son as notoriously curious and inquisitive about everything: "We have a joke in our family. 'Now that's a Zach question.'" Zach was eager to point out that he was in "four-serve TAG" (i.e., placed in gifted-track classes in all four core subjects) but referred to himself as "a terrible writer." His math achievement record, he assured me, had always been near perfect.

Students With Low Self-Efficacy

An only child for 12 of her 13 years and an aspiring psychiatrist, *Tanisha* seemed comfortable talking about herself and her experiences. Petite, well-groomed, and perhaps a tad behind the developmental curve for average 13-year-old girls, Tanisha explained that she enjoyed "playing," watching television, and talking on the phone with friends. Her mother noted that Tanisha had been distracted from schoolwork earlier in the year by her romantic interests. Math, Tanisha squirmed, had always been a challenge for her, and middle school math was increasingly difficult. Nevertheless, she was beginning to regain some confidence in her ability to handle her math coursework.

Arden, a blonde-haired student whose passion was singing, dancing, and acting in the school play, arrived for our interview with an enthusiastic but nervous smile and clutching a teen novel. She began by offsetting her aversion to math with her passion for reading and writing. Self-described as talkative, spontaneous, and social, Arden was characterized by her mother as someone who is creative and imaginative but who "swallows a lot of her stuff." The day before our interview, Arden had received her interim report card, on which was the lowest math grade she had ever earned—a 54.

Xavier spent his afternoons, evenings, and weekends playing video games, basketball, football, and just "hanging out." Although he appeared to feel slightly awkward in his overweight body, Xavier's endearing smile and eager-to-please demeanor made him agreeable to talk with. His mother described him as "a follower," which she said was likely why Xavier wound up in alternative school for several months after handling a friend's pellet gun at Carlyle Middle School (CMS) during seventh grade. Xavier said he had always struggled with mathematics and held a borderline-passing grade point average across middle school.

With a wry sense of humor and dirty blonde bangs draped across his eyes, *Chris* proudly declared that he did not fit the "preppy" or popular-kid mold at his middle school. Chris denied any association with "gothic freaks" but admitted that he and his friends, whom he described as "dorks," enjoyed doing "weird stuff" such as dressing up as ninjas and frightening people. A budding guitarist, Chris felt it important to point out that he hated feeling as if he had "a collar on" at school and at home, and he appreciated people who had a sense of humor and were willing on occasion to overlook his wrongdoings. Chris never felt that mathematics was his strong subject, despite having managed to do well in math during elementary school.

It seems important to point out that when Brandy, Jamaal, and Tanisha entered Grade 6, they began voluntarily taking a 40-mile bus ride twice each day to attend CMS. The school system's voluntary majority-to-minority (called "M-to-M") desegregation program, currently being phased out, permits students who are in the racial majority at their home schools (in this district, typically African American students who live in the southern end of the district) to receive free transportation to attend schools where they would be in the racial minority (typically at the northern end of the district). Because schools in the northern half of this district outperform schools from the southern half on standardized achievement tests and other measures, many parents opt to send their children north for the opportunity of a better education. For Brandy, Jamaal, and Tanisha, this arrangement meant an average daily bus commute of 3 hours.

Interpretations of Performance Experiences

Mastery Experiences of Students With High Self-Efficacy

Bandura (1997) noted that "performance situations contain constellations of factors that convey efficacy information" (p. 85). Brandy, Hannah, Jamaal, and Zach described how several factors related to their mathematics performance served as indicants of their capabilities in math. These mastery experiences were typically evoked by interview questions that invited students to talk about themselves as math students or to tell a story explaining the type of math student they are. For all students, strong academic performance seemed to go hand-in-hand with confidence. Zach and Hannah were quick to point out that they had never earned below a high A average in math. Each beamed about having outperformed others on standardized tests.

Zach noted that he scored in the 97th percentile of the Iowa Test of Basic Skills; Hannah remarked that she earned a higher score on the math portion of the Scholastic Aptitude Test than had many high school students. Jamaal also pointed out his stellar performance on standardized tests and noted that, were he to improve his study habits, he would certainly be capable of earning top grades in math. Brandy interpreted her high scores in her current math class as a powerful source of confidence. She was quick to recognize how instrumental her math teacher, Ms. Wheeler, had been in helping her to be successful.

For Jamaal and for Zach, performing well in math was a direct result of how easy math had always been. Jamaal admitted, "I don't push myself. Like, it just comes naturally. I'm just real confident at it because I never study for tests and I make good grades." Zach noted matter-of-factly that "math always comes easy to me more than any other thing." Coincidentally, their mothers told me that in their respective elementary schools, both boys had been so mathematically advanced in first grade that their teachers sent them to second-grade classes for math instruction. Both boys drew on this early experience of mastery to explain their self-assurance in geometry. The perception they held that math work was easy accompanied a belief that they possessed a natural aptitude for math. In fact, both boys' mothers spoke in awe of their precocious sons' giftedness. "Honestly, I don't know where Jamaal gets his gift from," noted Ms. Haines. Zach's mother attributed her son's success to an inborn trait: "You know, some people are just *so* not math. Either you have it or you don't in math. I'm a CPA [Certified Public Accountant], so, you know, obviously that's where they got their math."

Hannah recalled the boredom and ease of her math classes when she used to receive "on-level" instruction (i.e., not specialized for gifted students) in elementary school. She seemed less inclined than did her male counterparts to boast about how easy middle school math came to her, however. Rather, she took pride in the meticulous methods she used to ensure that her mathematics performances were always masterful: "I always show my work. And then I always, usually I always go back to check." Hannah's mother believed her daughter "put that 'work harder' on herself. Because she has really good study habits, and I think that helps her, you know, make the higher marks she has. And she's confident and comfortable with herself and what she knows." Ms. Barkley, who taught both Hannah and Zach, commented on the differences between these two students.

> I think it comes naturally to Hannah, but I think she works harder at it than Zach does. . . . She works a little harder to ensure that she has everything there. Where Zach would be more like, "I've got it. Here it is." . . . Zach can make 100s also, but Hannah would be more likely to have a 100 average.

Their academic records indicated that Zach and Hannah were equally able mathematics students. Hannah, however, seemed prone to attribute her

success—and her confidence—to her diligence and effort rather than to an inborn capacity for math, which her male counterparts flaunted. These highly confident boys held what Dweck (2000, 2006) has called an *entity* or *fixed view* of mathematics ability, whereas Hannah tended toward an *incremental* or *growth view*, believing that her ability in math was largely due to effort and hard work—factors she controlled.

Brandy began Grade 8 placed in a prealgebra class after having nearly failed math in Grade 7, but she quickly earned such high marks in Ms. Wheeler's class that her teacher promoted her to algebra. Brandy described her feeling of surprise and praised the skills of her math teacher, Ms. Wheeler, in making math seem effortless.

> Last year my highest grade in math was like a 71, and I had, like, Fs for most of the year and Cs for some parts. I was getting it, but I wasn't really *getting* it. And for this year, to make nothing less than a 90 . . . me and my parents started realizing that it wasn't me. It was the teacher.

Brandy attributed so much of her confidence to her teacher's skills that she worried math might again become difficult for her when she changed schools. "I don't know if all my teachers will be like Ms. Wheeler and make it as easy for me. That kind of scares me."

It was clear that Ms. Wheeler frequently sent Brandy messages that she was capable, but these messages were natural consequences of the routine opportunities for success that Ms. Wheeler structured for her students. What did she do to help students such as Brandy feel confident?

> I try to pace the subject so that it's simple. Little steps. But the thing about teaching math is it's got to be very sequential so that you go from here to here to here. All of a sudden you're way up here and they don't even know it. They'll say, "Oh, this is easy." That's the best compliment they can give me, especially in a high-level class, "That's easy." Because I will say to them, "No, that wasn't easy. You're just smart."

Such a teaching approach is no doubt what Bandura (Evans, 1989) had in mind when he emphasized that "in addition to convincing children they have the capabilities to perform well, one can also structure challenges for them in such a way that they will experience a high level of success" (p. 61). Such an approach was vital in helping Brandy to interpret her successes in math in a way that enhanced her efficacy beliefs.

(Non)Mastery Experiences of Students With Low Self-Efficacy

Unlike their counterparts with high self-efficacy, Tanisha, Arden, Xavier, and Chris described a struggle with mathematics that began or worsened during middle school. For these students, low grades in math and perceived

difficulty of math were factors that undermined their beliefs in their capabilities. Arden's low math average at the time of the interview made her aware of the growing conceptual challenge of middle school math, particularly algebra.

> Now it's just all different, and it's so much harder. . . . You, like, have to be perfect on all the fundamentals. Otherwise you won't get anything else. And that kind of stinks because I didn't get some of them.

Arden's mother agreed and added that Arden had struggled with math since elementary school. She blamed a weak third-grade teacher for loosening the already shaky foundation her daughter had in math: "I knew that was a pivotal year. I had heard third grade was, like, a really strong important year, and she had a horrible math teacher." Ms. Matthews, Arden's eighth-grade teacher, also attributed Arden's present difficulties in algebra to the large gaps in Arden's understanding of mathematics: "She has a terrible time with basic skills. I mean, if we ever do anything with fractions, she's lost."

Tanisha recalled the shock of her low math grades: "I never got a C before in my life. That was surprising." Unlike her low-confidence peers, however, Tanisha had experienced a turnaround in eighth grade that both her mother and teacher described as "night and day." But Tanisha believed that any improvement in her math performance was a result of "learning the steps and taking time, because like with other stuff, you can't just *get* math like that. You have to actually take the time and like sit down and like. Mostly everything was quick for me, but math it wasn't like that." Tanisha seemed convinced: "I've always done something wrong in math."

Xavier earned his first F on his report card when he was in seventh-grade math, after which "I just shut down. I just quit believing in myself." For him, the difficulty of math seemed overwhelming and success beyond reach. Note his view of his mathematics ability as a fixed entity. "It's just so hard. I, I don't think I'm smart enough for it or something." His mother sadly recalled the younger Xavier who "used to run in and show me, 'Look Mom, I got a 90 on my math test'" and who now tells himself "'I can't do it.'"

As noted above, math course placement in Grade 8 seemed to communicate important information to students about their mathematics capabilities. At the start of the school year, Arden and Tanisha were placed in algebra and Chris in honors algebra. All earned failing grades. Ms. Matthews, their teacher, recommended that each student move back a level—Arden and Tanisha to prealgebra and Chris to on-level algebra. Tanisha and Chris accepted the recommendation and expressed relief in the higher grades they earned and the better understanding they had of math concepts. As Chris explained, "In the beginning of the year I was in honors. And I flunked it. Like bad. I was in the 40s. But I switched and brought that up." Although he admitted having gaps in his understanding of certain mathematical concepts, such as percentages, he felt he was handling math better than he did initially. Tanisha felt similarly.

Arden, on the other hand, had missed several weeks of school during the first semester because of illness and attributed her failure to her absence. Discouraged and angered by her teacher's suggestions that she move back a level in math, she elected to remain in her algebra class. Ms. Cramer, afraid of crushing her daughter's hope, supported Arden's decision. Ms. Matthews dreaded the long-term consequences this would have for Arden in math:

> I told her mom, "You know, you can leave her in algebra, but I think you're playing games with what kind of confidence she's going to have in the future for math." Just 'cause the age that they're at right now, you know? They're so impressionable. And if Arden decides that she can't do math right now, then she'll probably think that forever.

Arden, nearly in tears, even admitted, "I'm just not doing good. Like since I've not been doing good and not understanding then there's like no confidence. Because I don't think I'm ever going to, like, get it." Though she claimed to put forth great effort in math, her efforts met little success. She longed for a classroom environment that was paced to provide her with frequent mastery opportunities: "I need to take it really slow. Like, I just need to like, you know, step-by-step understand the first concept so that I can understand the fifth one." Unlike the switch that Tanisha and Chris made from their more- to less-advanced math classes, which may have helped them salvage what confidence remained, Arden's choice to continue in algebra left her with skills inadequate for increasingly difficult task demands. Pajares (2006) observed that "academic work should be hard enough that it energizes, not so hard that it paralyzes" (p. 344). The repeated failures Arden described having in algebra may have had a paralyzing effect on her confidence.

Summary of Performance Experiences

Brandy, Hannah, Jamaal, and Zach called on a history of successful performances and their facility with math when describing their self-assuredness. Teachers and parents confirmed the mathematical abilities that these students possessed. Unlike her peers, however, Brandy attributed her recent successes in math to the learning environment provided by her math teacher, Ms. Wheeler, who Brandy maintained was the reason math had become manageable. Whether these students attributed their successes to internal or external, stable or unstable causes, their interpretations of their performances were favorable and self-affirming. Tanisha, Arden, Xavier, and Chris expressed few recollections of past success in math and felt that the increasing rigor of their math coursework revealed their weaknesses. They seemed to interpret the amount of effort math required of them as a sign of their inefficacy. Transferring to another math course level enabled Tanisha and Chris to salvage the belief that they could better handle math; remaining in a math class that was too difficult, on the other hand, left Arden with a crushed sense of efficacy. For Xavier, even the lowest math class seemed to afford few opportunities for success.

Interpretations of Vicarious Experience

Vicarious Experiences of Students With High Self-Efficacy

Vicarious experience from adults. Brandy, Hannah, Jamaal, and Zach each boasted their good fortune to have parents who not only pushed them in math but modeled an interest in the subject themselves. Hannah spoke of how much her mother, a high school algebra and geometry teacher, had helped her with math over the years and mentioned how excited she felt in those rare moments when she caught her mother in error. Brandy's father, an elementary mathematics teacher turned police officer, was fond of setting up math "quizzes" for his daughter at every occasion, particularly when they went shopping. Zach also spoke of his mathematically inclined parents, acknowledging that his mom "used math like every day" and his dad was "a human calculator." Jamaal credited his father with having helped him learn math at a very young age, but he explained that "math's not [my dad's] thing." In fact, Jamaal disclosed, "when my dad was in college, I used to help him with his homework." Although one might assume that seeing his father struggle with math would diminish Jamaal's belief in his own capabilities, just the opposite seemed to happen. Consider how Jamaal made sense of this:

> No one in my family has a math brain that I know of. No one. And I mean, I like to be the one. I would like to be the first one to break the barrier. And that's a little bit of more why I feel confident in it. Because I know that I can, and I have the mind for it.

Comparing his abilities to those of his family members made Jamaal feel more confident that he was (and could be) different.

Vicarious experience from peers. The students with strong confidence in their mathematics abilities made many more comments in reference to peers than to adults. In line with Bandura's (1997) theorizing that people typically compare themselves "to particular associates in similar situations, such as classmates, work associates, competitors, or people in other settings engaged in similar endeavors" (p. 87), all four seemed keenly aware of how their own performances compared with those of their classmates. Brandy noted, "I think I'm one of the people who gets it the easiest in math, 'cause at my table I'm always the first, and like my other partners are like, 'What's the answer? How'd you get that?'" She also spoke of her delight in outperforming her tenth-grade brother in math. Zach hesitated to rate his math confidence as a 10 out of 10 because he was aware of "some people in my class that always get everything. We'll just be starting it, and they can get it in, like, a second." Although he viewed himself as "better than most eighth graders" at math, being able to think of students who were more capable was enough to temper Zach's estimation of his own abilities.

Of all the students interviewed, Jamaal seemed to rely most on vicarious information from peers when evaluating his self-efficacy in math. He

described himself as highly competitive, noting that he and his math classmates often compared test grades to see who scored the highest. As if to indicate how much this fueled the competitive thrill, Jamaal reminded me that he was "in some pretty tough classes with some pretty smart people." In fact, Hannah and Jamaal, who were in the same class, both mentioned the remarkable performance of one particular fellow competitor, Stacey, who scored 100% on an important statewide test.

> I was real mad when Stacey had got a 100. I wasn't really mad, but I was kind of jealous. Like I envied it. Like I wished I was that one that got 100. I mean sometimes, now that, *that's* one of the things that give me the extra drive. That gives me the extra determination to work harder in math to get good grades like everyone else. (Jamaal)

Ms. Barkley, Jamaal's math teacher, pointed out the extraordinary degree to which Jamaal was "aware of the people around him. I think that's just the nature of him." And Jamaal's mother, who was no doubt even more aware of this nature, emphasized that the main reason she and her husband enrolled Jamaal in the district's M-to-M bussing program was to expose him to the challenge of learning alongside more accomplished peers. She explained, "I want him to compete. I want him to know that there's somebody out there that knows a lot more than you. Get with them. Ask them how do they do that." Jamaal's mother seemed to echo the observation made by William James (1899) more than a century ago that "the deepest spring of action in us is the sight of action in another" (p. 27).

Vicarious experience from self. Individuals often rely on personal comparative information or on cognitive self-modeling when forming beliefs about their capabilities (Bandura, 1997). Several such modeling experiences were important to Brandy, Hannah, and Jamaal. Hannah's beliefs about her math capability seemed directly tied to her internal standards. For instance, in an off-hand but telling remark, she recalled how sad she felt when she once earned an 89% on a math test. Her teacher, Ms. Barkley, referred to Hannah as a "perfectionist," someone likely to always say to herself convincingly, "Certainly I can do a little bit better." Hannah's mother echoed this observation and described her daughter as someone who placed a great deal of pressure on herself to excel in everything she set out to do.

Brandy was able to recite the internal dialogue she often had about her math work, specifying that one of the sources of her confidence was "my own conscience telling me that I can do it." She feared that students her age "put more pressure on ourselves than we actually need to. Like, we always thinking of the down side of things. Like on tests, 'What if I fail?' not, 'I can do this. I am going to pass.'" Jamaal took similar refuge in his internal dialogue:

> I'll be like, "Come on." I'll be thinking about different ways to solve problems and stuff like that. I'll be saying, "Come on, Jamaal, you can do this," and stuff like that. . . . I don't know what it does, but it's just like extra comfort to me.

Vicarious Experiences for Students With Low Self-Efficacy

Vicarious experience from adults. The students who reported low mathematics self-efficacy each characterized their own mothers (and sometimes both parents) as being deficient in math. Arden reported feeling frustrated when her parents could not help her understand math homework problems. Her mother confessed her own poor performance in and distaste for middle and high school math: "You know, when I was in school, I thought the same thing [as my daughter]. Especially algebra." Similarly, Xavier noted that his mom "said she even had problems with math. She said math was her worst subject." Ms. Relaford, Xavier's mother, admitted frustration in guiding her son mathematically: "I don't know how to do algebra. That was not my forte." Tanisha, who said her mother "was probably like me in school," added that her aunt sometimes tried to encourage her by recounting her own struggle in math. And although Chris made clear his admiration of his older brother and his father, neither was available to Chris as a role model in mathematics. Overall, these students were in want of people at home who could model for them the skills and strategies they needed to succeed in math.

Vicarious experience from peers. Though Tanisha, Arden, Xavier, and Chris reported fewer peer-referential self-judgments, they generally compared themselves unfavorably with more-capable peers. Arden, who remained in the on-level algebra class all year despite her failure, confessed that she often realized how much better her classmates were doing at math than she was. Watching classmates who were more competent made her feel "shamed . . . because, like, if they get it, I should get it." She was chagrined by how quickly her friends grasped new concepts and, by contrast, how long it took her to understand. Ms. Cramer, Arden's mother, recalled the turn for the worse Arden's self-efficacy took when, in Grade 4, Arden was one of only two students in her class who did not qualify for the school's talented and gifted program. For Arden this meant being left in her regular classroom one day a week while her talented and gifted classmates went on enrichment excursions elsewhere. Bandura (1997) has observed that such "evaluative school practices quickly impose comparative appraisals whether children like it or not" (p. 92). Indeed, Ms. Cramer marked this as the time when Arden began referring to herself as "the dumb one."

After Tanisha moved back from algebra to prealgebra in the early part of the school year, her teacher noticed that she continued making referential comparisons to her *former* algebra classmates, and this seemed to be the measuring stick by which Tanisha judged her own competency in math. Researchers have noted that people tend to look to individuals who are similar or slightly higher in ability when making self-comparative evaluations (Bandura, 1997; Wheeler & Suls, 2005). Tanisha listened carefully to what these more advanced students had to say about their experiences in the algebra class, believing that it would help her determine how well equipped she was to face algebra again in ninth grade.

> Some of my friends tell me about [algebra], and, you know, some of their tests that they told me about, they said it was hard. But, you know, that's kind of what makes me feel like I'm not going to do good in it. Because, like, if they can't do it, then I probably can't do it.

Likewise, Chris compared himself negatively to his classmates. His teacher, Ms. Matthews, noted that he often grumbled in class, "I don't get it. I'm the only one in here who doesn't get it." Xavier indicated that he felt similarly in ability to the students in his prealgebra class, but he lowered his estimate when asked how he compared to all students in eighth grade. "I probably would take myself down to like 2 to 4 [out of 10] 'cause there's a lot of kids that's in TAG and like honors algebra and stuff." He added that most of his friends were better at math than he was.

Vicarious experience from self. Of the four students with low self-efficacy, only Arden and Chris identified using cognitive self-modeling strategies to shore up their math confidence. Arden said that she "just kind of keep[s] telling myself that I'll do OK" as a way of "keeping my confidence up." Unfortunately, this strategy did little to ensure a better performance in math, which often shocked her. "I get [my work] back, and it's like, all wrong."

By his own admission, Chris often became angry with himself and others when he encountered difficulty in math. He made an effort to describe his internal dialogue. "I batter myself a lot. I tell myself, 'Why don't you do this crap? Why don't you study?'" Toward the end of our interview, a puzzled look came over his face as he struggled to explain this source of his confidence in math. Evaluating his math confidence was based

> more [on] what I tell myself. It's not as much as, you know, my grades and what teachers tell me, it's more like, you know, me saying, "Okay, I messed this test up, but you know, I can study and do better on the next one," instead of, you know, "What the heck is this?"

He realized that his tendency to select and to replay negative experiences was central, and detrimental, to his sense of efficacy in math. This cognitive reframing may be adaptive for Chris in that it serves to protect his self-esteem by allowing him to attribute his poor performance to external, changeable factors such as poor study skills or lack of effort (Dweck, 2006). In this way, Chris may be psychologically reserving space for his self-efficacy beliefs to return.

Summary of Vicarious Experience

Students were able to shed light on the relative importance of the multiple forms vicarious experiences can take. They relied on modeled information from parents, peers, and self to inform their confidence judgments. The heuristics students described using when interpreting this information makes evident the danger inherent in relying solely on observed or self-rated

experience when assessing vicarious experience. Though, in general, exposure to incompetent math models at home lowered youngsters' sense of efficacy, this was not always the case. Jamaal was able to construe his parents' inaptitude for math in a way that boosted his belief that he could be different. This observation is consistent with social cognitive theory and Bandura's (1997) admonition that "a host of personal, social, and situational factors affect how direct and socially mediated experiences are cognitively interpreted" (p. 79). Talking to Jamaal revealed that his appraisal of his family members' struggles with math coupled with his own successes provided him with evidence that he was different, and quite capable.

Each of the eight students interviewed seemed particularly attentive to how their peers were faring in mathematics and used this information as a basis by which to gauge their own math capabilities. Interestingly, however, only those students with high self-efficacy reported a competitive drive to outperform others. The four with low self-efficacy seemed convinced of their relative inferiority in mathematics, particularly when comparing themselves with slightly more capable peers.

The rare glimpses Brandy, Jamaal, Arden, and Chris were able to offer of what they say and think to themselves when doing mathematics indicated that the mental models students create may serve to nourish (or undermine) beliefs about their own capabilities. Purkey (2000) contended that "positive and realistic self-talk contributes to human dignity and personal efficacy" (p. 2) and that the responsibility of ensuring that students talk to themselves about themselves in positive ways rests not only with the student but with the family and school as well. Sadly, if negative self-messages are not properly redirected, they may chip away at the potential beneficial effects of even the smallest academic victory.

Interpretations of Social Persuasions

Social Persuasions for Students With High Self-Efficacy

Social persuasions from adults. Brandy, Hannah, Jamaal, and Zach each mentioned that encouragement from their teachers and parents helped them feel confident in math. Brandy and Jamaal held their current math teachers in highest esteem and viewed them as vital to their success. In fact, Brandy credited Ms. Wheeler's frequent support with having abolished Brandy's own negative view about her math capabilities and with having altered her outlook about math itself.

> Ms. Wheeler always says, "You can do this, guys. You can do this." Every time you tell somebody they can do it, they're going to start to believe it, and they're going to start to want to do it more and want to be better than what they are.

Ms. Wheeler described Brandy as someone who did not "fit the mold" of students in her algebra class because "she doesn't act like she has a brain in her

head at times, and then the next thing you know, she's aced the test." She added that Brandy was in an ethnic minority and that, because of this, she viewed Brandy's success in a different light. "It's very unusual to find a child like that in a higher-level class getting an A. So she sticks [out] . . . there it is. I'm looking at that going, 'there's a kid I could help get a scholarship.'"

Early in the school year, when Ms. Wheeler taught Brandy in prealgebra, she noticed a student in need of "refinement"; she believed she saw a diamond in the rough. She quickly placed Brandy in a higher-level math class and began to interact with Brandy in a way that served as a powerful social persuasion. Researchers have long contended that the expectations teachers hold for their students influence a number of classroom practices, such as verbal and nonverbal communication, differentiated instruction, level of challenge, classroom climate, and grading procedures (Good, 1987; Rosenthal, 2002). Having been handpicked by her teacher for refinement during eighth grade may well have been for Brandy a social persuasion that changed her academic trajectory.

Ms. Barkley had a similar, though less explicit, view about helping Jamaal in math. She was afraid that a well-behaved student such as Jamaal could easily "get lost in the shuffle. At the very beginning of the year I don't think I knew how smart Jamaal was because he wasn't showing it until I learned him." She lamented the fact that many teachers do not take the harder road of "learning" their students, which for her entailed paying closer attention to them and enabling them to give all that they are able to give. It was this personal attention that Jamaal said made Ms. Barkley "one of my favorite math teachers that I've ever had in my whole life." He heralded his teacher as someone who was natural to talk to and who always structured lessons in a way that guaranteed each student's understanding. Ms. Barkley, a highly respected teacher and chair of the mathematics department at CMS, described her goal to help all students feel capable. First and foremost, she identified the perils of a fixed-ability mindset.

> How many times do you hear people say, "I was never good at math. I don't understand it." If you can get them to think, "Hmm. I can understand this," then you've probably raised their confidence level by 50% just by thinking they can.

I asked Ms. Barkley what she thought was the best way to raise math confidence. "I guess you just try to keep making successful situations until they feel like Zach and Hannah."

To be sure, for Zach and Hannah, social persuasions from Ms. Barkley came as a natural product of the students' masterful math performances. Their many achievements meant that they were no strangers to external recognition from other sources too. Not only did both students mention the good feeling of being praised by their teachers in class; Hannah received the top school-wide academic honor at CMS in Grade 7, and Zach received a $50 monetary award from his parents each time he earned all As on his report card.

Usher

Brandy and Jamaal also expressed the importance of their parents' persuasions, although these messages carried a different tenor. Brandy noted that her mother's encouragement often contained the message that "everything's not going to be easy and not going to get handed to you every time you need it. You're gonna have to get your head on your shoulders and know what you want and go for it." She said that her mom had been through many challenges of her own and wanted Brandy to learn how to handle her struggles well. Jamaal's mother, who gave birth to Jamaal while herself a junior in high school, also spoke of how she and her husband urged their son toward a better path—one that would present obstacles that he must overcome.

> Well we're telling him that in this society, and I'm not going to say that racism is, it's still alive, but it's hidden. So being a Black man, you have to go that extra mile. You have to prove yourself. You have to prove a point. You have to prove that you want this and you're good at it. You're good at everything that you do. Whatever you touch is golden. So you have to believe that. And you have to go that extra mile to prove that.

Jamaal seemed particularly attentive to the messages from his father:

> [My dad] tells me all the time he lives his life vicariously through me. So he wants me to do things that he wasn't able to do, like play sports and be good at math, 'cause he's smart, but math's not his thing. And he also don't want me to make some of the mistakes that he made when he was young, so he tries to keep me out of trouble a lot.

Encouragement from his family was one source that gave Jamaal "that extra push," he told me, "but not enough to do my homework," he added parenthetically with a grin.

Some researchers have observed that African American students' academic self-efficacy beliefs in particular have profited from the persuasive messages sent by members of the African American community—teachers and parents in particular (e.g., Usher & Pajares, 2006). Walker (2000) noted that, historically, African American schools were driven by forms of interpersonal and institutional caring that conveyed to students that they were capable of achieving, despite the negative messages those students received in the larger world (see also Hughes et al., 2006). In other words, the positive social persuasions operating at a local level may have served to immunize African American students against some of the negative messages they received from the broader culture. The stories told by Brandy and Ms. Wheeler and by Jamaal, his parents, and Ms. Barkley suggest that, though these African American students may have received the same quantity of positive feedback for their academic work as did their White peers, the *quality* of that feedback was quite different, and its influence was more pervasive.

Social persuasions from peers. Brandy, Hannah, Jamaal, and Zach reported that they were often solicited for help by their classmates and peers, which gave them a psychological boost. Hannah recalled being asked during homeroom, "Why do you have to be so smart?" Brandy and Jamaal described friends who were envious of their success, and both mentioned that some peers called them names or otherwise tried to bring them down. Jamaal's mother remembered how much Jamaal was teased during elementary school because "it was not cool to be smart down south [in the district's lower-achieving schools]." Jamaal and Brandy felt that setting high personal goals protected them from feeling bothered by the taunting. "I know being smart will help me in the long run," said Brandy. "I'm keeping [my grades] up for college and scholarships. And just going forward in life."

Social Persuasions for Students With Low Self-Efficacy

Social persuasions from adults. Tanisha, Arden, Xavier, and Chris recounted tales of social persuasions from adults that ranged from empowering to demoralizing. Tanisha made significant progress in math during eighth grade and felt the accompanying pride of her teacher and family. Her mother was thrilled with Tanisha's improvement but noted that her daughter remained more attuned to her teacher's praise than to her family's. Indeed, Tanisha attributed her new-found confidence in math to the evaluative feedback she received on her work. Arden, on the other hand, expressed anger at her algebra teacher, Ms. Matthews, for having suggested early in the school year that she drop back to a prealgebra class. Her mother explained that Ms. Matthews's recommendation became to Arden like a looping vote of no confidence made more salient with every passing day. Consequently, her mother added, Arden had to pay the psychological cost of always feeling that "Ms. Matthews thinks I shouldn't be in here."

Chris expressed frustration that neither his parents nor his math teacher understood his needs. Although he was careful to point out that Ms. Matthews, his teacher, did not overtly discourage him, her impatience with his questions made him "feel low about what I can do." Pajares (2006) observed that "successful persuaders cultivate young people's beliefs in their capabilities while ensuring that the envisioned success is attainable" (p. 349). It seemed that the approach Ms. Matthews thought best fell short of enabling Chris to envision his own success. Instead, he became more convinced of his own inadequacy.

But Ms. Matthews was not the only person who fell short in persuading Chris that he was capable in math. He was aggravated by his parents' "theory that I'm a prodigy 'cause I did good in elementary school and I do good on big standardized tests. I wouldn't say I'm dumb, but I'm not a genius. I can't do everything right all the time." For him, the burden of his parents' high expectations coupled with their rare words of encouragement also diminished his belief that he could ever be successful in math.

Discouraging comments seemed to be the most consequential source of Xavier's low self-efficacy. When I asked him to describe what led him to "shut down" in math a year earlier, he explained,

> I just quit believing in myself. I just felt like no one was believing in me. And at that point my brother, he wasn't there. He was in college. And I just didn't think no one was believing in me, so I was just thinking, why would I, why should I believe in myself when no one was, you know, believing in me?

Xavier confided that a week prior to our interview, his mother told him that she did not understand why he was spending time studying for the state standardized math exam. He was overcome with emotion as he struggled to repeat his mother's words to me: "'You ain't gonna pass it anyway,' she said." His teacher, Ms. Matthews, also believed Xavier's low confidence stemmed from home and that "when he comes [to school] it's kind of like a self-fulfilling prophecy. He just assumes that he can't do it, so he just doesn't do it." Paradoxically, Ms. Matthews seemed to have long since thrown in the proverbial towel with Xavier. She made her own frustration and despair toward her student clear when I asked her to describe how she envisioned Xavier's future. She chuckled,

> Jail. I mean, I hate to say that, but I don't think that he'll go anywhere. I mean, there's some kids that you just can't save. For me, Xavier is that kid. I mean there is nothing that I say to him that seems to matter.

Though he made no mention of discouraging remarks from his teacher, Xavier said he yearned for someone who would take a more active role in his learning to ensure that he was grasping each concept. These multiple perspectives reveal how unaware each person was of the other.

Social persuasions from peers. Unlike their counterparts with high self-efficacy, Tanisha, Arden, Xavier, and Chris made few comments about messages that their age-mates sent them about their mathematics capabilities, and these comments were mixed. For example, Arden believed that support from her peers helped her feel better about her prospects in math. She often mentioned a few close friends who encouraged her in math. Xavier, on the other hand, received negative messages from peers about his math performance. "I thought I was good in math, but then people was telling me that I wasn't good. They would be like, 'You ain't good at math. I don't even know why you're doing it.'"

Summary of Social Persuasions

The persuasive messages that almost always accompany school success seemed to be noticeable and beneficial to students with high self-efficacy. Students with low self-efficacy rarely reported hearing such messages and

instead remarked that receiving little or no positive feedback curtailed their beliefs about their own capabilities. Brandy and Jamaal were fueled by their parents' persuasive coaching that they could reach their goals and even surpass the achievements of others. An equally important social injunction accompanied these messages of encouragement. The opposite was true for Xavier, who had become convinced that his mother did not believe that he could ever be successful in math. Unlike any other student I interviewed, Xavier seemed particularly bothered by the negative comments peers made about his math performance.

Construal of Physiological and Affective Information

Physiological and Affective States of Students With High Self-Efficacy

Brandy, Hannah, Jamaal, and Zach generally felt content in math, even eager to attend math class each day. They otherwise described their physiological arousal in math in terms of the discomfort they felt when confronting the unknown. Note how Jamaal described feeling when his math teacher introduced a new topic.

> Whenever we change subjects, I always start confused. And whenever I get confused, I get real tense. When we first started learning circles, I was so lost and confused I got hives and started sweating. I couldn't think straight. But other than that, I feel, I mean, I'm happy in math class. Math makes my day a lot of times.

Despite his occasional disequilibrium, Jamaal said he never doubted his capability to understand a math concept. Nor did tests arouse particular anxiety. "I take tests real good, so I don't get, like, tensed up. But it's just, I'm very curious before I take the test because I want to know what's on it." Perhaps the most palpable irritation Ms. Barkley conveyed during our interviews was with Zach's insatiable need to rectify immediately any discrepancy between what he understood and what was being presented to him. In fact, by Zach's and his mother's admission, Zach's intense anticipation and curiosity made him prone to quick frustration when his questions were not answered at once or when he did not understand what he missed on a test.

Brandy expressed a tendency to feel nervous before a test, particularly before standardized math tests used to determine course placement or promotion. She said she had to calm herself down before undertaking such evaluations—until she met her teacher, Ms. Wheeler, who had a clever way of reducing students' apprehension prior to tests.

> It makes it easy. Ms. Wheeler doesn't call it a test. She says, "It's a quiz, it's a worksheet, it's whatever you want it to be. Just make sure you do your best. It's a puzzle, it's a game. Just do your best." And [on] most tests she doesn't even put the word "Test" on it, or she doesn't tell us it's a test. It takes the pressure off so you can think about what you're doing more.

As a consequence, Brandy felt able to approach math tests unruffled, with the simple aim of doing her best rather than beset by doubts that she would fail. She described her math class as "a fun place to be."

Physiological and Affective States of Students With Low Self-Efficacy

The physiological and affective states that Tanisha, Arden, Xavier, and Chris experienced in math ranged from depression and apathy to anger and stress. Xavier's mother referred to his academic "depression," which she said was a result of having failed time and time again. Indeed, by his own account, depression seemed to dominate his approach to math. "I got self-esteem issues I think. 'Cause sometimes I think I can do it, and then, like another time I just be like totally down. 'I can't do this.'" Ms. Matthews proclaimed that Xavier showed extreme fatigue in her class, often putting his head down and sleeping when faced with material he felt was too confusing. During the week of our interview, Xavier reportedly slept through most of the standardized tests being given in school.

By all accounts, Chris approached his difficulties in math with impatience, agitation, and rage. He said that doing poorly in math made him "want to, like, throw the desk across the room," and that when he got angry, "I kind of shut down." Chris also vented his frustration with Ms. Matthews: "I get really, really, really, irritated with teachers when they won't help." When he became angry, he said he would purposefully skip help sessions or would not complete his homework. His mother described how Chris bunched up paper or slammed his book shut when he experienced difficulty. "He just gets really stressed out. You can just see. He gets angry. Chris has a temper." I happened to be standing outside Chris's math class as he finished a test the day of our interview. Clearly distressed, he had erased a hole in his paper and had to exchange his test for a new copy. I asked his teacher about this. Ms. Matthews explained that this was a typical test-taking experience for Chris, likely prompted because "he's pissed off at himself that he doesn't know how to do it. Or that he's not sure about it." Chris's agitation seemed to portend the negative performances he dreaded.

Arden depicted herself as having always had a negative attitude toward math. To those with whom she was completely honest, she said she described math this way: "'I hate it. It's horrible. I don't understand it. Ms. Matthews isn't doing it right. Or, I'm just falling short.' Or like, 'I don't understand it at all and I hate it and it's boring.'" She felt "extremely pressured" by the high-stakes standardized tests on which failure meant retention. She also described how difficult it was for her to remain focused in math.

After Tanisha did what her teacher called "a 180," she stopped laying her head down on her desk and started paying attention in math class. The only worry that Tanisha expressed about math was in regard to ninth-grade algebra. Her difficulty understanding algebra concepts at the beginning of eighth grade invoked a dread that she would "freak out" when encountering the concepts again the next year.

Summary of Construal of Physiological and Affective States

All students expressed at least brief moments of heightened physiological and affective arousal in mathematics. Only the students with low self-efficacy, however, interpreted this as a sign of incompetence. This is likely because of the degree of arousal students experienced. Bandura (1997) noted that "as a general rule, moderate levels of arousal heighten attentiveness and facilitate deployment of skills, whereas high arousal disrupts the quality of functioning" (p. 106). The uncomfortable cognitive dissonance described by students with high self-efficacy likely facilitated the acquisition of new skills. The arousal subsided as soon as students were able to reach a firmer understanding of new material or dissonant feedback. For the students with low self-efficacy, however, and particularly for the boys, their construal of physiological information left them with less confidence and impaired functioning. As Bandura observed, "By conjuring up aversive thoughts about their ineptitude and stress reactions, people can rouse themselves to elevated levels of distress that produce the very dysfunctions they fear" (p. 106).

Self-Regulated Learning

As each interview was analyzed, it became evident how much students with high and low self-efficacy differed in the degree to which they felt able to (and perhaps were urged to) regulate their own learning. For most students, the ability to self-regulate one's own learning was directly related to self-efficacy and to its sources—mastery experience and physiological arousal in particular.

Self-Regulated Learning for Students With High Self-Efficacy

Of the eight students interviewed, none was as self-regulated as Hannah, who described her "obsessive" need to rewrite her math notes until they were perfect. Hannah approached her math work in a systematic manner, always well in advance of her next class. "I'm, like, dedicated to do my math homework," she explained, adding that she completed problems from easiest to most difficult, showing her work at every step, and rechecking each problem after she had reached the end of the assignment. Ms. Barkley characterized Hannah as "a very meticulous math student. Every step written down neatly, explicitly, and usually correctly." Ms. Murphy, Hannah's mother, mentioned that in the summer Hannah would complete packets of enrichment math work, wait a month, and then review them all again before school started to be sure she remembered the skills she acquired. Such habits helped Hannah approach her math class with confidence. Hannah added that when she encountered a math concept that posed any difficulty for her, she would face the challenge directly by finding similar problems to work through. Self-regulated learning was a means of equilibrating her confidence, reducing her anxiety, and ensuring her own mastery of the material.

Zach described a systematic approach to completing his homework, which he did "before anything else" each afternoon. His mother added that "it is just a given in our house. It's just a given. When they were little, they would come home, have a snack, do their homework." Until they were older, she explained, her children would be required to sit at the table until homework was complete. She said this habit had become so ingrained in them that she never needed to check for homework completion anymore. Hannah's mother described a similar expectation in her household. Brandy had a habit of completing her math homework at school to avoid having to do it late in the evening after her long bus ride. Each of these strategies helped students approach math class prepared to face new lessons.

Unlike his high self-efficacy counterparts, Jamaal admitted that his work habits were deficient. Both he and his mother described him as "lazy" with his academic work. An avid athlete, Jamaal acknowledged that he often viewed math homework as an unnecessary review and that, as long as his grades were high, he need not waste much time on it. As his interest grew in football and social activities, completing math homework came at an increasingly high cost. This shift in values likely led Jamaal to minimize time spent on math outside school (Wigfield, Hoa, & Klauda, 2008). When I asked him whether he felt he was capable of being the top math student in his school, Jamaal assured me that, but for his poor self-regulation, he was certain he could. And his work habits, he was sure, were within his control.

Self-Regulated Learning for Students With Low Self-Efficacy

Tanisha, Arden, Xavier, and Chris expressed having great difficulty regulating their work in mathematics. Arden described her difficulty staying focused in class when the material did not make sense to her. "I just kind of block it out, I guess. And like, I take notes and stuff, but when you go back and read those, those don't help at all." Although she and her mother claimed she attended extra help sessions offered by her teacher, Ms. Matthews had not seen Arden after school for several months. Arden's involvement in the school play had required her to considerably reduce the time she spent on schoolwork. Her trouble attending to lectures, her poor note taking, and the fact that she had missed extra help sessions meant a shaky foundation for Arden in math.

Chris also found more appealing ways to spend his time than doing math homework. He explained that the good intentions he had of doing his homework each day were usually thwarted by e-mail, computer games, and his guitar, activities that were more valuable to him. Ms. Matthews was aware of the problem.

> He just needs to get his organization together because that would help him study. I really think that's where, that's like the missing piece with him. So if he could just fall in line with his homework, and practice it the way that it needs to be practiced, then when he gets to the test he would say, "Oh, I've done this five times. I know how to do it now."

Similarly, Tanisha and her mother and teacher blamed Tanisha's early failure in math on her poor study habits during the first semester of the school year. Her mother was encouraged to see Tanisha's gradual improvements.

Xavier's work habits had only worsened, however. His mother complained of having to punish her son to motivate him to complete any of his work. She was also uncertain as to whether Xavier was attending math help sessions or the school's free Saturday math tutorial. According to Xavier, his "slacking off" was the reason that he did not make it into algebra in eighth grade. His teacher agreed. "I would say 70–80% of [Xavier's trouble in math] is due to work habits, because I think that he could do it if he tried." His poor study habits were a part of the self-fulfilling prophecy she felt she was witnessing.

Summary of Self-Regulatory Information

The relationship between self-efficacy beliefs and self-regulatory processes has been shown to be reciprocal in nature, such that altering students' self-regulatory processes can change their self-perceptions and vice versa (Zimmerman, 2008; Zimmerman & Cleary, 2006). Students' ability to self-regulate their mathematics learning may have supported their mathematics self-efficacy beliefs. Those who struggled to maintain a habitual study place and time, who lacked organizational skills, and who had difficulty following material covered in class were those whose self-efficacy beliefs also suffered. To the contrary, the strong self-regulatory skills that most students with high self-efficacy displayed may have helped them approach math with greater confidence. As theorized by Bandura (1997), students are unlikely to implement self-regulatory learning strategies unless they possess a belief that they will be successful in doing so. The increase of competing demands for students' time and attention may encroach on the time students spend and the value they place on math. Additional research should target the sources of students' beliefs in their efficacy to manage these interfering factors.

Conclusions

The central goal of this study was to use qualitative methods to investigate the rules or heuristics that students with high and low self-efficacy use to select and interpret information related to their mathematics self-efficacy. The study's findings demonstrate that students with high mathematics self-efficacy also reported having high levels of achievement in mathematics, and students with low self-efficacy recounted their poor performance and struggles. This observation is consistent with Bandura's (1997) social cognitive theory, which posits that the interpretations students make of their past successes and failures serve as an important source of information about their efficacy. Mastery experience has also emerged as a powerful source of self-efficacy in both quantitative and qualitative investigations in this academic domain (e.g., Lent et al., 1996; Lopez, Lent, Brown, & Gore, 1997; and see

Usher & Pajares, in press). When students feel they have mastered requisite subskills, when they have accomplished difficult tasks, when they interpret performances as successful, they develop a robust belief in their personal efficacy (Bandura, 1997). If this is the case, teachers of mathematics should take care to deliver instruction in such a way as to maximize the opportunity for "*authentic* mastery experiences," however small (Pajares, 2006, p. 344). Helping students acquire a sense of mastery often requires ingenuity, patience, and perseverance and should not be confused with artificial attempts to boost students' self-esteem by assigning work that provides little challenge or satisfaction.

Results from this study also reveal that students do not uniquely rely on their own experiential repertoire in mathematics to refine their efficacy judgments. Models provide opportunities for vicarious learning. Recall that Jamaal interpreted his parents' failures in mathematics as compelling evidence that he could be different, that he had what it takes to succeed. Quantitative methods that have typically been used to investigate the sources (e.g., correlational/regression analyses that assume the successful experiences of social models are positively related to self-efficacy) would not have revealed why or how students such as Jamaal interpret the unsuccessful experiences of others in such a way as to *enhance* self-efficacy. As this and other qualitative studies have demonstrated, people often rely on the experiences of others to refine beliefs in their own capabilities (e.g., Zeldin & Pajares, 2000). With careful thought, quantitative methods could be designed that may permit a better understanding of these relationships on a larger scale.

Similarly, qualitative inquiry revealed that Brandy credited her teacher's ability to provide her with opportunities for successive attainments as essential to improving her mathematics competency. As Brandy explained, Ms. Wheeler provided both the skill transmission and the social validation that were instrumental in building her own sense of competence during eighth grade. Although quantitative and qualitative findings would have likely converged on this point, the perspective gained from conversing with Brandy and her teacher enables outsiders to catch a glimpse of the ways in which a teacher's pedagogical approach nurtured her student's perceptions of mastery in a manner that was maximally persuasive.

One new and potentially important finding emerged from students' interpretations of their physiological and affective arousal in math. Students with high self-efficacy framed their bouts of heightened arousal in ways that were motivating; those with low self-efficacy experienced a level of distress that left them feeling disheartened and often paralyzed. This observation underscores the complexity of physiological and affective arousal as a source of self-efficacy and calls into question findings from quantitative research that have shown no relationship between arousal and self-efficacy. As Bandura (1997) asserted, the relationship between physiological arousal and self-efficacy may not always be negative or linear and therefore may need to be modeled more flexibly in quantitative research.

Qualitative inquiry also clarified links between self-efficacy and self-regulation. It may come as little surprise that most students with high self-efficacy proactively rely on a stock of self-regulatory skills when learning math. Those with low self-efficacy struggled to manage their math work and rarely sought help from teachers. Self-efficacious students are more likely to use cognitive and metacognitive strategies in the classroom than are those who doubt their competence (Zimmerman & Schunk, 2008). Likewise, helping students become better self-regulators of their learning can increase their self-efficacy perceptions (e.g., Schunk & Lilly, 1984; Schunk & Swartz, 1993; Zimmerman & Bandura, 1994; Zimmerman & Kitsantas, 1999).

Several interviews in this study revealed that, consistent with theorists' contentions, the message students send themselves—the internal dialogues—are related to their beliefs about their mathematics capabilities (Bandura, 1997; Purkey, 2000). Bandura (1997) included *cognitive self-modeling*—visualization of one's own self coping in diverse situations and under challenging circumstances—as a part of vicarious experiences. He argued that individuals find satisfaction and confidence when they "visualize themselves repeatedly confronting and mastering progressively more challenging or threatening situations" (p. 95). Self-talk and self-modeling may be part of a student's larger repertoire of self-regulatory skills. Both Brandy and Jamaal were able to coach themselves through difficulties. Having a stock of such self-regulatory strategies served to put into place for some students what Zimmerman and Kitsantas (2005) called a *self-empowering cycle* that enhances both confidence and competence in mathematics. The preliminary findings in this study pave the way for future efforts to investigate the benefits that students might gain from envisioning their own success.

Findings from this study point to the significance of contextual influences in the formation of self-efficacy beliefs, in this case, course placement and assignment. Parents, teachers, and students alike noted this importance. Such designations can carry with them information from all four hypothesized sources of self-efficacy. Being enrolled in geometry in eighth grade and the talented and gifted program served as a boost and a confirmation to Hannah, Jamaal, and Zach that they were ahead of most students their age. Jamaal seemed to thrive on the competitive environment in his geometry class. Brandy was promoted from prealgebra to algebra during the school year, which sent her a powerful persuasive message that she was capable. Chris and Tanisha moved back a level in mathematics after experiencing difficulty at the beginning of the year. The move left them able to review concepts that they would need for mastery of more-complex skills and hence provided them with more opportunities for mastery. For Arden, however, remaining in algebra despite her teacher's plea that she move back a level only reinforced her sense of inefficacy. If Arden's mother was correct, this self-doubt traced back to when Arden did not qualify for placement in the school's talented and gifted program in elementary school.

Interviews with teachers and parents provided a unique look at the complex environments in which self-efficacy beliefs take root. One implication

to emerge from these interviews is that teachers and parents should become more aware of the messages—both explicit and implicit—that they send to students, for these messages might travel with students for the rest of their lives, framing their interpretations of information related to their academic competence. Indeed, college students and adults have illustrated the lingering, potent effects of the messages significant others sent them during their childhood and adolescence about their academic capabilities (Pajares, 1994; Zeldin & Pajares, 2000).

Other conversations served as a reminder that praise can have unintended effects. Recall Zach's mother, the CPA who praised her son for his good fortune in being born with an ability for math. "Either you have it or you don't in math," she claimed. Parents who communicate a belief to their children that mathematics (or any other) ability is a fixed entity and that success reflects ability simultaneously send the message that failure reflects a *lack* of ability, a message that can have problematic consequences for motivation (Molden & Dweck, 2006). These students may tend to frame difficulties as evidence that they lack natural ability (Dweck & Leggett, 1988). Consequently, this fixed-ability mindset makes "confidence and motivation more fragile" (Dweck, 2006, p. 205). Helping all students believe that academic competencies can be improved through effort and perseverance enables them to interpret efficacy-relevant information adaptively, thereby safeguarding their self-efficacy (Schunk, 2008).

An additional aim of this study was to examine whether students appear to interpret the sources of self-efficacy differently as a function of their gender or race. Few qualitative differences in boys' and girls' remarks about their sense of competence in mathematics emerged, though girls generally reported being better self-regulators than did boys. This is in contrast to interview results with women and men who pursued careers in mathematics, science, or technology and who interpreted the sources of self-efficacy quite differently (Zeldin et al., 2007; Zeldin & Pajares, 2000). Women interpreted vicarious experience and social persuasions as the most influential sources of self-efficacy, whereas men attended more to their mastery experiences. Interestingly, teachers and parents of the eighth-grade students in this study were more likely to attribute girls' successes in mathematics to hard work than to ability. They spoke of girls' conscientiousness in mathematics, which often manifested in girls' expressed fear of failure. Teachers and parents rarely questioned boys' mathematics ability but emphasized their surprise that boys could get by in mathematics despite their substandard work habits. It is difficult to conclude how these messages might be transmitted to children and what, if any, long-term effects they might have, but, as already noted, teachers and parents should closely examine the messages they may be sending to these youngsters. As all of the adults in this study were women, future research might target male perspectives on these issues.

I also analyzed the data for possible differences in the way African American and White students talked about their self-beliefs in mathematics.

The greatest distinction I observed in participants' comments was the emphasis that Jamaal, Brandy, and Xavier placed on the social persuasions they received from their parents and teachers. Quantitative findings have also indicated that social persuasions are an important source of academic self-efficacy for African American middle school students (Usher & Pajares, 2006). Both Ms. Wheeler and Ms. Haines underscored their belief that encouragement is central to fostering African American students' beliefs in their academic capabilities. It remains less clear whether African American students receive the messages sent to them in qualitatively different ways, though this would be an important question to examine further.

Limitations

I made every effort to select the design, methodology, and analyses in this study so as to maximize the study's potential contribution to an understanding of how mathematics efficacy beliefs take hold during middle school. I have tried to craft a compelling narrative of each student based on the data to provide what Eisner (1998) would call "a confluence of evidence that breeds credibility" (p. 110). Nevertheless, several limitations deserve mention.

The conclusions I have drawn are situated within the framework of social cognitive theory and may differ from those drawn by researchers from other theoretical homes. Some may ask whether the open-ended nature of the interview questions invited judgments that more closely reflect students' mathematics self-concept than self-efficacy. To be sure, the present methodological approach may blur these conceptual lines, but the focus of this study was on *sources* of self-efficacy beliefs, which themselves likely undergird higher-order self-concept beliefs (see Bong & Skaalvik, 2003).

This study relied on interviews conducted with 23 participants who were asked to reconstruct experiences with respect to their own (or to their student's or child's) mathematics competence at a single point in time. Such a design prohibits a causal analysis of the development of mathematics self-efficacy. The hypothesized reciprocity between personal, environmental, and behavioral determinants suggests that reverse causal ordering is also plausible. To address this question of causal ordering, future designs may incorporate interviews over the course of a school year with simultaneous self-efficacy assessment. For example, Zimmerman (2008) has proposed such a model for integrating the assessment of self-efficacy, self-regulated learning strategies, and achievement. Finally, the interviews here are representative of students in a specific context (e.g., students with high and low mathematics self-efficacy in Grade 8 at a selected suburban school) and do not represent all middle school students. I urge readers to determine for themselves the transferability of the data presented here and to use the present account as what Lee Cronbach (1975) called "a working hypothesis, not a conclusion" (p. 125) as they examine the formation of self-efficacy in other contexts.

Note

I would like to express my appreciation to Frank Pajares, Samuel Candler Dobbs Professor of Education at Emory University, for his helpful comments and suggestions on an earlier version of this article. I would also like to thank the students, parents, and teachers who graciously agreed to participate in this study.

References

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Adolescence and education: Vol. 5. Self-efficacy and adolescence* (pp. 307–337). Greenwich, CT: Information Age.

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review, 15*, 1–40.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43*, 485–499.

Cronbach, L. (1975). Beyond the two disciplines of psychology. *American Psychologist, 30*, 116–127.

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*. Philadelphia: Psychology Press.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York: Random House.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256–272.

Eccles, J. S. (2004). Schools, academic motivation, and stage-environment fit. In R. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., pp. 125–153). Hoboken, NJ: Wiley.

Eccles, J. S., & Midgley, C. (1989). Stage-environment fit: Developmentally appropriate classrooms for young adolescents. In C. Ames & R. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 139–186). San Diego, CA: Academic Press.

Eisner, E. (1998). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York: Macmillan.

Evans, R. I. (1989). *Albert Bandura: The man and his ideas—a dialogue*. New York: Praeger.

Good, T. L. (1987). Two decades of research on teacher expectations: Findings and future directions. *Journal of Teacher Education, 4*, 32–47.

Hampton, N. Z., & Mason, E. (2003). Learning disabilities, gender, sources of self-efficacy, self-efficacy beliefs, and academic achievement in high school students. *Journal of School Psychology, 41*, 101–112.

Hughes, D., Rodriguez, J., Smith, E. P., Johnson, D. J., Stevenson, H. C., & Spicer, P. (2006). Parents' ethnic-racial socialization practices: A review of research and directions for future study. *Developmental Psychology, 42*, 747–770.

Hutchison, M. A., Follman, D. K., Sumpter, M., & Bodner, G. M. (2006). Factors influencing the self-efficacy beliefs of first-year engineering students. *Journal of Engineering Education, 95*, 39–47.

James, W. (1899/2001). *Talks to teachers on psychology*. Mineola, NY: Dover.

Klassen, R. (2004). A cross-cultural investigation of the efficacy beliefs of South Asian immigrant and Anglo non-immigrant early adolescents. *Journal of Educational Psychology, 96*, 731–742.

Lent, R. W., Brown, S. D., Gover, M. R., & Nijjer, S. K. (1996). Cognitive assessment of the sources of mathematics self-efficacy: A thought-listing analysis. *Journal of Career Assessment, 4*, 33–46.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology, 38*, 424–430.

Lent, R. W., Lopez, F. G., Brown, S. D., & Gore, P. A. (1996). Latent structure of the sources of mathematics self-efficacy. *Journal of Vocational Behavior, 49*, 292–308.

Lopez, F. G., Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Role of social-cognitive expectations in high school students' mathematics-related interest and performance. *Journal of Counseling Psychology, 44*, 44–52.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage.

Molden, D. C., & Dweck, C. S. (2006). Finding "meaning" in psychology: A lay theories approach to self-regulation, social perception, and social development. *American Psychologist, 61*, 192–203.

Pajares, F. (1994). Inviting self-efficacy: The role of invitations in the development of confidence and competence in writing. *Journal of Invitational Theory and Practice, 3*, 13–24.

Pajares, F. (2006). Self-efficacy beliefs during adolescence: Implications for teachers and parents. In F. Pajares & T. Urdan (Eds.), *Adolescence and education: Vol. 5. Self-efficacy beliefs of adolescents* (pp. 339–367). Greenwich, CT: Information Age.

Pajares, F., Johnson, M. J., & Usher, E. L. (2007). Sources of writing self-efficacy beliefs of elementary, middle, and high school students. *Research in the Teaching of English, 42*, 104–120.

Pajares, F., & Schunk, D. H. (2005). Self-efficacy and self-concept beliefs: Jointly contributing to the quality of human life. In H. Marsh, R. Craven, & D. McInerney (Eds.), *International advances in self research* (Vol. 2, pp. 95–121). Greenwich, CT: Information Age.

Pajares, F., & Urdan, T. (Eds.). (2006). *Adolescence and education: Vol. 5. Self-efficacy beliefs of adolescents*. Greenwich, CT: Information Age.

Purkey, W. W. (2000). *What students say to themselves: Internal dialogue and school success*. Thousand Oaks, CA: Corwin Press.

Rosenthal, R. (2002). The Pygmalion effect and its mediating mechanisms. In J. Aronson (Ed.), *Improving academic achievement: Impact of psychological factors on education* (pp. 25–36). New York: Academic Press.

Schunk, D. H. (2008). Attributions as motivators of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, Research, and Applications* (pp. 245–266). New York: Erlbaum.

Schunk, D. H., & Ertmer, P. A. (2000). Self-efficacy and academic learning: Self-efficacy enhancing interventions. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 631–650). San Diego, CA: Academic Press.

Schunk, D. H., & Lilly, M. W. (1984). Sex differences in self-efficacy and attributions: Influence of performance feedback. *Journal of Early Adolescence, 4*, 203–213.

Schunk, D. H., & Swartz, C. W. (1993). Goals and progress feedback: Effects on self-efficacy and writing achievement. *Contemporary Educational Psychology, 18*, 337–354.

Usher, E. L., & Pajares, F. (2006). Sources of academic and self-regulatory efficacy beliefs of entering middle school students. *Contemporary Educational Psychology, 31*, 125–141.

Usher, E. L., & Pajares, F. (in press). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*.

Walker, V. S. (2000). Valued segregated schools for African American children in the South, 1935–1969: A review of common themes and characteristics. *Review of Educational Research, 70*, 253–285.

Wheeler, L., & Suls, J. (2005). Social comparison and self-evaluations of competence. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 566–578). New York: Guilford.

Wigfield, A., Eccles, J., Mac Iver, D., Reuman, D., & Midgley, C. (1991). Transitions at early adolescence: Changes in children's domain-specific self-perceptions and general self-esteem across the transition to junior high school. *Developmental Psychology, 27*, 552–565.

Wigfield, A., Hoa, L. W., & Klauda, S. L. (2008). The role of achievement values in the regulation of achievement behaviors. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 169–195). New York: Erlbaum.

Zeldin, A., Britner, S. L., & Pajares, F. (2007). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research on Science Teaching*. Advance online publication. Retrieved November 7, 2007. doi: 10.1002/tea.20195.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*, 215–246.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*, 64–70.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*, 166–183.

Zimmerman, B. J., & Bandura, A. (1994). Impact of self-regulatory influences on writing course attainment. *American Educational Research Journal, 31*, 845–862.

Zimmerman, B. J., & Cleary, T. J. (2006). Adolescents' development of personal agency. In F. Pajares & T. Urdan (Eds.), *Adolescence and education: Vol. 5. Self-efficacy beliefs of adolescents* (pp. 45–69). Greenwich, CT: Information Age.

Zimmerman, B. J., & Kitsantas, A. (1999). Acquiring writing revision skill: Shifting from process to outcome self-regulatory goals. *Journal of Educational Psychology, 91*, 241–250.

Zimmerman, B. J., & Kitsantas, A. (2005). The hidden dimension of personal competence: Self-regulated learning and practice. In A. J. Elliot & C. Dweck (Eds.), *Handbook of competence and motivation* (pp. 509–526). New York: Guilford Press.

Zimmerman, B. J., & Schunk, A. (2008). Motivation: An essential dimension of self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 1–30). New York: Erlbaum.

Manuscript received December 20, 2007
Revision received July 27, 2008
Accepted August 3, 2008