Received 03/16/10
Revised 08/23/10
Accepted 08/23/10

Special Section
Science, Technology, Engineering, and Mathematics (STEM) Careers

Social Cognitive Factors, Support, and Engagement: Early Adolescents' Math Interests as Precursors to Choice of Career

Heather T. Rowan-Kenyon, Amy K. Swan, and Marie F. Creager

The authors examined the central hypothesis that students' early perceptions of support and sense of engagement in math classes and math activities strongly influence the broadening or narrowing of their math interest. The focus was on the first wave of qualitative data collected from 5th-, 7th-, and 9th-grade students during the 2007–2008 academic year as part of a longitudinal study. Findings indicate the importance of using group work and extrinsic motivation in middle school math classes to broaden interest; peer classroom behavior was often a detractor of math interest.

Keywords: social learning and cognitive theory, math interest, middle school students

With the need for a stronger global workforce in the United States, careers and education in science, technology, engineering, and mathematics (STEM) have been declared national priorities (National Science Board [NSB], 2007). For older high school and college students, high math and science self-efficacy and positive outcome expectations have been shown to have a strong association with specific educational and career interests (Hackett & Betz, 1981). These beliefs have a strong negative influence on some women's choices to pursue STEM-related majors and careers. By contrast, limited information is available on the role of other factors on early, pre-high school career interests. In fact, little is known

Heather T. Rowan-Kenyon, Department of Education Leadership and Higher Education, Boston College; Amy K. Swan, Department of Higher Education, and Marie F. Creager, Counseling Department, University of Virginia. Marie F. Creager is now at Counseling Education Department, Virginia Commonwealth University. *A previous version of this article was presented at the annual meeting of the American Educational Research Association, San Diego, California, April 2009. This research was funded by the National Science Foundation. The opinions expressed in this article are those of the authors and do not necessarily represent the views of the National Science Foundation or its employees. The authors thank Mary Deacon and Christian Steinmetz who assisted with the collection of data.* *Correspondence concerning this article should be addressed to Heather T. Rowan-Kenyon, Department of Education Leadership and Higher Education, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467 (e-mail: rowanken@bc.edu).*

about children's career development at all (McMahon & Watson, 2008; Porfeli, Hartung, & Vondracek, 2008). Few studies have examined the relationship of social cognitive factors and support to STEM choices with young people in late childhood and early adolescence. Furthermore, few studies have focused on the ways that math engagement, in addition to perceived support from peers, teachers, or parents, might influence the development of STEM interests, particularly mathematics interest, among middle and high school students.

In this article, we present qualitative findings from the 1st year of a 3-year study designed to characterize STEM interests, goals, and behaviors among girls and boys in late childhood and early adolescence. We focused on mathematics as the critical foundation and early filter for later STEM-related educational and career options. More specifically, the research we present in this article examined student perceptions of support and barriers to the development of math interests and the perceived influence of math engagement. Given that the development of math interest is complex and highly phenomenological, based on each person's experiences and meaning making, qualitative inquiry is the most appropriate approach for examining these perceptions.

Social cognitive career theory (Lent, Brown, & Hackett, 1994) acknowledges human agency in the career development process through the key mechanisms of self-efficacy, outcome expectations, and personal goals. The theory further positions career-related interest, choice, and performance within the interlocking developmental processes of academic and career interests, goals, and performance (Lent, 2005). The first two processes (i.e., interest development and goal development) are most directly related to STEM-related interests in pre- and early adolescence.

Children and adolescents are exposed to a variety of educational, recreational, and peer environments; experiences; and activities (e.g., math classes, mechanical tasks, computer activities). These also influence later career interests and choices (Lent, 2005; Lent et al., 1994). Parents, teachers, peers, and others sometimes unintentionally encourage young people to pursue some activities or tasks and to achieve expected levels of performance (Lent, 2005; Lent et al., 1994). Through repeated encouragement and concomitant practice, children cultivate some skills, forming positive self-efficacy beliefs and a set of positive outcome expectations related to the associated tasks (Lent, 2005; Lent et al., 1994).

Individuals are more likely to develop interest in an activity if they believe they are competent at it (self-efficacy) and believe that performing the activity will produce valued outcomes (Lent et al., 1994). Likewise, a person is less likely to develop an interest in, and may even develop an aversion to, activities or tasks in which they have lower self-efficacy or expect undesirable outcomes. These early interests lead to goals for sustaining or increasing involvement in particular activities. Subsequently, these goals increase the likelihood of continued practice and of persistence in the face of challenges (Lent et al., 1994). Achievements that accrue through practice (e.g., self-satisfaction, awards, grades) modify existing levels of self-efficacy and outcome expectations. This cyclical feedback loop leads to more and more clearly defined interests that eventually lead to specific career-related behavior, including choice of college major and choice of career.

Contextual and individual variables (e.g., gender) influence these social cognitive variables (Lent et al., 1994). Parental, teacher, and peer cultural expectations related to gender-appropriate behavior may influence girls to participate in activities that are different from those in which boys are encouraged to participate. Male and female students may also receive different types or quantities of feedback on their performance in activities and school subjects (Eccles, 1987). Such biased access to opportunities for practicing and observing behaviors and discouraging participation in nontraditional activities negatively influence some individuals' career-related self-efficacy in traditionally White, male fields such as mathematics and engineering (Hackett & Betz, 1981; Lent et al., 1994).

This career support or lack of support is important for young people's career development (Lent, Brown, & Hackett, 2000), especially support in the immediate contexts of family and school (Kenny, Gallagher, Alvarez, & Sibby, 2002). Perceived support from both parents and teachers is instrumental in its effect on career-related outcomes for middle and high school students (Lapan, Hinkelman, Adams, & Turner, 1999; McWhirter, Hackett, & Bandalos, 1998). Parents are a particularly important source of support for student development of math and science self-efficacy, levels of engagement, and career options (Flores & O'Brien, 2002; Navarro, Flores, & Worthington, 2007; Turner, Steward, & Lapan, 2004).

In addition, sources of perceived support within the school context, including perceived teacher support, play a critical role in providing students with a sense of belonging and engagement (Eccles & Midgley, 1989; Walker & Greene, 2009). Perceptions of less support in a classroom have a negative impact on early adolescents' interest in what is being taught in that classroom, although perceptions of teacher support contribute significantly to school engagement (A. M. Ryan & Patrick, 2001). Similarly, teacher support appears to be a necessary condition for positive school behavior and achievement outcomes (Hamre & Pianta, 2001).

Engagement in classroom tasks influences the extent to which students believe that current learning is instrumental to their future success (Greene, Miller, Crowson, Duke, & Akey, 2004; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996). In addition, middle school students' engagement in mathematics and their perception of its usefulness may decrease during the transition to middle school, leading to decreased effort and persistence in mathematics (Midgley, Feldlaufer, & Eccles, 1989; Pajares & Graham, 1999; Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991). Some research has suggested that middle school girls exhibit greater interest in and enjoyment of math than their male peers (Cleary & Chen, 2009). However, there is still a wide gender gap in the eventual choice of college major and of careers in this field.

Our research examined the central hypothesis that students' early perceptions, tentatively established before and during middle school, strongly influence their broadening or narrowing of educational and career options at this critical point in their educational and career trajectories. These perceptions include perceived supports and perceived sense of engagement in school learning. We specifically addressed engagement in math class and math activities, as well as the perceived supports associated with this content area. Teachers' and parents' STEM-related perceptions are associated with students' perceptions and, thus, influence the narrowing or widening of the zone of possible options (Gottfredson, 1981). We focused on the first wave of data collected as part of a longitudinal study funded by the National Science Foundation. Our results are based on data collected from fifth-, seventh- and ninth-grade students during the 2007–2008 academic year. Specifically, the research question for our study was how do students describe perceived supports, barriers, and engagement as influencing their math interest?

Method

Participants

Sixty-seven students participated in focus groups for the phase of the study on which this article is focused, as did three parents and eight teachers. These students are part of a larger sample of 352 students. There are approximately 8,700 students in Central City Public Schools (CCPS; a pseudonym) where this study was conducted, with 11 elementary schools, three middle schools, and two high schools. We invited the principals at four of the elementary schools and all of the middle schools and high schools to participate in the study. One high school, two middle schools, and four elementary schools accepted our invitation. These seven schools had large percentages of both Black/African American and White students. The percentage of Black/African American students in the district ranged from 48% to 59%, although White students made up between 37% and 49% of the district population. In the elementary schools, the Black/African American population ranged from 30% to 58%, and the White population ranged from 37% to 64%. Approximately half of the students in CCPS were eligible to participate in the National School Lunch Program. In our study schools, participation in this program varied from 31% at one elementary school to 64% at another elementary school and one middle school. More than three fourths of all students in CCPS passed the math achievement test in 2008. Disparities are evident in pass rates, with White students passing at approximately 20 percentage points higher than did Black students. There were no patterns by gender.

Procedure

For each school involved in the study, the school principals designated a primary contact person. Each student at these schools who was in the fifth, seventh, or ninth grade received parental consent forms and student assent forms to invite participation for our longitudinal study. Approximately 1,037 permission slips/consent forms were distributed (*n*s = 273, 221, and 353 for fifth, seventh, and ninth grades, respectively). Of these, 352 (33.9%) were returned and signed by the parent/guardian and the student. A subsample of these students was selected to participate in the focus groups, which are the focus of this article. The research team conducted two focus groups per grade (i.e., one group of boys and one group of girls) at each school, for 14 focus groups at the seven schools, including eight groups of fifth graders, four groups of seventh graders, and two groups of ninth graders. Focus group participants were selected by school contacts from the students who had parental consent. Students were chosen so that the focus groups would be diverse in terms of race/ethnicity and math ability. There were 36 White participants, 22 Black/African American participants, and 10 participants of other races/ethnicities. The focus groups included 36 girls and 31 boys, resulting in seven groups each of girls and of boys. The researchers asked the contact person at each school to select students who represented a range of math ability. Trained graduate research assistants conducted the focus groups, each of which lasted approximately 1 hour. All groups were digitally recorded and transcribed. In addition to the student groups, focus groups with several parents and teachers were also conducted.

There was one parent focus group of two parents and an individual interview was held with another parent at the same school. There were two teacher focus groups, one of elementary school teachers and another of middle school teachers. Four teachers participated in each of these focus groups.

Protocol

We developed data collection protocols based on Lent et al.'s (1994, 2000) conceptual framework, a literature review on STEM interest development, and wording appropriate to participants' grade levels. The protocols included seven primary questions with one or two probing questions for each primary question. Topics included classroom environment; motivation; sources of encouragement; expectations of parents, teachers, and peers; and perceived math ability. Questions included the following: What do you most like about math? What types of math work (activities or assignments) do you like the most? How do you think others expect you to do in math? The student focus groups lasted for approximately 1 hour. Parent and teacher protocols covered the same topics as the student focus groups. These focus groups also lasted approximately 1 hour. The following questions were included: How do you talk with your child about their math class at school?—parent question. What role do you think the math teacher plays in your child's future career plans and future education?—parent question. What have you noticed about student beliefs and perceptions about math in your classes?—teacher question.

Analysis

An analysis was first conducted by two graduate research assistants and two undergraduate interns who developed initial coding themes based on one of the focus groups. Following this, a coding team of two graduate research assistants and a postdoctoral fellow, with guidance from one of the principal investigators (i.e., the first author), used these initial codes and combined them with codes identified through a review of the literature. Then, to ensure credibility, two members of this three-member team coded each transcript and compared coding, including the third member's input when the two original coders could not reach consensus. When this coding had been completed, research team members developed themes based on the data. Transcripts were then entered into NVivo for analysis specifically focused on student perceptions of supports, barriers, and perceived levels of engagement related to the development of math interests. Additional emerging codes not previously delineated were also identified at this time.

We used several strategies to ensure the trustworthiness and credibility of our qualitative findings and conclusions. To ensure construct validity, we collected information from multiple sources with different perspectives (i.e., students, parents, and teachers). We used standardized focus group protocols to ensure reliability (Yin, 2009). The use of a team of coders allowed for an ongoing audit of the process of individual interpretations of the data.

Results

The qualitative analyses provide insight into the role of perceived supports and levels of engagement in relation to students' math interest. Students' perceptions were influenced by experiences both inside and outside the classroom, as reflected in their discussions about the nature of family involvement, teacher support, and sources of motivation. In addition, students and teachers discussed elements of the classroom environment that helped or hindered engagement in math.

Parent Support

Students at all grade levels discussed ways their parents and other family members conveyed expectations regarding math performance and helped motivate students to meet these expectations. Students said that their parents expected them to get good grades, encouraged them to do their math homework, and wanted them to do their best. One seventh-grade boy said, "My dad expects me to do pretty good in math. My mom and dad expect me to do really good in math so I can have a good career when I get older." A fifth-grade girl said that her mother expected her to earn good grades, but if she did not, her mother "wouldn't be very mad . . . if there's something that I really don't understand she's okay with it and she knows that I just tried my best and that's all that matters." Several students, particularly at the elementary and middle school levels, explained how their parents assisted them with their math homework. For example, a fifth-grade girl spoke of how her father had helped her prepare for a math test, "But then he helped me a lot and we went to the computer and he went to this program that had worksheets that you could print out for math and that helped me a lot."

Several parents of fifth-grade students echoed students' comments, explaining that they worked on math homework with their children and encouraged them to do well. One parent explained that it was the parents' responsibility to be involved in their children's studies, and to "make sure that their kids are excelling." Fifth- and seventh-grade teachers also discussed parental involvement as an important component of students' math success. Seventh-grade teachers observed that variations in levels of parental support may be related to parental education and income level. One teacher explained that parents with a college education might have the additional knowledge needed to assist their children in math. Another teacher said that she worried about students from low-income families, some of which included parents who worked at night, because there may not be a person at home "making sure [the] student is studying and studying as hard as they need to." Parental involvement was characterized in terms of encouragement and support. Students, parents, and teachers also spoke of support in terms of rewards and punishment.

Student participants explained how parents and family members motivated them by rewarding their academic performance. Good grades, particularly for fifth-grade boys and girls and seventh-grade girls, resulted in rewards such as money, gifts, or special privileges (e.g., cell phone use). Punishment for poor math performance included being grounded or losing privileges. According to a ninth-grade boy, "My parents just don't let me go hunting and fishing if I get bad grades." However, not all students received incentives to do well. One student said, "I guess my mom's in a good mood when I get good grades. She doesn't really give me anything."

Across grade levels, few students described being intrinsically motivated to do well in math class (i.e., doing well in math because they found the subject inherently interesting or enjoyable; R. M. Ryan & Deci, 2000). For students who were motivated to do well in math class, the connection between math and their current or future life was often prominent. For example, one male ninth grader said, "I'm motivated a lot because math is used in everyday life so you gotta know it." A fifth-grade girl said, "Yeah, like I want to be a marine biologist and you have [to] mainly excel at math and science for that, so those are like the two main subjects that I have to excel in." Other students linked success in math with attendance at an elite college or working as an engineer or a doctor. Few students said they were motivated to do well simply because they enjoyed math or thought it was fun (i.e., were intrinsically motivated).

Teacher Support

Most student participants stated that their math teachers expected them to do well on assignments and to earn good grades. According to the students, teachers encouraged students to try their hardest and to improve their grades. As one fifth-grade boy said, his teacher "expects us to get it right away with straight As right down the list; that's what she expects!" When students had trouble meeting high expectations, they described the ways teachers supported and encouraged them. Several participants said that their teachers offered regular after-school tutoring. Other students noted that teachers took time to review material if several students did not understand a concept or incorrectly responded to test problems. "When we don't get something," a fifth-grade girl said, the teacher "takes her time and explains it to us and goes over it again." Parallel to this perception of students, fifth- and seventh-grade teachers said that working to help students master math concepts was one of the aspects of teaching they most enjoyed. As one seventh-grade teacher said, "turning on the light bulb sometimes, it's very rewarding."

At the elementary and middle school levels, both girls and boys noted that their teachers rewarded good or improved grades. Students "like to be rewarded for their achievements and accomplishments within the classroom. . . . With some, it's just verbal praise and with others, they have to actually . . . see their reward," stated a male seventh-grade teacher. A female teacher in the same focus group agreed, adding that her students expected rewards and some were unhappy when she did not provide them. Students and teachers gave examples of the rewards used to motivate students in the classroom: small prizes (e.g., pencils, stickers), activities (e.g., computer games, lunch with a friend in the classroom), and "student of the week" awards. Student participants were enthusiastic about these rewards opportunities, as well as some of the teaching strategies used by their math teachers.

Engagement in the Classroom

Students at all grade levels preferred class activities that were visually or physically engaging, or that allowed them to collaborate with peers.

Members of a fifth-grade girls group spoke positively about teachers' PowerPoint presentations, SMART Board interactive whiteboards, and linking cubes. One student in this group explained, "I learn better when I . . . do stuff more with my hands instead of writing notes." A seventh-grade teacher referred to her use of activities: "When I pull out my toys and they get to play, they get all excited." She added that these activities take extra time and so are difficult to incorporate into classes because of the pressures of testing and curricular demands.

Some student participants believed that they rarely had opportunities to work in groups. Some stated that they preferred to work alone. A ninth-grade boy explained, "I'm an individual worker. I do everything on my own, so I mean, he lets us do it, but I choose not do it." Fifth-grade girls, speaking positively about this type of cooperative learning, said that they enjoyed working in groups because it was helpful and fun. As one said, "I think it's better to work together . . . in groups because if someone is really quiet or something they might not answer it that well but . . . if someone else got it right, they can show them and they can learn better." Another fifth-grade girl agreed, explaining that working alone can be stressful, but working with a partner lessened her anxiety by helping clarify tasks. A ninth-grade girl went further, explaining the interactive nature of group learning: "They help me if I need help and then I help them and, you know, since we're always in groups and it's always the interaction with each other."

Parent and teacher focus group data revealed frustrations with the content, structure, and pace of the math curriculum. Parents and teachers alike noted that the material currently taught in fifth- and seventh-grade math is more advanced than material they learned at the same age. One parent explained that she did not study algebra until seventh or eighth grade, whereas her child was studying algebra in the fifth grade. "It's like they're speeding everything up," she said. A seventh-grade teacher agreed, explaining that the math curriculum has become more advanced over time: "Some of the things that we teach them I learned in college, especially in statistics. The expectations of what a seventh-grade child . . . is supposed to know and understand by the end of the school year frustrate all of us."

Parents and teachers were concerned about the sequence and fast pace of math classes. One parent of a fifth grader explained that her son had struggled in math class because he had difficulty mastering one topic before moving on to the next. A seventh-grade teacher said, "I think we push kids too fast through our math programs so that they don't get the basic understanding." This lack of basic understanding on the part of students, she posited, may contribute to students' lack of intrinsic motivation. "They don't enjoy it as much," she said. Parents and teachers attributed some of these challenges to the yearly standardized end-of-course exams. A parent of a fifth grader said it seemed that teachers were rushing through material in order to cover everything on the exams. A fifth-grade teacher said that it was frustrating to teach all students at the same pace, knowing that some students were being left behind in their understanding of class material.

As they described daily life in their math classrooms, some fifth- and seventh-grade students, but no ninth-grade students, explained that they found the behavior of some of their peers distracting. Fifth-grade girls, in particular, described feeling frustrated by classmates whose actions drew attention away from math work. As one fifth-grade girl explained, "you're trying to learn and you're trying to be a good student and those distractions are not going to make you a better student . . . they are keeping you from learning." According to these girls, classmates' disruptive behavior caused teachers to become angry and focus on behavior management, rather than on engaging all students in instruction and learning.

Discussion

The results of this study could be organized around the primary themes of preference for small-group activities, use of extrinsic motivation, and the disruptive influence of peer behaviors. Many participants made positive comments about group work and felt that it helped them master math concepts. This result is consistent with studies that have demonstrated the benefits of cooperative learning (Slavin, 1995). In math class, as in other arenas of learning, small-group cooperative learning fosters a supportive learning environment (Leikin & Zaslavsky, 1997), engages all students in learning, and structures support and the sharing of ideas and information (Gillies, 2004). This, in turn, results in experiences of increased engagement in math and a sense of belonging. However, it is important to note that not all students enjoyed working with others. It is not clear if this finding was related to gender or to other factors. Nonetheless, this is an important work skill and one that businesses note that many of their new, young employees lack.

Participants also described the use of extrinsic motivation by teachers and parents as a means of encouragement. In contrast, few students described intrinsic motivation to do well in math. Although it is understandable that instructors and family members might want to reward strong class performance and good grades, some research has suggested that extrinsic motivation is negatively correlated with academic outcomes (Lepper, Corpus, & Iyengar, 2005). In fact, attending only to extrinsic incentives may undermine the enjoyment and natural interest produced in well-constructed learning situations (Lepper et al., 2005) and, thus, restricts later interest in certain career areas. On the other hand, intrinsic motivation is highly related to mathematics achievement (Chiu & Xihua, 2008).

Finally, according to the students in our study, disruptive behavior by peers was an important negative factor in the development of math interest and success. Negative and unruly behavior distracts students and forces teachers to deal with discipline rather than instruction (Zabel, 2008). This finding underscores the importance of activities that engage all children in the process of learning and of positive classroom management. Effective teachers convey clear behavioral expectations to students at the beginning of the school year, respond to emerging problems without disrupting lessons (Emmer & Stough, 2001), and provide developmentally appropriate and effective lessons. Poorly designed lessons and ineffective classroom management reduce the opportunities for students to fully engage in math content, to develop positive math self-efficacy, and to have positive math outcome expectations.

Implications

Childhood and adolescent experiences influence choices, including career choices, made later in life. Intervention early in this trajectory is therefore critical. Engagement in and perceived support for mathematics, an early filter for later STEM-related vocational options, is one area in which targeted interventions can occur. Knowing the focus and timing of those interventions is the larger focus of the research of which this study is a part. The results presented here underscore the importance of perceived supports and delineate some of the obstacles to engagement.

In working with students during early adolescence, it is helpful for teachers to use the School Counseling National Model developed by the American School Counseling Association (ASCA; 2003). The foundation of this model is ASCA's National Standards, which identify three domains of K–12 student development as the focus for school counseling programs. Each domain (academic, career, and personal/social) includes three standards and delineates student competencies. Each domain is relevant to the findings of this study. The career and academic domains are directly relevant, although the personal/social domain is indirectly relevant because our findings regarding the potential influence of students' affective responses on academic and career development align with the domain's focus on students gaining the knowledge, skills, and attitudes to help them understand themselves, set goals, and make decisions.

Counselors can use ASCA's (2003) National Model as a framework and rationale for interventions. Following are some of the implications from our findings in relation to the ASCA National Standards.

Professional school and career counselors should engage parents in the various aspects of the career development process, beginning early in a child's formal education. The students in this study were already developing their ideas of how they wanted to learn and, therefore, how they wanted to work. They were also developing perceptions of the reasons for liking or disliking math. These are directly related to Standards A and C in the Career domain of the ASCA Model; the focus in this doman is on the need for students to develop skills to help them make informed career decisions that are based on self-knowledge and their investigating the world of work, along with understanding the relationship between these things and education. Parents can help to shape these early experiences of self in relation to learning and to work through discussion and at-home activities. Children's understanding of career and of "life as worker" is critical to later engagement and attitudes about careers. Understanding how their personal qualities, including interests and likes and dislikes, and their academic work relate to their future careers is a critically important task that can be facilitated by counselors working with parents and teachers (Academic Standard C, Career Standards A and C, Personal Social Standard A; ASCA Model). Likewise, helping students to connect the methods and processes involved in learning, such as group work and team accomplishment, can be helpful. Working in cooperative groups in a classroom is similar to undertakings in many of the STEM fields, for example, design teams, planning meetings, and goal-setting meetings.

Encouraging parents and teachers to provide instrumental and emotional support to students as they learn and engage in math is important (Akos, Shoffner, & Ellis, 2007; Sciarra & Whitson, 2007). Equally important are students' perceptions of that support. The students in our study clearly were motivated by rewards and punishments. This is not unique to children. Adults work not only for self-expression but also to get paid, an extrinsic motivator. Adults and children alike also respond to intrinsic motivation. They feel motivated when someone tells them they have done well on a project, thereby encouraging them to continue to do well. Children benefit from this kind of praise. Helping students understand that their teachers support the effort and concentration they put into their math studies is one area in which career and professional school counselors can intervene.

Counselors can provide workshops and parenting sessions to help parents learn how to help their children with math and how to connect math to their lives and aspirations. This enlists parents in helping their children with a number of the ASCA (2003) Standards. Teachers mentioned their concerns about the struggles some parents may have in helping their children. This struggle is not always due to a lack of content knowledge, but may also be due to a lack of knowledge in facilitating children's desire to do well and in helping children with any complex problem or new learning. For parents, this skill extends to many parenting arenas.

Math and science teachers are also critically important in early STEM-related career interest development. The students in our study reacted to teachers' interactions with them. This finding is supported by additional research suggesting that engagement, a sense of belonging, and mattering are critical to academic achievement (Dixon & Tucker, 2008; Sciarra & Seirap, 2008; Uwah, McMahon, & Furlow, 2008). Students also appreciated and were more engaged when teachers used certain approaches to teaching. School and career counselors can partner with teachers to facilitate infusion of real-life, hands-on activities in the classroom. These activities should also include some connection to the use of math in students' world outside school (ASCA, 2003; Academic Standard C). This would have the added benefit of encouraging students to further develop their math interest and to observe how math is connected to various careers (ASCA, 2003; Career Standard C). Teachers also would benefit from workshops on motivating students through social incentives and emotional support and guidance.

Disruption in the classroom or workplace can lead to disengagement. These students commented on the difficulties they had in learning when their peers were disruptive. Workshops, in-service sessions, individualized skill-building sessions on classroom management, and ongoing support from professional career and school counselors can help teachers minimize the effects of these impediments on learning. Knowing that time with math will be engaging and will have minimal disruptions leads to expectations of positive outcomes in the math classroom.

One of the limitations of this study is the use of a limited sample of volunteer students in one U.S. school district, thus the findings are not generalizable to other schools in other states. Also, we explored student perceptions about math at one point in time instead of exploring student perceptions over a longer period. We are in the process of collecting longitudinal data on these students, which will allow us to report on changes over time in the future. In addition, it was not possible to examine data to determine if there were differing trends by race, income level, or math ability. Future qualitative work in this area should examine these individual demographic factors further to investigate their relationship to math self-efficacy, math engagement, and perceived supports and barriers. Researchers should investigate these findings to see how prevalent these perceptions are for students from other areas of the country. More extensive qualitative and quantitative research should be done with teachers and parents in examining not only their perceptions, but their perceptions in relation to students' development of math interest and choices of STEM-related studies and careers.

This study supports the development of early and marked perceptions of math and math learning. Perceptions of positive parental and teacher support and opportunities to engage in math learning were related, in these participants' minds, with their striving to do well in math. If students cannot maintain engagement in the tasks of the math classroom, either because of disruption or because of perceptions of a lack of teacher support, students will, over time, come to view their math learning as unrelated to their future (Greene et al., 2004; Miller et al., 1996). On the other hand, if students perceive high levels of teacher support, they are more likely to be interested in class content, to be more engaged (A. M. Ryan & Patrick, 2001), and to have higher levels of achievement (Hamre & Pianta, 2001).

References

Akos, P., Shoffner, M., & Ellis, M. (2007). Mathematics placement and the transition to middle school. *Professional School Counseling, 10,* 238–244.

American School Counselor Association. (2003). *The ASCA national model: A framework for school counseling programs.* Alexandria, VA: Author.

Chiu, M. M., & Xihua, Z. (2008). Family and motivation effects on mathematics achievement: Analyses of students in 41 countries. *Learning and Instruction, 18,* 321–336. doi:10.1016/j.learninstruc.2007.06.003

Cleary, T. J., & Chen, P. P. (2009). Self-regulation, motivation, and math achievement in middle school: Variations across grade level and math context. *Journal of School Psychology, 47,* 291–314. doi:10.1016/j.jsp.2009.04.002

Dixon, A. L., & Tucker, C. (2008). Every student matters: Enhancing strengths-based school counseling through the application of mattering. *Professional School Counseling, 12,* 123–126.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11,* 135–172.

Eccles, J. S., & Midgely, C. (1989). Stage/environment fit: Developmentally appropriate classrooms for early adolescents. In R. P. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 139–181). New York, NY: Academic Press.

Emmer, E. T., & Stough, L. M. (2001). Classroom management: A critical part of educational psychology, with implications for teacher education. *Educational Psychologist, 36,* 103–112.

Flores, L. Y., & O'Brien, K. M. (2002). The career development of Mexican American adolescent women: A test of social cognitive career theory. *Journal of Counseling Psychology, 49,* 14–27. doi:10.1037/0022-0167.49.1.14

Gillies, R. M. (2004). The effects of cooperative learning on junior high school students during small group learning. *Learning and Instruction, 14,* 197–213. doi:10.1016/S0959-4752(03)00068-9

Gottfredson, L. S. (1981). Circumscription and compromise: A developmental theory of occupational aspirations. *Journal of Counseling Psychology, 28,* 545–579. doi:10.1037/0022-0167.28.6.545

Greene, B. A., Miller, R. B., Crowson, H. M., Duke, B. L. & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. *Contemporary Educational Psychology, 29,* 462–482. doi:10.1016/j.cedpsych.2004.01.006

Hackett, G., & Betz, N. E. (1981). A self-efficacy approach to the career development of women. *Journal of Vocational Behavior, 18,* 326–339.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72,* 625–638. doi:10.1111/1467-8624.00301

Kenny, M. E., Gallagher, L. A., Alvarez, R., & Sibby, J. (2002). Sources of support and psychological distress among academically successful inner-city youth. *Adolescence, 37,* 161–182.

Lapan, R. T., Hinkelman, J. M., Adams, A., & Turner, S. (1999). Understanding rural adolescents' interests, values, and efficacy expectations. *Journal of Career Development, 26,* 107–124. doi:10.1177/089484539902600202

Leikin, R., & Zaslavsky, O. (1997). Facilitating student interactions in mathematics in a cooperative learning setting. *Journal for Research in Mathematics Education, 28,* 331–354.

Lent, R. W. (2005). A social cognitive view of career development and counseling. In S. D. Brown & R. W. Lent (Eds.), *Career development and counseling: Putting theory and research to work* (pp. 101–127). Hoboken, NJ: Wiley.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45,* 79–122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology, 47,* 36–49. doi:10.1037/0022-0167.47.1.36

Lepper, M. R., Corpus, J. H., & Iyengar, S. S. (2005). Intrinsic and extrinsic motivational orientations in the classroom: Age differences and academic correlates. *Journal of Educational Psychology, 97,* 184–196. doi:10.1037/0022-0663.97.2.184

McMahon, M., & Watson, M. (2008). Children's career development: Status quo and future directions. *The Career Development Quarterly, 57,* 4–6.

McWhirter, E. H., Hackett, G., & Bandalos, D. L. (1998). A causal model of the educational plans and career expectations of Mexican American high school girls. *Journal of Counseling Psychology, 45,* 166–181. doi:10.1037/0022-0167.45.2.166

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989). Change in teacher efficacy and student self- and task-related beliefs in mathematics during the transition to junior high school. *Journal of Educational Psychology, 81,* 247–258. doi:10.1037/0022-0663.81.2.247

Miller, R. B., Greene, B. A., Montalvo, G. P., Ravindran, B., & Nichols, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. *Contemporary Educational Psychology, 21,* 388–422. doi:10.1006/ceps.1996.0028

National Science Board. (2007). *A national plan for addressing the critical needs of U.S. science, technology, engineering, and mathematics education system.* Arlington, VA: National Science Foundation.

Navarro, R. L., Flores, L. Y., & Worthington, R. L. (2007). Mexican American middle school students' goal intentions in mathematics and science: A test of social cognitive career theory. *Journal of Counseling Psychology, 54,* 320–335. doi:10.1037/0022-0167.54.3.320

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology, 24,* 124–139. doi:10.1006/ceps.1998.0991

Porfeli, E. J., Hartung, P. J., & Vondracek, F. W. (2008). Children's vocational development: A research rationale. *The Career Development Quarterly, 57,* 25–37.

Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal, 38,* 437–460.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25,* 54–67. doi:10.1006/ceps.1999.1020

Sciarra, D. T., & Seirap, H. (2008). The multidimensionality of school engagement and math achievement among racial groups. *Professional School Counseling, 11,* 218–228.

Sciarra, D. T., & Whitson, M. L. (2007). Predictive factors in postsecondary educational attainment among Latinos. *Professional School Counseling, 10,* 307–316.

Slavin, R. (1995). *Cooperative learning: Theory, research and practice* (2nd ed.). Boston, MA: Allyn & Bacon.

Turner, S. L., Steward, J. C., & Lapan, R. T. (2004). Family factors associated with sixth-grade adolescents' math and science career interests. *The Career Development Quarterly, 53,* 41–52.

Uwah, C. J., McMahon, H. G., & Furlow, C. F. (2008). School belonging, educational aspirations, and academic self-efficacy among African American male high school students: Implications for school counselors. *Professional School Counseling, 11,* 296–305.

Walker, C. O., & Greene, B. A. (2009). The relations between student motivational beliefs and cognitive engagement in high school. *The Journal of Educational Research, 102,* 463–471.

Wigfield, A., Eccles, J., MacIver, D., Reuman, D., & Midgley, C. (1991). Transitions at early adolescence: Changes in children's domain specific self-perceptions and general self-esteem across the transitions to junior high school. *Developmental Psychology, 27,* 552–565. doi:10.1037/0012-1649.27.4.552

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed., Applied Social Research Methods Series Vol. 5). Thousand Oaks, CA: Sage.

Zabel, J. E. (2008). The impact of peer effects on student outcomes in New York City public schools. *Education Finance and Policy, 3,* 197–249.