Reputations Matter: Peer Expectancy Socialization among Adolescents in the Classroom

By

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Dedication

For Maria

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Abstract

Peers play a crucial role in the development of adolescents' self-beliefs and behaviors. This multiple manuscript dissertation consists of two standalone studies examining peer processes in math and science classrooms among adolescents. One way that peers have been shown to matter for students' adjustment is through peer academic reputations, or PAR, which captures the overall opinions and expectations of peers regarding a specific classmate's academic ability. In the first study of my dissertation, I expand upon prior research on PAR (which has primarily been conducted with young children in the elementary school context) by examining the association of PAR with early adolescents' academic self-concept, intrinsic value, academic worry and engagement in math and science classes. I compare girls and boys in the last year of elementary school (5^{th} grade) and the first year of middle school (6^{th} grade). Results of analyses with hierarchical linear modeling showed that PAR at the beginning of the school year predicted changes in students' academic self-concept, worry, and engagement (but not intrinsic value) from fall to spring, controlling for fall levels. Furthermore, PAR was found to operate similarly for girls and boys in both the elementary and middle school context. The second study in this dissertation concerns the underlying mechanism of the effect of PAR by examining expectancy socialization among peers in middle school math and science classrooms. First, I develop a new survey assessment to measure peer communication of expectancy cues and conduct exploratory factor analysis to determine whether students perceive distinct types of expectancy cues from peers. Three factors corresponding to praise, criticism, and help emerged from the EFA. Second, I test whether the three types of expectancy cues are related to PAR and academic self-concept concurrently and over time. Using structural equation modeling, I investigate whether expectancy cues partially mediate the association of PAR with academic self-concept across the school year. Correlations indicated that, in general, help and praise were significantly positively related to PAR and academic self-concept for both girls and boys, whereas the associations of criticism were

weaker and in the opposite direction, and only emerged for boys. Structural equation modeling revealed that help expectancy cues, but not praise or criticism, partially mediated the association of PAR with academic self-concept. Thus, students known as "smart" are more frequently approached for help by peers, and these helping interactions are related to increased academic self-concept over time. There was evidence that gender moderated the relationship between expectancy cues and academic self-concept, such that help and praise expectancy cues were more strongly related to academic self-concept for boys than girls. With insight into how expectancy socialization occurs among peers in math and science and the role of gender in this process, this work is a key step in understanding the development and implications of PAR during adolescence. Taken together, the two studies in this dissertation contribute new information about how peer interactions in the classroom provide a context for the socialization of students' academic self-beliefs and behaviors in math and science

Chapter 1

Introduction

Adolescence is a time of much change, during which youth are exploring different identities and developing competencies in specific domains (Steinberg, 2015). For some, adolescence can mark the beginning of a downward trajectory in motivation and engagement at school in general, and in math and science in particular (Juvonen, Le, Kaganoff, Augustine, & Constant, 2004; Eccles et al., 1993; Marsh & O'Mara, 2008). In a stage of life where youth are increasingly concerned with their peers' opinions and fitting in, classmates play an important role in shaping adolescents' beliefs about their ability. Thus, research examining how and why classroom peer processes matter for students' motivational beliefs and behaviors in math and science is important for supporting adolescents who are at-risk of experiencing such declines.

Peer Academic Reputation (PAR) represents the expectations and opinions of peers about one's academic ability, and has received attention in the literature as one way that peers shape their classmates' academic self- beliefs and behaviors (e.g., Hughes, Chen, Kwok & Luo, 2010; Gest, Rulison, Davidson & Welsh, 2008). This dissertation consists of two standalone studies examining the nature, development and implications of PAR for students' adjustment among adolescents in math and science classes. Study 1 expands upon prior research on PAR by examining how PAR relates to girls' and boys' academic self-beliefs and behaviors in 5^{th} and 6^{th} grade math and science classes. Building on findings from Study 1, in Study 2 I examine whether and how peers communicate their opinions and expectations about one another's ability during classroom peer interactions. I develop and validate a survey assessment of peer expectancy cues, and test the mediating role of expectancy cues in the association of PAR with students' academic self-concept. This is a notable contribution, given most research has established links between PAR and adjustment and inferred the mechanism of the effect rather than directly measuring it.

It is theorized that expectancy socialization underlies the effect of PAR on students' adjustment (e.g., Altermatt & Kenney-Benson, 2006; Pomerantz, Grolnick & Price, 2005; Altermatt, 2012). Expectancy socialization occurs through the communication of expectancy cues from peers that convey others' opinions and expectations of a student's ability. For example, having a high PAR may lead to more positive expectancy cues from peers in terms of increased opportunities for cooperation, fruitful help exchanges, and positive reinforcement from peers (Altermatt, 2012; Gest et al., 2008). These positive expectancy cues over time may bolster students' self-perceptions of their ability. Most prior work on expectancy socialization has focused on expectancy cues from parents and teachers (e.g. Frome & Eccles, 1998; Eccles, Jacobs, & Harold, 1996; Kuklinski & Weinstein, 2001), and there is less empirical research on peer communication of expectancy cues. Studies that have examined discourse among peers relevant to expectancy cues have been with young children in first and second grades (Altermatt, Pomerantz, Ruble, Frey & Greulich, 2002), or have been conducted in the lab setting (Altermatt & Broady, 2009). The current research contributes new insights by extending work on PAR and expectancy socialization to adolescents in the context of math and science. With insights into subject-specific peer processes, these two studies provide valuable information about how to promote positive classroom relations that support adolescents' motivation and engagement in math and science

Background Literature Review

Motivation and Engagement in Adolescence

Expectancy-value theory (Eccles et al., 1983; Eccles & Wigfield, 2002) provides a framework for understanding the factors that affect students' academic beliefs and behaviors. In this theoretical perspective, expectancies refer to beliefs about one's ability to complete an activity or task ("can I do it?"). Values refer to an individual's reasons for engaging (or not engaging) in an activity, such as interest and enjoyment (do I want to do it?"). Expectancies and values are multifaceted and informed by a broad range of factors, including culture, family, and personal goals (Eccles et al., 1983; Wigfield & Eccles, 2002).

The term engagement refers to students' effort, attention and persistence, as well as emotional states (such as enjoyment) students experience when working on an academic task (Skinner, Wellborn & Connell, 1990). Skinner's conceptualization of engagement includes both behavioral and emotional components that exist on a spectrum from engagement to disaffection. Motivation and engagement/disaffection in the classroom are thought to exist together in a feedback loop (Skinner, Furrer, Marchand & Kindermann, 2008). Students with high levels of motivation are likely to be more behaviorally engaged in the classroom, which may lead to increased opportunities for positive interactions with peers and teachers. In turn, these positive interactions and opportunities bolster students' self-confidence and learning. The same is true for students who are low in motivation. Lack of motivation leads to disaffection, which creates conditions (such as more negative interactions with teachers) that hinder motivation over time (Skinner et al., 2008).

Declines in academic motivation and engagement during the adolescent years have been well-documented (Eccles et al., 1993; Simmons & Blythe, 1987; Eccles, Midgley, & Adler, 1984). Students' expectations about their ability to do well, as well as their value for schoolwork, decline from childhood to adolescence (Eccles, Midgley, & Adler, 1984). At the same time, adolescents report higher levels of academic anxiety and negative attitudes about school and lower levels of engagement (Anderman & Maehr, 1994; Harter, Whitesell & Kowalski, 1992). Related to engagement, in a study of 7th to 11th graders, Wang and Eccles found that declines in GPA across grade levels were most pronounced for students who experienced declines in behavioral engagement.

These downward trends in motivation and engagement during adolescence may be related to the changing peer culture, which becomes more supportive of deviant behavior and less supportive of academic effort and achievement (Galvan, Spatzier, & Juvonen, 2011; Kiefer & Ryan, 2011) Given that academic adjustment during adolescence sets the stage for students' long-term educational and career trajectories (Simpkins, Davis-Keane, & Eccles, 2006), understanding the factors that precipitate these declines is important.

This dissertation examines classroom peer processes in relation to adolescents' motivation and engagement in math and science. I situate the current investigation in math and science because prior work has indicated that motivation and engagement vary across school subjects, and gendered beliefs about academic ability persist in the domains of math and science (Steele, 2010; Leaper, 2015).

In line with expectancy-value theory, in Study 1 I assess students' motivation in terms of the following constructs: academic self-concept, intrinsic value, and academic worry. Academic self-concept refers to the expectation that one can do well on an academic task (expectancy belief; Eccles et al., 1983). Intrinsic value is the extent to which a student is interested in and enjoys the task at hand (value belief). Academic worry/anxiety refers to the extent to which a student worries about their ability to do well. Academic worry may be considered a negative expectancy belief or could also be conceptualized as a 'cost' of engaging in a specific task (i.e. worry/anxiety are negative emotions and students may avoid engaging in a task when they experience these feelings). Expectancy value theory states that students will be motivated to engage in a task when they have high expectancies for success and high value for the task, and there are low costs associated with the task. Thus, academic self-concept, intrinsic value and academic worry provide a concise set of constructs for assessing adolescent motivation in terms of E-V.

Students' behavioral engagement in the classroom was also assessed in relation to PAR in Study 1. Skinner's model of engagement includes both behavioral (i.e., effort) and emotional (i.e., enjoyment) aspects. I use Skinner's measure to assess behavioral engagement in the classroom. These items tap into students' effort, attention and persistence on academic tasks. Emotional engagement refers to students' interest and enjoyment in class. There is significant conceptual overlap between the intrinsic value construct and emotional engagement in Skinner's model. Both constructs tap into interest and enjoyment of a given task. Thus, I consider intrinsic value to also serve as an indicator of emotional engagement.

In Study 2, I hone my focus to academic self- concept as a motivational outcome variable due to practical and theoretical reasons. Practically, I needed to keep the survey a reasonable length given I was adding a new scale with 15 items assessing expectancy cues, as well as three peer nomination items which take considerable time for students to answer. Theoretically, the bulk of the literature on PAR has examined academic self-concept and engagement as outcomes (e.g., Gest et al., 2005; 2008). My results from Study 1 showed that student reports of academic self-concept and teacher reports of behavioral engagement had the most robust associations with PAR. It was not an option to have teachers provide reports of behavioral engagement in Study 2. Thus, in order to build on prior research and theory while taking practical concerns into consideration, I focused on academic self-concept as the key outcome in Study 2.

The outcomes in both Study 1 and Study 2 were examined specific to the context of math and science, which is the issue I turn to next.

Motivation and engagement in math and science

Promoting student interest and retention in math and science continues to be an issue of great concern (Maltese & Tai, 2010; National Research Council, 2010). The decision to pursue upper level math and science in high school and college is influenced by motivational beliefs and behaviors that develop in adolescence (Eccles, Simpkins, & Davis-Keane, 2006). However, adolescence is also a time when many students report decreased self-concept and interest in math and science (e.g., Martin, Way, Bobis, & Anderson, 2014; Anderman & Maehr, 1994). Taking a domain- specific approach to examining classroom peer relations is important for addressing this issue.

Students’ motivational beliefs and behaviors have been shown to differ across school subjects. Students’ ideas about how to learn, what is expected, and their responses to achievement situations differ across school subjects (e.g. Stodolsky, Salk & Glaessner, 1991). Compared to English and social studies which involve more writing and subjective evaluation, students tend to view math and science as involving objective, clear-cut solutions to problems (e.g., a specific formula) (Lampert, 1990; Schoenfeld, 1992). Furthermore, in math and science classes, information about other students’ performance and ability might be available in a format that makes comparison easier than in other subjects (Martin et al., 2014).

Taking a subject-specific approach to examining motivational beliefs and behaviors in adolescence is also warranted because of gender stereotypes that still exist in the domains of math and science. Girls may be especially vulnerable to declines in motivation in math and science. Despite earning higher grades in math and science class than their male peers (Robinson & Lubienski, 2011), girls do not tend to have higher perceptions of ability or value for these subjects (Leaper, 2015). Such differences may be due, in part, to how adolescents view the role of ability versus effort in math and science class. Compared to other school subjects, adolescents are more likely to attribute success in math and science to natural ability rather than trying hard (Stodolsky, Salk, & Glaessner, 1991). For example, when a student believes that academic challenges are a result of a lack of ability, they may experience more worry or anxiety, and be less likely to take risks and put forth extra time and effort to understand a concept (Anderman & Maehr, 1994). Stereotypical beliefs about girls’ and boys’ natural ability in math persist (Steele, 2010); if girls believe they must work extra hard to overcome a lack of natural ability in math and science, this may undermine their confidence and effort in math and science.

Thus, I situate my dissertation in the domains of math and science to understand the development of motivational beliefs and behaviors and gender dynamics specific to these domains. I focus on peer relations in the classroom context, which is the issue I turn to next.

Peers and Motivation

Adolescents' academic and social lives are closely intertwined. On a daily basis at school, students navigate their social world with peers at same time as they are learning and practicing academic content. Peers take on increased significance during adolescence (Brown, 2004), and youths' sense of identity is informed by their peers' feedback and opinions (Wentzel & Muenks, 2016; Harter et al., 1999). As such, classroom peer relations provide a context for the development of adolescents' academic beliefs and behaviors at school (Rodkin & Ryan, 2012)

The role of peers in shaping students' academic adjustment is multifaceted. Having close friends and being accepted by the peer group are associated with positive academic adjustment (Berndt & Keefe, 1995; (Ladd, Kochenderfer-Ladd, Visconti, & Ettekal, 2012). Characteristics of the peer group have also been shown to be important for individual's academic beliefs and behaviors. Altermatt & Pomerantz (2003) found that changes in children's academic performance across the school year were explained by the academic performance of their close friends. Similarly, students who associate with friends who find school boring or misbehave in class show lower levels of value for academics and increases in disruptive behavior over time (Shin & Ryan, 2014a). Peer norms for disruptive behavior in the classroom also have an impact on students' academic adjustment (e.g. Dijkstra & Gest, 2014).

During adolescence in particular, the effect of peers on the development of academic beliefs and behaviors may be amplified. Adolescence is a stage characterized by heightened self- consciousness and sensitivity to feedback, especially from peers (Harter, 2006; Steinberg, 2014). Furthermore, cognitive development affords early adolescents increased capabilities to use social comparative information to evaluate their competence (Ruble, Boggianno, Feldman & Loebl, 1980; Butler, 1999). Adolescents are likely to look to their peers for information about how to interpret their academic performance, thus shaping their beliefs about their ability.

One specific way that peers have been shown to matter for student motivation, engagement and achievement at school is through peer reputations. The term peer academic reputation (PAR) refers to peers' expectations and opinions regarding students' academic competence in the classroom (Gest, Domitrovich & Welsh, 2005). PAR has been shown to predict changes in student's academic self-concept, effort and performance (e.g., Gest et al., 2005, 2008; Hughes et al., 2009) among students in elementary school. It is theorized that daily experiences and interactions with peers in the classroom are shaped by PAR, and over time a student's PAR may be internalized and shape a student's own beliefs about their ability through a process called *expectancy socialization* (Hughes et al., 2009; Molloy, Ram, & Gest, 2011).

In study 1, I build upon prior research on PAR with young children by examining PAR in relation to early adolescents' motivational self- beliefs and behaviors among 5th graders in the last year of elementary school and 6th graders in the first year of middle school. In Study 2, I investigate the expectancy socialization process which is thought to underlie the effect of PAR. I develop a new survey measure to assess peer communication of expectancy cues in the classroom, and use structural equation modeling to test whether expectancy cues partially mediate the association of PAR with students' academic self-concept over time.

Taken together, the two studies in this dissertation have both theoretical and practical implications. Theoretically, this research advances our current understanding of the role of classroom peer relations in the development of students' achievement beliefs and behaviors in the context of math and science. Practically, it yields important information for teachers who work with early adolescents. With insights into how peer processes affect academics, teachers may structure their classrooms in ways that promote more positive peer interactions and better support early adolescents' motivation, engagement and achievement.

References

Altermatt, E. R. (2012). Children’s achievement-related discourse with peers: Uncovering the processes of peer influence. In A. M. Ryan and G. W. Ladd (Eds.), Peer relationships and adjustment at school (pp. 109-134). Charlotte: Information Age Press.

Altermatt, E. R., & Brody, E. F. (2009). Coping with achievement-related failure: An examination of conversations between friends. Merrill-Palmer Quarterly, 55(4), 454–487.

Altermatt, E. R., & Kenney-Benson, G. A. (2006). Friends’ influence on school adjustment: A review of three perspectives. In A. V. Mitel (Ed.), *Trends in educational psychology* (pp. 137–153). New York: Nova Science Publishers.

Altermatt, E. R., & Pomerantz, E. M. (2003). The development of competence-related and motivational beliefs: An investigation of similarity and influence among friends. *Journal of Educational Psychology, 95*(1), 111-123.

Altermatt, E. R., Pomerantz, E. M., Ruble, D. N., Frey, K. S., & Greulich, F. K. (2002). Predicting changes in children’s self-perceptions of academic competence: A naturalistic examination of evaluative discourse among classmates. *Developmental Psychology, 38,* 903-917.

Anderman, E. M., & Maehr, M. L. (1994). Motivation and schooling in the middle grades. *Review of educational Research*, *64*(2), 287-309.

Berndt, T. J., & Keefe, K. (1995). Friends' influence on adolescents' adjustment to school. *Child Development, 66*(5), 1312-1329.

Brown, B.B. (2004). Adolescents’ relationships with peers. In R. Lerner & L. Steinberg, (Eds.) *Handbook of adolescent psychology, 2nd edition* (pp. 363-394). Hoboken, NJ: John Wiley & Sons, Inc.

Butler, R. (1999). Information seeking and achievement motivation in middle childhood and adolescence: The role of conceptions of ability. *Developmental Psychology, 35*(1), 146- 156.

Chen, Q., Hughes, J. N., Liew, J., & Kwok, O.-M. (2010). Joint contributions of peer acceptance and peer academic reputation to achievement in academically at-risk children: Mediating Processes. *Journal of applied developmental psychology*. *31*(6):448- 459.

Dijkstra, J. K., & Gest, S. D. (2014). Peer norm salience for achievement, prosocial behavior, and bullying: Implications for adolescent school experiences. *Journal of Early Adolescence 35*(1), 79-96.

Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece,

J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75-146). San Francisco, CA: Freeman.

Eccles, J.S., Jacobs, J.E., & Harold, R.D. (1990). Gender role stereotypes, expectancy effects, and parents' socialization of gender differences. *Journal of Social Issues, 46,* 183-201.

Eccles, J. S., Midgley, C., & Adler, T. (1984). Grade-related changes in the school environment. *The development of achievement motivation,* 238-331.

Eccles, J. S., Midgley, C., Wigfield, A., Buchanan, C. M., Reuman, D., Flanagan, C., & Mac Iver, D. (1993). Development during adolescence: The impact of stage-environment fit on young adolescents' experiences in schools and in families. *American psychologist, 48*(2), 90-101.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual review of psychology, 53*(1), 109-132.

Frome, P. M., & Eccles, J. S. (1998). Parents' influence on children's achievement-related perceptions. *Journal of Personality and Social Psychology, 74*(2), 435-452.

Galván, A., Spatzier, A., & Juvonen, J. (2011). Perceived norms and social values to capture school culture in elementary and middle school. *Journal of Applied Developmental Psychology,* 346-353.

Gest, S. D., Domitrovich, C. E., & Welsh, J. A. (2005). Peer academic reputation in elementary school: Associations with changes in self-concept and academic skills. *Journal of Educational Psychology*, *97*(3), 337-346.

Gest, S. D., Rulison, K. L., Davidson, A. J., & Welsh, J. A. (2008). A reputation for success (or failure): The association of peer academic reputations with academic self-concept, effort, and performance across the upper elementary grades. *Developmental Psychology, 44*(3), 625-636.

Harter, S. (2006). Developmental perspectives on the self. In N. Eisenberg (Ed.), *The handbook of child psychology*: *Volume on social and personality development,* (*4th ed).* New York: Wiley.

Harter, S., Stocker, C., & Robinson, N.S. (1999). The perceived directionality of the link between approval and self-worth: The liabilities of a looking glass self-orientation among young adolescents. *Journal of Research on Adolescence, 6*(3), 285-308.

Harter, S., Whitesell, N. R., & Kowalski, P. (1992). Individual differences in the effects of educational transitions on young adolescent's perceptions of competence and motivational orientation. *American Educational Research Journal*, *29*(4), 777-807.

Hughes, J. N., Dyer, N., Luo, W., & Kwok, O. (2009). Effects of peer academic reputation on achievement in academically at-risk elementary students. *Journal of Applied Developmental Psychology*, *30*(2), 182-194.

Juvonen, J., Le, V. N., Kaganoff, T., Augustine, C. H., & Constant, L. (2004). *Focus on the wonder years: Challenges facing the American middle school*. New York: Rand Corporation.

Kiefer, S. M. & Ryan, A. M. (2011). What characteristics are associated with social success? Changes in students' perceptions of social success during early adolescence. *Applied Developmental Psychology, 32*, 218-226.

Kuklinski, M. R., & Weinstein, R. S. (2001). Classroom and developmental differences in a path model of teacher expectancy effects. *Child development, 72*(5), 1554-1578.

Ladd, G. W., Kochenderfer-Ladd, B., Visconti, K. J., & Ettekal, I. (2012). Classroom peer relations and children's social and scholastic development: Risk factors and resources. In A. M. Ryan & G. W. Ladd (Eds.), Peer relationships and adjustment at school (pp. 11– 49). Charlotte, NC: IAP Information Age Publishing.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American educational research journal*, *27*(1), 29- 63.

Leaper, C. (2015). Gender and social-cognitive development. In R. M. Lerner, L. S. Liben, & U. Mueller (Eds.), *Handbook of child psychology and developmental science* (7th ed.) (Vol. 2, pp. 806-853). Hoboken, NJ: John Wiley & Sons, Inc.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, *32*, 669-685.

Marsh, H. W., & O 'Mara, A. J. (2008). Reciprocal effects between academic self-concept, self-esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality and Social Psychology Bulletin, 34,* 542-552.

Martin, A. J., Way, J., Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle years of school. *The Journal of Early Adolescence*, *35*(2), 199-244.

Molloy, L. E., Ram, N., & Gest, S. D. (2011). The storm and stress (or calm) of early adolescent self-concepts: Within-and between-subjects variability. *Developmental Psychology*, *47*(6), 1589-1607.

National Research Council. (2010). Rising above the Gathering Storm Revisited: Rapidly Approaching Category 5. Washington, DC: National Academies Press.

Pomerantz, E. M., Grolnick, W. S., & Price, C. E. (2005). The role of parents in how children approach achievement. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 259-278). New York: Guilford.

Robinson, J. P., & Lubienski, S. T. (2011). The development of gender achievement gaps in mathematics and reading during elementary and middle school: Examining direct cognitive assessments and teacher ratings. *American Educational Research Journal*, *48*(2), 268-302.

Rodkin, P. C., & Ryan, A. M. (2012). Child and adolescent peer relations in an educational context. In K. Harris, S. Graham, & T. Urdan, (Eds.), *Educational psychology handbook* (pp. 363-389). Washington DC: APA Publications.

Ruble, D. N., Boggianno, A. K., Feldman, N. S., & Loebl, J. H. (1980). Developmental analysis of the role of social comparison in self-evaluation, *Developmental Psychology, 16*, 105- 115.

Schoenfeld, A. (1992). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 334–370). New York: MacMillan.

Shin, H. & Ryan, A. M. (2014a). Early adolescent friendships and academic adjustment: Examining selection and influence processes with longitudinal social network analysis. *Developmental Psychology, 50*, 2462-2472.

Simmons, R. G., & Blyth, D. A. (1987). *Moving into adolescence: The impact of pubertal change and school context.* Hawthorne, NY: Aldine de Gruyter.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology, 42*(1), 70-83.

Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic? *Journal of educational psychology, 100*(4), 765-781.

Skinner, E. A., Wellborn, J. G., & Connell, J. P. (1990). What it takes to do well in school and whether I've got it: A process model of perceived control and children's engagement and achievement in school. *Journal of educational psychology*, *82*(1), 22-32.

Steele, C. M. (2010). *Whistling Vivaldi: How stereotypes affect us and what we can do.* New York, NY: Norton & Co.

Steinberg, L. (2014). *Age of Opportunity: Lessons from the New Science of Adolescence*. New York, NY: Houghton Mifflin.

Stodosky, S.S., Salk, S., & Glaessner, B. (1991). Student views about learning math and social studies. *American Educational Research Journal*, *28*(1):89-116.

Wang, M.T. & Eccles, J.S. (2012). Adolescent behavioral, emotional, and cognitive engagement trajectories in school and their differential relations to educational success. *Journal of Research on Adolescence, 22*(1), 31-39.

Wentzel, K.R., & Muenks, K. (2016). Peer influence on students' motivation, academic achievement, and social behavior. In K.R. Wentzel & G.B. Ramani (Eds.), *Handbook of social influences in school contexts: Social-emotional, motivation, and cognitive outcomes* (pp. 13-30). Charlotte, NC: Information Age Press.

Chapter 2

The Association of Peer Academic Reputations in Math and Science with Achievement Beliefs and Behaviors during Early Adolescence

Promoting student interest and retention in Science, Technology, Engineering and Math (STEM) is necessary for meeting the needs of the growing job market (National Science Board, 2010). Whether a student persists in upper level math and science courses in high school is influenced by motivational beliefs and behaviors that develop in early adolescence (Simpkins, Davis-Kean, & Eccles, 2006). During early adolescence, peer interactions and opinions are especially salient for students' self-evaluations and behaviors (Wentzel & Muenks, 2016). One fruitful approach for understanding how peers matter for student adjustment is by examining reputations among peers and how those reputations affect motivation and behavior (Hughes, Im, & Wehrly, 2014). Peer reputations represent the aggregate opinions and expectations of peers in a classroom regarding a particular student's characteristics or abilities (Rubin, Bukowski, & Bowker, 2015). One specific type of reputation, *peer academic reputation* (PAR), has been shown to predict changes in students' academic self-concept, effort and performance (Gest et al., 2005; Gest, Rulison, Davidson, & Welsh, 2008; Hughes, Dyer, Luo, & Kwok, 2009).

Extant research on PAR has been conducted with samples of children in elementary school. Little is known about the implications of PAR in early adolescence or specific to the domains of math and science. In addition, PAR has not been examined in middle school settings, which vary in important ways from elementary school settings

(Anderman, 2013; Eccles & Roeser, 2010). Thus, the focus of the current study is on PAR in relation to the development of achievement-related beliefs and behaviors among early adolescent students (5th graders in elementary school and 6th graders in middle school) in math and science classes. The current study also builds on existing research by examining an expanded set of outcomes, which is helpful for understanding the full range of implications of PAR for student functioning. Prior work has studied PAR in relation to academic self-concept and student engagement. I examine these outcomes in addition to early adolescents' intrinsic value for math and science and worry about math and science coursework.

Peer Academic Reputation

Peer reputations influence student adjustment through mutual reinforcement between the individual and the peer context (Molloy, Ram, & Gest, 2011). For example, having a reputation for being disliked or aggressive creates social conditions (such as exclusion by peers) that lead to further maladaptive behavior and reinforcement of the reputation (Hoglund & Chisholm, 2014). Research on peer reputations has often focused on social reputations and implications over time for students' risky behavior, health outcomes and psychological symptoms (e.g., Prinstein, Rancourt, Guerry, & Browne, 2009). However, peer reputations are also important for students' academic self-beliefs and motivation (Wentzel & Muenks, 2016; Gest et al., 2005; Gest et al., 2008). The term *peer academic reputation* refers to peers' expectations and opinions regarding different students' academic competence in the classroom (Gest et al., 2005).

Classrooms are inherently social places, and students' interactions with one another while learning and practicing academic content provide unique information about peers' academic functioning (Rodkin & Ryan, 2012). In the same way that individuals assess their own abilities and form their self-concepts based on past experiences and performance, students also notice their peers' academic behaviors and form opinions about them. Students' daily experiences with peers in the classroom are shaped by peer reputations, and over time reputations may be internalized and subsequently affect students' own beliefs and behaviors. In the academic domain, the process by which others' opinions and expectations influence an individual's own self-concept and behavior is called *expectancy socialization* (e.g., Altermatt & Kenney-Benson, 2006; Pomerantz, Grolnick & Price, 2005). Regarding PAR, expectancy socialization is thought to operate through *expectancy cues* provided by peers that convey to students what others think about their academic competence (Altermatt, 2012).

Expectancy cues are communicated through social interactions, differential treatment and feedback between peers in the classroom. Three key mechanisms have received attention in the literature: cooperation/avoidance, help exchanges and praise/criticism (Altermatt, 2012; Gest et al., 2008). First, having a reputation as a good student is likely to afford more positive and cooperative interactions with peers. Students may be more inclined to approach and work together on schoolwork with peers who they perceive as academically competent. In contrast, students may avoid working with their classmates who have reputations for struggling in school (Schwartz, 1981; Wentzel, Filisetti & Looney, 2007). Second, peer academic reputations affect help exchanges between students. Students perceived as capable are more likely to be approached for help by peers (Newman, 2000). Further, when students with positive academic reputations ask peers for help, they tend to get longer and more elaborate explanations than students with less positive academic reputations (Juvonen & Nishina, 1997). Finally, differential praise and criticism provide a mechanism for the creation, maintenance and consequences of PAR in the classroom. In a study of children's discourse in the classroom, Altermatt, Pomerantz, Ruble, Frey & Greulich (2002) found that when students' positive statements about their work (e.g., "My picture is the best!") were met with affirmation by a peer (e.g., "Yeah. Yours is good. I can't draw."), their self-perceptions of competence increased over time. Collectively, having a reputation for being a good student in class leads to increased opportunities for cooperation, fruitful help exchanges, and positive reinforcement which convey positive expectancy cues from peers and promote motivation, engagement and achievement. In line with this conceptualization, PAR has been shown to be important in predicting changes in elementary school students' academic self-concept, engagement and achievement (Gest et al., 2005; Gest et al., 2008; Hughes et al., 2009; Chen et al., 2010).

In addition to academic self-concept and engagement, I examine PAR in relation to changes in academic worry and intrinsic value. The different social interactions that are associated with PAR are expected to diminish worry and bolster students' value over time.

Students with high PAR are less likely to worry about successfully completing academic tasks because they have the help and support of peers in class if they experience difficulty (Ryan, Patrick & Shim, 2005). Further, cooperation, help exchanges and positive feedback among classmates should also promote students' feelings of relatedness in the classroom. As articulated in self-determination theory, intrinsic motivation is fostered when students' need for relatedness is met (Ryan & Deci, 2000; Skinner, Kindermann, & Furrer, 2008). I examine these associations in math and science, the issue I turn to next.

Peer Academic Reputation in Math and Science

There has been much attention in recent years about how to promote student retention in STEM fields (Maltese & Tai, 2010; Martin, Way, Bobis, & Anderson, 2015). Understanding the development of achievement-related beliefs and behaviors in math and science is important for addressing this issue (Wigfield et al., 2015). It is likely that students form opinions about each other's academic functioning that are specific to particular subjects. For example, students who receive the best grades on math and science tests are not necessarily the same students who read and write well. Thus, it is important to investigate subject-specific academic reputations. Early adolescents' self-beliefs in math and science in sixth grade predict their later choices to pursue math and science courses in high school (Simpkins et al., 2006). Both teachers' and parents' expectations have been shown to play a role in this process (Eccles, Jacobs, & Harold, 1990). Peer expectations captured within an academic reputation are also likely to be important for the development of students' math and science beliefs and behaviors.

The nature of math and science classes provides a context where academic reputations are likely to be made salient for students, perhaps even more so than in other school subjects. In math and science, information about other students' performance and ability might be available in a format that makes comparison easier than in other subjects (Martin et al., 2015). In contrast to language arts or social studies classes, which often emphasize writing and evaluating information, math and science coursework more often involves formulas and clear-cut “right” or “wrong” answers (Franke, Kazemi, & Batley, 2007). Students are better able to garner information about their peers’ performance in math and science classes because they can more readily compare results on assignments and tests (Kilpatrick, Swafford, & Findell, 2001; Stodolsky & Grossman, 1995).

PAR is also important to examine in math and science because stereotypes that exist in these subject areas might affect reputations among peers. Girls and minorities are underrepresented in college degree attainment and careers in STEM fields (Beede et al., 2011; Hrabowski, 2011). Stereotypes persist of African Americans having less innate academic ability than European Americans and males as superior to females in math and science (Leaper, 2015; Steele, 2010). There is limited research on group differences in the nature or effects of PAR. One study found African American boys had lower general PAR than African American girls but did not examine the effects on student beliefs and behaviors (Graham, Taylor & Hudley, 1998). Another study found no gender differences in the nature of effects of general PAR (Gest et al., 2008). I add to the literature by exploring if group differences exist in PAR in math and science along stereotypical lines (i.e., African Americans and females would have lower PAR) as well as the implications for academic adjustment across the school year.

Peer Academic Reputation in Middle School

In the United States, early adolescence is often accompanied by a change in school setting. Many students transition from smaller elementary schools in the 5th grade to larger middle schools in the 6th grade. In elementary school, students tend to stay with the same teacher and group of peers throughout the whole school day, whereas in middle school students tend to move to different classrooms with different teachers and peers throughout the day (Juvonen, Le, Kaganoff, Augustine, & Constant, 2004). Given structural differences between the elementary and middle school environment, it is important to examine if PAR matters for student development in middle school as has been documented in elementary school classrooms.

I expect that PAR will be important for middle school students' academic adjustment because the peer processes through which academic reputations develop (e.g. peer interactions, feedback, help exchanges, and differential treatment from peers) also operate in this context. Day in and day out, middle school classes come together for an hour to learn math and science and a distinct classroom context emerges. Teachers and peers contribute to the nature of the classroom context (Pianta & Hamre, 2009). Just as math and science middle school teachers affect students' beliefs and behaviors in math and science (e.g. Midgley, Feldlaufer, & Eccles, 1989; Ryan & Patrick, 2001), so does the peer context of those classrooms. However, there are important developmental changes during early adolescence and the transition to middle school that may affect the magnitude and meaning of PAR for students' motivation and engagement.

Early adolescence is a stage characterized by increased self-consciousness and sensitivity to feedback, especially from peers (Harter, 2006; Steinberg, 2014). Cognitive development affords early adolescents increased capabilities to use social comparative information to evaluate their competence (Ruble, Boggianno, Feldman & Loebl, 1980; Butler, 1999). Thus, it may be that the effects of PAR on motivation and engagement will be amplified for students in middle school compared to students in elementary school. However, simultaneously, peer culture is changing in ways that support deviance and discourage compliant behavior (Kiefer & Ryan, 2011; Cillessen & van den Berg, 2012). In middle school, high effort and achievement in the academic domain are less likely to be seen as "cool" compared to in elementary school (Galván, Spatzier & Juvonen, 2011). Compared with children, early adolescents are more likely to hide or downplay their effort toward schoolwork (Juvonen & Murdock, 1995). Thus, the effects of PAR on students' beliefs and behaviors may be diminished in middle school, especially as related to engagement and value. If students are the recipients of cues that they are smart, but in a context where smartness is not highly valued, such cues may promote internal perceptions of competence and diminish worry about failure, but not enhance value or engagement in the classroom. I explore such grade level moderation effects in the current study.

Overview and Summary of Hypotheses

In summary, with a sample of 5th grade (elementary school) and 6th grade (middle school) students, I examine the implications of PAR for students' academic outcomes in math and science (self-concept, intrinsic value, academic worry and engagement). In line with prior research, I anticipate that PAR will be positively associated with changes in academic self- concept and engagement (e.g., Gest et al., 2008). Further, based on our conceptualization that PAR leads to differential social interactions (increased cooperation, fruitful help exchanges and praise) among students in the classroom, I hypothesize that PAR will be associated with enhanced value and diminished worry across the school year. Given our study is the first to examine PAR in the middle school setting, I explore possible grade level differences of PAR in association with academic outcomes (e.g., if associations of PAR with academic outcomes are magnified in 6th grade students compared to 5th grade students due to the increased importance of peer opinions during this stage, or if the positive association of PAR with engagement and value is attenuated in 6th grade compared to 5th grade due to achievement being seen as less “cool”). Finally, I explore group differences by gender and ethnicity regarding the association of PAR with academic outcomes across the school year.

Method

Participants

Participants attended 55 classrooms with different teachers (28 6th grade math or science classrooms from middle schools serving students in grades 6 through 8, and 27 5th grade classrooms from elementary schools serving students in grades kindergarten through 5). These public schools were from three Midwestern school districts located in small to moderate size urban areas. The demographics and academic achievement of the school districts are comparable. The percentage of students meeting state standardized testing standards was between 62% and 74%. The school districts serve a sizable proportion of low-income (50-71%) and middle-income families. The total sample (N = 840) was comprised of students who had data at both waves and was about half female (51.1%) and ethnically diverse (36% African American, 47% European American, 7% Hispanic, 6% Asian American and 3% other ethnic groups).

Procedure

Letters describing the project were sent home with permission slips for all students two weeks prior to data collection. Eighty-four percent of the students were granted parental permission to participate in the project. Surveys were administered in

October (time 1) and May (time 2). Trained administrators gave paper surveys to students during their math or science classes (about 60% of students were in math class and responded about math, and about 40% of students were in science class and responded about science). Preliminary analyses indicated the pattern of results for math and science were the same, so analyses combined students from math and science classes. Teachers completed surveys about each student during this time.

For the student surveys, the instructions and items were read aloud by the administrator while students read along and responded. Students were told that the purpose of the survey was to find out about students' beliefs and behaviors and that the survey was not a test and there were no right or wrong answers. Students were assured that the information in the survey would be kept confidential. In addition, students were told that filling out the survey was voluntary.

Students were provided a blank sheet of paper to cover their answers as they went along so as to keep their responses private. I visited the schools one additional day to administer make-ups for students who were absent on the first day of survey administration.

Measures

Peer Academic Reputation. I used peer nominations to assess PAR in math or science class. Students were asked to nominate peers in math/science class for “who gets good grades” and “who does NOT get good grades.” Students checked names off class lists that were embedded in the survey under each of these items. I tallied the number of nominations that each student received for each of these items. Scores on each item could range from zero (no nominations received) to the total number of nominators in a given classroom (typically around 20). For “gets good grades,” the mean ranged from 2.09 to 5.55, the median was 2, and the maximum ranged from 8 to 21. For “does NOT get good grades,” the mean ranged from 1.50 to 4.08, the median was 1, and the maximum ranged from 6 to 19. These raw scores were standardized within classrooms to account for varying class size. The two items were moderately negatively correlated (r =-.51). The negative item (i.e., “who does NOT get good grades”) was reverse scored and the mean of the two items was used as the measure of each student’s PAR. I explored the positive and negative reputation items separately and each showed similar associations with the academic outcomes at about the same magnitude but opposite valence. This provided justification for combining the two dimensions into a single PAR index.

Self-Concept. I used Eccles’ measure for self-concept (Eccles et al., 1989). Students responded to four items pertaining to their ability in math/science. Sample items include: “How good at (math/science) work are you?” and, “In general, how good are you at learning something new in (math/science)?” Students responded on a 1 to 5 scale, with 1 being *“not at all good”* and 5 being *“very good.”* The measure was reliable in our sample (Cronbach’s alpha = .85).

Intrinsic Value. I used a measure of intrinsic value established by Eccles (Eccles et al., 1983; see also Fredricks & Eccles, 2002). Students responded to three items about how much they value math/ science. A sample item is: “In general, I find working on (math/science) class work to be enjoyable.” Students responded on a 1 to 5 scale with 1 being *“not at all true”* and with 5 being *“very true.”* Another sample item is, “In general, I find working on math/science assignments…” with 1 being “*very boring*,” 3 being

"*OK,"* and 5 being "*very interesting."* The measure was reliable in our sample (Cronbach's alpha = .89)

Worry. I assessed students' worry about math/science schoolwork with a measure taken from Ryan & Shim (2006). Sample items include: "When I do my math/science work, I worry about how poorly I am doing," and "I worry about whether or not I will do well in my (math/science) class." Students responded to four items on a 1 to 5 scale, with 1 being "*not at all true"* and 5 being "*very true*." The four-item measure was reliable in our sample (Cronbach's alpha = .86).

Engagement. I used a measure developed by Skinner and colleagues (Skinner et al., 2008) to assess students' behavioral engagement. Teachers rated each student on three different items about their behavioral engagement in math/science class. Sample items include "The student pays attention in class" and "The student tries hard in class." Responses were on a scale of 1 to 5 scale with 1 being *"never"* and 5 being *"always."* The measure was reliable in our sample (Cronbach's alpha = .93).

Results

Analytic Plan

Analyses examined the associations of fall PAR with spring academic outcomes, controlling for fall levels. Preliminary analyses (descriptive statistics including means, standard deviations, and correlations) were conducted followed by hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002). HLM is a regression-based technique that has advantages over ordinary least squares regression in that it partitions the variance into student-level and class- level components (Raudenbush & Byrk, 2002). Our research questions concern the association of student-level characteristics, but students in our sample were nested in classrooms. By using HLM, I was able to generate estimates of our student-level coefficients while accounting for any variation that exists at the class level. The ICC's indicated minimal variation at the class level for academic worry (3%), more variation for academic self-concept and intrinsic value (7 and 9%, respectively) and the most variation for engagement (14%). Despite the minimal class- level variation for academic worry, HLM was used for consistency and because it best represented the nested structure of the data.

Descriptive Statistics

Correlations. I examined correlations separately by grade, gender and ethnicity, but the patterns were highly similar across groups, so I present the correlations for the whole sample in Table 1. At both time points, PAR was positively correlated with self-concept, intrinsic value, and engagement and negatively correlated with worry about math/science coursework. Also of note is the high stability of PAR in math/science across the school year (r = .85) indicating that students' views and opinions of their peers' abilities do not change much across the school year.

Group Differences in Mean Levels. Table 1 also shows the means and standard deviations of all variables in the fall and spring. I examined ethnic, gender and grade level differences with analysis of variance. There were no significant interactions (e.g., grade X gender) but there were several main effects. For ethnicity, I compared African American and European American students due to small numbers of students in other ethnic groups. There was only one construct that showed a difference by ethnicity: African American students were rated as lower in engagement by their teachers in the fall (M = 3.50 for

African American students and $M = 4.02$ for European American students, $F = 66.65$, $p < .001$) and in the spring ($M = 3.48$ for African American students and $M = 3.98$ for European American students, $F = 56.51$, $p < .001$).

There were several constructs that showed gender differences. In the fall, girls had more positive PAR than boys ($M = .20$ for girls and $M = -.20$ boys, $F = 52.97$, $p < .001$). Teacher reports of student engagement were also higher for girls than for boys ($M = 4.02$ for girls and $M = 3.63$ for boys, $F = 39.22$, $p < .001$). In the spring, girls again had more positive PAR than boys ($M = 0.19$ for girls and $M = -.17$ boys, $F = 32.94$, $p < .001$) and teacher reports of engagement were higher for girls than for boys ($M = 3.97$ for girls and $M = 3.61$ for boys, $F = 30.41$, $p < .01$). However, by spring girls reported greater levels of worry about their math/ science schoolwork than boys ($M = 2.61$ for girls and $M = 2.34$ boys, $F = 8.99$, $p < .01$).

In the fall, there were no differences between fifth graders and sixth graders in PAR, academic self-concept, value, worry, or engagement. By spring, fifth graders reported higher intrinsic value for math/science than sixth graders ($M = 3.48$ for 5th graders and $M = 3.22$ for 6th graders, $F = 10.54$, $p < .01$). Additionally, teachers rated fifth graders higher on engagement than sixth graders in the spring ($M = 3.88$ for 5th graders and $M = 3.71$ for 6th graders, $F = 6.53$, $p < .05$).

Hierarchical Linear Models

Separate models were run for each of the four dependent variables: academic self-concept, intrinsic value, worry, and engagement at the end of the school year (time 2; see Table 2). All four models controlled for fall levels of the dependent variable to assess the extent to which PAR was important to change over time. Preliminary models controlled for grade, gender and ethnicity. Grade and gender were significant predictors in some models whereas ethnicity was not. Thus, grade and gender were retained in the final models but ethnicity was not. Further, I was interested in possible variations in the association of PAR and the outcome variables by grade, gender and ethnicity (i.e., African American compared to European American students). I examined interaction terms to see if the effects of PAR varied for any of these groups. None of the interaction terms were significant so they were not included in the final models. Thus, the results of PAR I report in this section were similar for 5th and 6th graders, boys and girls as well as African American and European American students.

Academic self-concept. Controlling for gender, grade and fall academic self-concept, PAR in the fall was positively associated with academic self-concept in the spring (B = .11, p < .05). Thus, having a positive PAR was associated with enhanced self-concept across the school year. Neither gender nor grade were associated with students' academic self-concept, controlling for fall levels. Results for all models are shown in Table 2.

Intrinsic Value. PAR in the fall was not associated with intrinsic value in the spring, controlling for gender, grade, and fall-levels of intrinsic value (B = .05, p > .05). Gender (B =.17, p < .01) and grade (B = -.18, p < .05) were associated with intrinsic value in math and science in the spring, controlling for fall levels. Thus, girls reported higher levels of intrinsic value compared to boys, and 6th graders reported lower levels of intrinsic value compared to 5th graders.

Worry. Controlling for gender, grade and fall levels of academic worry, PAR in the fall was associated with students' self-reported academic worry in math and science in the spring (B= -15, p <.05). Thus, having a positive PAR in the fall was associated with lower levels of reported academic worry across the school year. Gender was also associated with academic worry (B = -.23, p < .01), with females reporting higher levels of academic worry than boys.

Engagement. Controlling for gender, grade and fall levels of engagement, PAR in the fall was associated with higher levels of teacher-reported engagement in the spring (B = 0.14, p < .05). Thus, having a positive PAR in the fall is associated with increased levels of engagement across the school year. Furthermore, grade was associated with engagement (B = -.20 p < .01) indicating 5th grade teachers reported higher levels of student engagement than 6th grade teachers.

Discussion

Young adolescents' motivation and engagement in math and science are important to their learning and achievement in the short-run and to their choices and achievement in STEM courses and careers in the long-run (Maltese & Tai, 2010; Simpkins et al., 2006). Motivation and engagement are dynamic and sensitive to the social context (Wigfield et al., 2015). Peers are a salient part of the social context in classrooms. Our results indicate that peer dynamics in math and science classrooms matter in important ways for young adolescents' motivation and engagement in math and science. Specifically, students' PAR in math and science classrooms was associated with changes in students' academic beliefs and behaviors across the school year.

I conceptualized that students' PAR in math and science affects their beliefs and behavior through expectancy cues provided by peers that convey to students what others think about their competence in math and science. Expectancy cues are communicated through social interactions, differential treatment and feedback among peers in a classroom and over time these experiences shape students' beliefs and behaviors about math and science (Altermatt, 2012).

When students have a reputation for competence, peers are more likely to want to work with them on tasks, ask for and receive help from them, and respond to them with praise rather than criticism. Taken together, these interactions and experiences serve to bolster students' motivation and engagement (Altermatt, 2012; Newman, 2000; Wentzel et al., 2007). As hypothesized, I found PAR in the fall of the school year was associated with changes across the school year in students' self-perceptions of ability and worry as well as teacher reports of behavioral engagement in math and science classrooms. Our findings contribute to a growing body of work showing that peers matter in important ways for students' academic adjustment in general (e.g., Ryan & Ladd, 2012) and math and science in (e.g., Robnett & Leaper, 2012).

Contrary to our hypothesis, PAR was not associated with changes in students' value for math or science. It does not seem that the positive social interactions and messages about competence that stem from PAR relate to increased value over time. Value and perceived competence are distinct aspects of motivation; a student might believe she is good at math but not value it or vice versa. Eccles' Expectancy X Value theory of motivation has shown that these constructs factor separately with unique antecedents and consequences (Eccles et al., 1983; Wigfield et al., 2015). Our results suggest these facets of motivation may be sensitive to different processes in the peer ecology. Shin & Ryan (2014) found that the characteristics of one's friends predicted changes in value but not perceived competence. Robnett & Leaper (2012) found that perceived friend support for STEM subjects was associated with adolescents' interest in STEM careers. Thus, it may be that processes within close friendships are associated with students' value, whereas expectancy socialization processes among peers in the classroom matter for perceived competence. Perceived competence predicts achievement whereas value predicts selection of courses in STEM (Wigfield et al., 2015). As such, understanding how different peer experiences are linked to different facets of motivation is important and could have different implications for supporting adolescents' commitment to STEM.

Novel to this study was the investigation of PAR in middle school classrooms. With half of our sample in elementary school classrooms and half in middle school classrooms, I was able to examine if PAR had similar implications at both grade levels. There was no significant interaction for grade level and PAR effects. Our results indicate that PAR operates in middle school math and science classrooms in similar ways as has been documented in elementary school classrooms. Although early adolescence is a stage when peer opinions matter more to individuals (Steinberg, 2014), PAR did not have a stronger relation to achievement beliefs and behaviors for middle school students compared to elementary school students. Despite a changing social landscape in middle school where effort and achievement are less admired (e.g., Galván, 2011), PAR had a similar positive association with engagement (and a null association with value) at both grade levels. Perhaps this is due to the fact that our elementary and middle school students were only one grade level apart (i.e., 5^{th} versus 6^{th}). It is possible that I could have found grade differences for PAR if I examined 5^{th} graders compared to 7^{th} graders.

Another possible explanation is that I examined peer dynamics within math and science classrooms, whereas most prior work has examined peer dynamics within the entire grade at school (e.g., Galván et al., 2011). Perhaps in the smaller setting of the classroom, where students are in closer proximity to the teacher, peer dynamics concerning social status and achievement play out in less extreme fashion than in the larger social scene at school.

Given negative societal stereotypes regarding minority students' academic ability and female students' math and science abilities, I explored gender and ethnic differences in PAR. I found few differences for African American and European American students in our sample. There was an interesting pattern of results in regard to gender. Girls' PAR was higher than boys' in both the fall and spring. Thus, students recognize that girls earn higher grades than boys. Similarly, teachers reported that girls were more engaged than boys in both the fall and spring. Nonetheless, despite such recognition by teachers of their engagement, and peers of their achievement, girls did not have more positive motivational beliefs. There were no gender differences in self-concept or intrinsic value in the fall or spring of the school year. Our findings are in line with prior research that has shown while early adolescent girls earn higher grades in math and science class than their male peers (Robinson & Lubienski, 2011), they do not tend to have more favorable perceptions of ability or value for these subjects (Leaper, 2015). Interestingly, in our sample, girls reported higher levels of worry in math and science compared to boys by the end of the year.

This pattern may be due to differences in how girls and boys approach achievement situations (Leaper, 2015). Pomerantz, Altermatt, and Saxon (2002) note two ways in which girls and boys engage in school differently. First, girls tend to be more concerned with pleasing others which can heighten their effort in school but leave them vulnerable to anxiety over whether they are disappointing others. Second, girls are more sensitive to feedback than boys. Girls tend to view feedback as diagnostic of their ability whereas boys tend to adopt a confident approach and deny the informational value of feedback. Both girls' wanting to please others and their attunement to feedback may increase effort and achievement, but at the same time leave them vulnerable to anxiety (Pomerantz et al., 2002). Our findings support this conceptualization. Further, I show that such dynamics play out against a backdrop of peers' widely acknowledging girls as the high achievers in math and science.

However, it is important to note that recognizing girls as the high achievers does not mean that young adolescents do not hold stereotypical views about girls' math and science ability (Leaper, 2015; Steele, 2010). In fact, having a positive PAR may itself play into girls' motivation and worry. Natural ability is different than getting good grades, and if girls believe they must work extra hard to overcome a lack of natural ability in math and science, this may undermine their confidence and increase their worry.

The distinction between effort and ability is important to consider in relation to our measure of PAR. I asked students to nominate peers for "who gets good grades" and "who does not get good grades" in their math or science class. It is likely that students view both ability and effort as contributing to good grades. Asking students about which peers are "smart in math/science" or "work hard in math/science" could be illuminating in regard to potential gender differences. Previous work has asked students "who is good/not very good at reading" and "almost always/almost never knows the right answer when the teacher asks a question" (e.g., Gest et al., 2008). It is likely that these different items are tapping into a similar construct of PAR, but future work examining how different PAR items relate to each other and to student motivation, engagement and achievement could address potential multi-dimensionality of the PAR construct. Along these lines, investigating which peers have a reputation for "who enjoys the work we do in math/science" might tap into a different facet of PAR which matters for student development of value or interest. Just as motivation and engagement are multi-dimensional (Wigfield et al., 2015), it is possible that PAR is multi-dimensional. Conversely, students may not be attuned to their peers' academic profiles with as much nuance as their own beliefs and behaviors. Future work addressing this issue could be informative about the nature and consequences of PAR.

Our study had both strengths and limitations. Strengths of our study include the fairly large and somewhat diverse sample, a longitudinal design, and the use of student, teacher, and peer reports to capture different facets of students within both elementary and middle school classrooms. Further, I used HLM to control for classroom variations when examining associations of PAR and student outcomes.

Despite the strengths, our study was limited in that I did not control for students' actual grades in examining PAR which leaves open the possibility that PAR reflects grades rather than peer processes emanating from PAR. While this alternative explanation is attenuated somewhat by prior research that has shown PAR predicts changes in achievement beliefs and behaviors above and beyond GPA (Hughes et al., 2009) and teacher-rated academic skills (Gest et al., 2008), it is a limitation of our study. In addition, I explored ethnic differences regarding two groups (i.e., African American and European

American students). Future work with larger and more diverse samples would allow additional exploration of ethnic differences in PAR. Further, I only examined change across two time points within a school year. Future work could examine students' PAR in math and science over a longer time frame, through middle school and even into high school. This would be informative about the development of PAR, motivation and engagement in adolescence.

Another direction for future research is to begin to integrate teacher and peer influences on student motivation and engagement in the classroom. There has been growing recognition in recent years about the important role that teachers play in peer dynamics and relations in the classroom setting (Cappella & Neal, 2012: Gest & Rodkin, 2011; Farmer, Lines & Hamm, 2011; Ryan, Kuusinen, & Bedoya-Skoog, 2015). Relevant to PAR, Cohen (1986) has described how teachers can promote inclusion and equitable participation among students of differing abilities through group work and collaborative tasks. Although teacher and peer factors are intertwined, they are often examined separately rather than in conjunction. Consideration of how these different processes work together would advance current theory and knowledge on the development of achievement-related beliefs and behaviors. This may be particularly important for students who have low or negative PAR. While having a positive PAR is related to enhanced perceptions of ability and engagement and diminished worry over time, the opposite is true for students who have a negative PAR. Students with a negative PAR are vulnerable to declines in motivation and engagement over time. Are there actions a teacher can take to prevent such declines? Can a teacher manage students' reputations in class? For example, if a teacher gives a student an opportunity to demonstrate competence or praises them for doing something well, would it promote a positive PAR in a classroom? Perhaps if a teacher emphasizes task mastery and personal improvement rather than relative performance it may mitigate the negative effects of PAR.

In conclusion, by examining PAR in math and science classrooms, the present research contributes a better understanding of the factors that matter for young adolescents' motivation and engagement in math and science. Given the central role that motivation and engagement play in learning, achievement, and ultimately course and career selection in STEM, this is noteworthy. Attention to peer dynamics in math and science classrooms by educators is warranted and likely to be important in promoting success for early adolescents.

Footnote

[1]Measures were found to be reliable when run separately for European American and African American students (Cronbach's alpha exceeded 0.82 for all scales for both groups).

References

Altermatt, E. R. (2012). Children's achievement-related discourse with peers: Uncovering the processes of peer influence. In A. M. Ryan and G. W. Ladd (Eds.), *Peer relationships and adjustment at school (*pp. 109-134*).* Charlotte: Information Age Press.

Altermatt, E. R., & Kenney-Benson, G. A. (2006). Friends' influence on school adjustment: A review of three perspectives. In A. V. Mitel (Ed.), *Trends in educational psychology* (pp. 137–153). New York: Nova Science Publishers.

Altermatt, E. R., Pomerantz, E. M., Ruble, D. N., Frey, K. S., & Greulich, F. K. (2002). Predicting changes in children's self-perceptions of academic competence: A naturalistic examination of evaluative discourse among classmates. *Developmental Psychology, 38,* 903-917.

Anderman, E. M. (2013). Middle school transitions. In J. Hattie & E. M. Anderman (Eds.), *International guide to student achievement* (pp. 176-178). New York, NY: Routledge.

Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. *Economics and Statistics Administration Issue Brief*, (04-11).

Butler, R. (1999). Information seeking and achievement motivation in middle childhood and adolescence: The role of conceptions of ability. *Developmental Psychology*, *35*(1), 146- 156.

Cappella, E., & Neal, J. W. (2012). A classmate at your side: Teacher practices, peer victimization, and network connections in urban schools. *School Mental Health, 4,* 81-94.

Chen, Q., Hughes, J. N., Liew, J., & Kwok, O. M. (2010). Joint contributions of peer acceptance and peer academic reputation to achievement in academically at-risk children: Mediating processes. *Journal of Applied Developmental Psychology*, *31*(6), 448-459.

Cillessen, A. H. N. & van den Berg, Y. (2012). Popularity and school adjustment. In A. M. Ryan and G. W. Ladd (Eds.), *Peer relationships and adjustment at school* (pp. 135-164). Charlotte: Information Age Press.

Cohen, E. G. (1986). *Designing groupwork: Strategies for the heterogeneous classroom*. New York: Teachers College Press.

Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75-146). San Francisco, CA: Freeman.

Eccles, J. S., Jacobs, J. E., & Harold, R. D. (1990). Gender role stereotypes, expectancy effects, and parents' socialization of gender differences. *Journal of Social Issues*, *46*(2), 183-201.

Eccles, J., & Roeser, R. (2010). An ecological view of schools and development. In J. L. Meece & J. S. Eccles (Eds.), *Handbook of research on schools, schooling and human development* (pp. 6-21). New York, NY: Routledge.

Eccles, J. S., Wigfield, A., Flanagan, C. A., Miller, C., Reuman, D. A., & Yee, D. (1989). Self- concepts, domain values and self-esteem: Relations and changes at early adolescence. *Journal of Personality*, *57*(2), 283-310.

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Science Bulletin, 21*(3), 215-225.

Farmer, T.W., Lines, M.M., & Hamm, J.V. (2011). Revealing the invisible hand: The role of teachers in children's peer experiences. (Introduction to the special issue*). Journal of Applied Developmental Psychology*, *32*(5), 247-256.

Franke, M. L., Kazemi, E., & Battey, D. (2007). Mathematics teaching and classroom practice. In F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 225–256). Charlotte, NC: Information Age.

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: Growth trajectories in two male-sex-typed domains. *Developmental Psychology, 38*(4), 519-533.

Galván, A., Spatzier, A., & Juvonen, J. (2011). Perceived norms and social values to capture school culture in elementary and middle school. *Journal of Applied Developmental Psychology*, 346-353.

Gest, S. D., Domitrovich, C. E., & Welsh, J. A. (2005). Peer academic reputation in elementary school: Associations with changes in self-concept and academic skills. *Journal of Educational Psychology*, *97*(3), 337-346.

Gest, S. D., & Rodkin, P. C. (2011). Teaching practices and elementary classroom peer ecologies. *Journal of Applied Developmental Psychology*, *32*(5), 288-296.

Gest, S. D., Rulison, K. L., Davidson, A. J., & Welsh, J. A. (2008). A reputation for success (or failure): The association of peer academic reputations with academic self-concept, effort, and performance across the upper elementary grades. *Developmental Psychology*, *44*(3), 625-636.

Graham, S., Taylor, A. Z., & Hudley, C. (1998). Exploring achievement values among ethnic minority early adolescents. *Journal of Educational Psychology*,*90*(4), 606-620.

Harter, S. (2006). Developmental perspectives on the self. In N. Eisenberg (Ed.), *The handbook of child psychology*, *volume on social and personality development* (*4th ed).* New York: Wiley.

Hoglund, W. L., & Chisholm, C. A. (2014). Reciprocating risks of peer problems and aggression for children's internalizing problems. *Developmental psychology*, *50*(2), 586- 599.

Hrabowski, F.A. (2011). Boosting minorities in science. *Science, 331*(6014), 125.

Hughes, J. N., Dyer, N., Luo, W., & Kwok, O. (2009). Effects of peer academic reputation on achievement in academically at-risk elementary students. *Journal of Applied Developmental Psychology*, *30*(2), 182-194.

Hughes, J. N., Im, M. H., & Wehrly, S. E. (2014). Effect of peer nominations of teacher–student support at individual and classroom levels on social and academic outcomes. *Journal of School Psychology*, *52*(3), 309–322

Juvonen, J., Le, V. N., Kaganoff, T., Augustine, C. H., & Constant, L. (2004). *Focus on the wonder years: Challenges facing the American middle school*. New York: Rand Corporation.

Juvonen, J., & Murdock, T. B. (1995). Grade‐level differences in the social value of effort: Implications for self‐presentation tactics of early adolescents. *Child* *development*, *66*(6), 1694-1705.

Juvonen, J., & Nishina, A. (1997). Social motivation in the classroom: Attributional accounts and developmental analysis. In P. R. Pintrich, & M. L. Maeher (Eds.), *Advances in motivation and achievement* (Vol. 10, pp. 181-211). Greenwich, CT: JAI.

Kiefer, S. M. & Ryan, A. M. (2011). What characteristics are associated with social success?: Changes in students' perceptions of social success during early adolescence. *Applied Developmental Psychology, 32,* 218-226

Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding it up: How children learn mathematics. National Research Council. National Academies Press.

Leaper, C. (2015). Gender and social-cognitive development. In R. M. Lerner, L. S. Liben, & U. Mueller (Eds.), *Handbook of child psychology and developmental science* (7th ed.) (Vol. 2, pp. 806-853). Hoboken, NJ: John Wiley & Sons, Inc.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, *32*, 669-685.

Martin, A. J., Way, J., Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle school years. *Journal of Early Adolescence, 35*, 199-244.

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989). Student/teacher relations and attitudes toward mathematics before and after the transition to junior high school. *Child Development, 60*(4), 981-992.

Molloy, L. E., Ram, N., & Gest, S. D. (2011). The storm and stress (or calm) of early adolescent self-concepts: Within-and between-subjects variability. *Developmental* *psychology, 47*(6), 1589-1607.

National Science Board (NSB). (2010). *Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital.* Arlington, VA: National Science Foundation.

Newman, R. S. (2000). Social influences on the development of children's adaptive help seeking: The role of parents, teachers, and peers. *Developmental Review, 20*, 350-404.

Pederson, F.V., Barker, E.D., & Borge, A.I.H. (2007). Timing of middle-childhood peer rejection and friendship: Linking early behavior to early adolescent adjustment. *Child Development, 78*(4), 1037-1051.

Pianta, R. C., & Hamre, B. K. (2009). Conceptualization, measurement, and improvement of classroom processes: Standardized observation can leverage capacity. *Educational Researcher, 38*(2), 109-119.

Pomerantz, E. M., Altermatt, E. R, Saxon, J. L. (2002). Making the grade but feeling distressed: Gender differences in academic performance and internal distress. *Journal of Educational Psychology, 94*, 396-404.

Pomerantz, E. M., Grolnick, W. S., & Price, C. E. (2005). The role of parents in how children approach achievement. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 259-278). New York: Guilford.

Prinstein, M.J., Rancourt, D., Guerry, J. D., & Browne, C.B. (2009). Peer reputations and psychological adjustment. In K. H. Rubin, W. M. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups* (pp. 548-567). New York, NY: Guilford.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Sage.

Robinson, J. P., & Lubienski, S. T. (2011). The development of gender achievement gaps in mathematics and reading during elementary and middle school: Examining direct cognitive assessments and teacher ratings. *American Educational Research Journal*, *48*(2), 268-302.

Robnett, R. D. & Leaper, C. (2012). Friendship groups, personal motivation and gender in relation to high school students' STEM career interest. *Journal of Research on Adolescence*, *23*(4), 652-664.

Rodkin, P. C., & Ryan, A. M. (2012). Child and adolescent peer relations in an educational context. In K. Harris, S. Graham, & T. Urdan, (Eds.), *Educational psychology handbook* (pp. 363-389). Washington DC: APA Publications.

Ruble, D. N., Boggianno, A. K., Feldman, N. S., & Loebl, J. H. (1980). Developmental analysis of the role of social comparison in self-evaluation, *Developmental Psychology, 16*, 105- 115.

Rubin, K.H., Bukowski, W.M., & Bowker, J.C. (2015). Children in peer groups. In R. Lerner (Series Ed.), M.H. Bornstein & T. Leventhal (Vol. Eds.), *Handbook of child psychology and developmental science, Vol. 4: Ecological settings and processes in developmental systems*. Wiley-Blackwell.

Ryan, A. M., Kuusinen, C. M., & Bedoya-Skoog, A. (2015). Managing peer relations: A dimension of teacher self-efficacy that varies between elementary and middle school teachers and is associated with observed classroom quality. *Contemporary Educational Psychology*, *41*, 147-156.

Ryan, A. M., Patrick, H., & Shim, S. S. (2005). Differential profiles of students identified by their teacher as having avoidant, appropriate or dependent help-seeking tendencies in the classroom. *Journal of Educational Psychology, 97 (2)* 275-285.

Ryan, A. M., & Ladd, G. W. (Eds.). (2012). Peer relationships and adjustment at school. Charlotte, NC: Information Age Press.

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*(2), 437-460.

Ryan, A. M., & Shim, S. S. (2006). Social achievement goals: The nature and consequences of different orientations toward social competence. *Personality and Social Psychology Bulletin, 32*(9), 1246-1263.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development and well-being. *American Psychologist, 55*, 68-78.

Schwartz, F. (1981). Supporting or subverting learning: Peer group patterns in four tracked schools. *Anthropology and Education Quarterly, 12,* 99-121.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, *42*(1), 70-83.

Shin, H. & Ryan, A. M. (2014). Early adolescent friendships and academic adjustment: Examining selection and influence processes with longitudinal social network analysis. *Developmental Psychology, 50*, 2462-2472.

Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2008). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and Psychological Measurement, 69*(3), 493-525.

Steele, C. M. (2010). *Whistling Vivaldi: How stereotypes affect us and what we can do.* New York, NY: Norton & Co.

Steinberg, L. (2014). *Age of Opportunity: Lessons from the New Science of Adolescence*. New York, NY: Houghton Mifflin.

Stodolsky, S. S., & Grossman, P. L. (1995). The impact of subject matter on curricular activity: An analysis of five academic subjects. *American Educational Research Journal*, *32*(2), 227-249.

Wigfield, A., Eccles, J. S., Fredricks, J., Simpkins, S. D., Roeser, R., & Schiefele, U. (2015). Development of achievement motivation and engagement. In R. Lerner, M. Lamb, & C. Garcia Coll (Eds.), *Handbook of child psychology (7th ed., vol. 3).* New York: Wiley.

Wentzel, K. R., Filisetti, L., & Looney, L. (2007). Adolescent prosocial behavior: The role of self-processes and contextual cues. *Child Development, 78,* 895-910.

Wentzel, K.R., & Muenks, K. (2016). Peer influence on students' motivation, academic achievement, and social behavior. In K.R. Wentzel & G.B. Ramani (Eds.), *Handbook of social influences in school contexts: Social-emotional, motivation, and cognitive outcomes* (pp. 13-30). Charlotte, NC: Information Age Press.

Table 1.1

Correlation Coefficients, Means and Standard Deviations for PAR and Achievement Beliefs and Behaviors

	1	2	3	4	5	6	7	8	9	10
Fall PAR	--									
Spring PAR	.85**	--								
Fall Self- Concept	.32**	.37**	--							
Spring Self-Concept	.27**	.27**	.61**	--						
Fall Intrinsic Value	.13**	.16**	.57**	.39**	--					
Spring Intrinsic Value	.08*	.16**	.41**	.57**	.61**	--				
Fall Worry	-.19**	-.21**	-37**	-.33**	-.24**	-.27**	--			
Spring Worry	-.16**	-.17**	-32**	-.32**	-.22**	-.25**	.51**	--		
Fall Engagement	.63**	.59**	.32**	.28**	.13**	.10**	-.20**	-.16**	--	
Spring Engagement	.59**	.63**	.33**	.33**	.15**	.19**	-.21**	-.17**	.73**	--
M	.02	.00	3.90	3.92	3.34	3.51	2.52	2.49	3.76	3.77
SD	.49	.53	.86	.87	1.21	1.19	1.29	1.30	1.02	.99

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 1.2

Hierarchical Linear Student-Level Model for PAR and Achievement Beliefs and Behaviors

	Spring Self Concept		Spring Intrinsic Value		Spring Worry		Spring Engagement	
Level 1 Variables	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Fall reports of self-concept, value, worry, or engagement	0.617***	0.035	0.614***	0.032	0.520***	0.030	0.691***	0.024
Gender	0.089	0.056	0.172*	0.064	-0.234**	0.077	0.109	0.061
Grade	-0.029	0.067	-0.182*	0.089	0.031	0.085	-.197 **	0.066
Fall PAR	0.114*	0.055	0.052	0.074	-0.153*	0.075	0.141*	0.056

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Chapter 3

The Mechanism behind the PAR Effect: Peer Communication of Expectancy Cues in Middle School Math and Science Classrooms

Adolescence is a stage of life when peer opinions and feedback take on increased significance. In the classroom context, peer academic reputations have been identified as one way that peers socialize adolescents' self-beliefs about their academic competence (Gest, Domitrovich, & Welsh, 2005; North & Ryan, 2018). The current study aims to elucidate the process that underlies the effect of peer academic reputations on students' academic self-concept. Specifically, I examine expectancy socialization among adolescents in middle school math and science classes.

It is theorized that youth communicate expectancy cues to their peers regarding their academic ability through patterns of daily interactions in the classroom (Gest, Rulison, Davidson & Welsh, 2008; Altermatt, Pomerantz, Grolnick & Price, 2002). Expectancy cues are thought to be differentially communicated to classmates based their peer academic reputations, and over time this elicits change in students' own self-beliefs (e.g., Altermatt & Kenney-Benson, 2006; Pomerantz, Grolnick & Price, 2005). However, research has not examined expectancy socialization processes directly but rather inferred such processes by establishing links between peer academic reputations and changes in self-beliefs over time.

In the current study I develop a new survey assessment to measure students' perceptions of expectancy cues from peers. I assess how students' perceptions of expectancy cues from peers relate to their peer academic reputations and academic self-concept concurrently and over time. Finally, I explore the role of gender in peer expectancy socialization. Given that stereotypes about girls' ability in math and science persist, exploring gender differences in expectancy socialization in these domains is important. To my knowledge, the current study is the first to empirically examine peer expectancy socialization in the classroom context with adolescents. By situating my investigation in math and science classrooms, the current research provides new insight into how peers socialize adolescents' academic self-beliefs in specific subjects,

Academic Self-concept in Adolescence

Academic self-concept is related to a multitude of important behavioral and emotional outcomes for adolescents (Marsh & Martin, 2010). When students feel confident in their ability to be successful at school, they are more likely to pursue challenging academic tasks, engage in class activities, and persist in the face of difficulty (Marsh & O'Mara, 2008). Expectancy value theory (Eccles et al., 1983; Eccles & Wigfield, 2002) provides a framework for understanding the factors that affect adolescents' academic self-concept. In this theoretical perspective, expectancies refer to beliefs about one's ability to complete an activity or task ("can I do it?"). Expectancies are informed by a broad range of factors, including the beliefs and behaviors of important others (Eccles et al., 1983; Wigfield & Eccles, 2002). Although most work has centered around parents and teachers as socializers of students' expectancy beliefs, peers are also important socializers during adolescence.

Peers and Academic Self-concept

Adolescents' academic and social lives are closely intertwined. On a daily basis at school, students navigate their social world with peers at same time as they are learning and practicing academic content. The role of peers in the development of academic self-concept may be amplified during adolescence. During this stage of life, youth's sense of identity is informed by their peers' feedback and opinions (Wentzel & Muenks, 2016; Harter et al., 1999). In the classroom, adolescents are likely to look to their peers for information about how to interpret their academic performance, thus shaping their expectations for future performance.

Peer academic reputation has been shown to predict changes in student's academic self-concept over time, above and beyond prior achievement (e.g. Gest et al., 2005, 2008; Hughes, Dyer, Luo, Kwok 2009). In other words, being known as "smart" is associated with gains in academic self-concept over time. For a full understanding of the effect of peer academic reputations, it is informative to examine other similar classroom peer reputations in addition to the measurement of peer academics reputation with nominations of "who is really smart?" Thus, as a contrast to peer academic reputation, I also examine two different classroom reputations— "who tries really hard?" and "who do you like to work with?" In doing so, this study contributes a more nuanced picture of how peer expectancy socialization operates among adolescents in the classroom setting.

Expectancy Cues from Parents and Teachers

Expectancy socialization occurs through expectancy cues that convey others' opinions and expectations of an individual's capabilities (e.g. Eccles, Jacobs, & Harold, 1998; Altermatt & Kenney-Benson, 2006). Expectancy cues shape individual's daily experiences and over time are internalized and affect one's self-beliefs. Expectancy socialization has most often been studied regarding students' interactions with their parents and teachers. For example, Frome & Eccles (1998) found that parents' perceptions of children's academic competence predicted children's own perceptions of competence, over and above students' grades. This effect is thought to occur through parents' provision of opportunities and experiences, the advice they give, and the importance they attach to different pursuits (Eccles, Jacobs, & Harold, 1998). Teachers also form expectations about students' capabilities, and communicate these expectations to students both directly and indirectly through instruction, teacher-student interactions, and emotional support (e.g. McKown & Weinstein, 2008; Kuklinski & Weinstein, 2001).

Expectancy Cues from Peers

Compared to parents and teachers, there has been less attention to peer expectancy socialization. Given the importance of peers for social and scholastic development during adolescence, it is likely that peer expectancy socialization plays a role in the development of adolescents' beliefs about their academic ability. There has been some attention to discourse among peers relevant to expectancy cues (Altermatt et al., 2005; Altermatt, 2009). Such work has identified three key mechanisms for communication of expectancy cues among peers: cooperation/avoidance, help exchanges and praise/criticism (Altermatt, 2012; Hughes et al., 2009; Gest et al., 2008).

Cooperation. Being approached to cooperate with peers on an academic task is a positive expectancy cue. Students may be more inclined to work together on schoolwork with peers who they perceive as academically competent and avoid working with classmates who have reputations for being unmotivated or struggling in school (Gest et al., 2008; Schwartz, 1981; Wentzel, Filisetti & Looney, 2007). Being approached to work together on a task by another student indicates that others perceive you as capable and value your ideas. This may lead to positive patterns of supportive interactions in the classroom over time (e.g., Hughes et al., 2009). In contrast, when students are rarely approached to cooperate with peers, they may miss out on this support.

Help Exchanges. Expectancy cues are also communicated through help exchanges in the classroom. Students perceived by their peers as academically competent are more likely to be approached for help with schoolwork (Newman, 2000). When students provide help to their peers, they may be more likely to feel like a leader in the classroom and their self-perception of their own competence may increase over time (Wittrock, 1990; Gillies, 2004). Students who have a negative peer academic reputation will likely not be approached by peers for help, which may have detrimental effects on students' sense of relatedness with peers in the classroom.

Praise and Criticism. Differential praise and criticism from peers represent a third way that expectancy cues are communicated in the classroom. In a study of children's discourse in the classroom, Altermatt, Pomerantz, Ruble, Frey & Greulich (2002) found that when students' positive statements about their work (e.g., "My picture is the best!") were met with affirmation by a peer (e.g., "Yeah. Yours is good. I can't draw."), their self-perceptions of competence increased over time. It is likely that students with positive peer academic reputations will be the recipients of more praise from peers and less criticism. Similar to what has been documented in the parent and teacher expectancy literature, patterns of positive or negative feedback over time may bolster or detract from students' self-perceptions of competence and value for school.

Collectively, a positive peer academic reputation is likely to lead to increased opportunities for cooperation, fruitful help exchanges, and praise from peers. Although research has highlighted possible mechanisms through which peer academic reputations affect students' academic self-concept, empirical examination or observation of expectancy cues in the classroom are scarce and have not been linked to changes in adolescents' self-concepts over time. As noted by Altermatt (2012), more research is necessary to understand the daily "micro- interactions" that youth experience with peers in the classroom when working on academics. Developing a survey assessment to measure students' perceptions of expectancy cues from peers is a first step in addressing this gap.

Math and Science

The current study is situated in the domains of math and science. With the increasing needs of the job market, promoting student interest and retention in math and science is an issue of great concern (Maltese & Tai, 2010; National Research Council, 2010) The decision to pursue upper level math and science in high school and college is influenced by motivational beliefs and behaviors that develop in adolescence (Eccles, et al., 2006). However, adolescence is also a time when many students report decreased self-concept in math and science (e.g. Martin, Way, Bobis & Anderson, 2014; Anderman & Maehr, 1994). Research specific to the context of math and science classes is important for understanding and addressing this issue.

A subject-specific approach is also warranted because of gender stereotypes in math and science. Girls may be particularly at risk for declines in academic self-concept in math and science. Despite earning higher grades in math and science class than their male peers, girls do not tend to have higher perceptions of their ability (Leaper, 2015). It may be the case that stereotypical beliefs about girls' and boys' ability in math and science are perpetuated in the context of classroom peer interactions. Thus, situating the current investigation in math and science classrooms will provide new insights into how to best support all students in these domains.

Overview

The current study has three key aims. First, I develop a new scale to measure students' perceptions of expectancy cues from peers in their math and science classes and use exploratory factor analysis to assess whether expectancy cues form distinct factors or represent the same overall construct. The second aim of the study is to examine whether students' perceptions of expectancy cues from peers help to explain the link between peer academic reputations and changes in academic self- concept over time. Related to the second aim, I contrast peer academic reputation with two other similar measures of classroom reputations: "who do you like to work with?" and "who tries really hard?" Third, I examine gender differences in peer reputations, perceptions of expectancy cues, and academic self-concept. Figure 1 shows the conceptual framework for this study.

Method

Procedure and Participants

Participants were 124 seventh grade students at a middle school in a small midwestern city in the United States. The middle school serves approximately 600 students in grades seven and eight. The school serves predominately middle class and upper-middle class families; seven percent of students at the school qualify for free or reduced lunch. The demographic makeup of the school is 93.4% white, 2.9% Hispanic, and 1.8% other racial/ethnic background.

Standardized test scores for students in seventh-grade in math, science, and English exceeded the statewide averages. Sixty-five percent of students at the school scored at or above grade level in math, fifty percent of students scored at or above grade level in science, and seventyfive percent of students scored at or above grade level in English.

The seventh-grade students at the school were divided into three academic teams. All students in the seventh grade were initially recruited to participate in the study. However, the lead teacher on one of the three teams went on maternity leave in October, and the kids on that team transitioned to a different schedule with a long-term sub. Given these logistical issues I excluded this team from the final sample. One month prior to data collection, I visited each academic team during unstructured work time to introduce the project and distribute paper permission slips to students. Students returned the slip to their math or science teacher with a parental signature indicating whether they would participate in the project. In all, sixty- two percent of students were granted permission to participate. The final sample consisted of 124 students (age 11-13) and was 52% female.

Surveys were administered during students' math class twice during the school year. The surveys pertained to students' experiences in both math and science class, but I chose to administer the survey during math because the setup allowed students to spread out more easily and keep their answers private. Time 1 of survey administration took place in early February in the middle of the year, and Time 2 was late May at the end of the year. Surveys were administered using Qualtrics, allowing students to use their personal laptops to complete the surveys. Trained survey administrators gave instructions to the students and read the items aloud while students followed along and responded. Students were told that the purpose of the survey was to find out about students' beliefs and behaviors in math and science and that the survey was not a test and there were no right or wrong answers. In the first half of the survey, students were told to think about their experiences in math class, and the second half of the survey students were told to think about science class. Students were assured that the information in the survey would be kept confidential. As a token of appreciation students in the class were given a small gift (such as a mechanical pencil) after each survey.

Measures

Peer academic reputation. Peer nominations were used to assess peer academic reputations in math and science. Students were told to nominate peers by writing their names next to the question "Who is really smart?" This measure is similar to peer nominations used in prior research on PAR (e.g., Gest et al., 2008; Hughes et al., 2010). Students completed separate nominations for classmates in math class and in science class, and could nominate an unlimited number of peers for each item. The number of nominations that each student received from their peers was tallied, and the raw scores were standardized within each academic team by dividing raw scores by the total number of students. Because there was regular "whole-group" time where all students on the academic team gathered in one large classroom to work on math and science, I opted to make the reference group the whole academic team rather than just the specific class.

Academic behavior. Peer nominations were used to assess two other academic behaviors: "who do you like to work with?" and "who tries really hard?" These serve as a contrast to PAR and provide insight into the distinction between ability, effort, and likeability components of academic reputations.

Academic self-concept. Four items were adapted from Eccles and colleagues (1989) to assess students' self-perceptions of their ability in math and science. Sample items include: "How good at math work are you?" and, "In general, how good are you at learning something new in math?" Items were scored on a scale of 1 to 5, with 1 being *"not at all good"* and 5 being *"very good."* The measure was reliable in my sample (Cronbach's alpha = .85).

Expectancy cues. There are no established measures of peer communication of expectancy cues in the literature. Based on past research on teacher and parent expectations, as well as research on peer discourse in the classroom, I developed 20 items to assess the key mechanisms by which expectancy cues among peers are theorized to be communicated (e.g., Altermatt et al., 2002). These categories are: cooperation, avoidance, help exchanges, praise and criticism. To develop the scale, first a literature search was conducted to examine existing measures of expectancy cues from teachers and parents (e.g. Weinstein & Marshall, 1984; Eccles, Jacobs & Harold, 1998). I also referred to scales assessing students' perceptions of peer academic support to develop the expectancy cues scale (e.g. Classroom Life Inventory, Johnson 1985; see also Patrick, Ryan & Kaplan, 2007).

The preliminary list of items developed for the expectancy cues scale assess students' experiences with peers in math and science class and ask about how often students perceive that their classmates wanted to work with them (cooperation), didn't want to work with them (avoidance), said positive things about their work (praise), said negative things about their work (criticism), or approached them for help with academic work (help). The initial list of 20 items on the expectancy cues scale were first reviewed by a panel of experts in the fields of motivation and classroom peer relations. Following multiple rounds of review with experts, I then had two middle school students who were not participating in the study respond to the items and provide feedback on whether there were some questions that were hard to understand or answer. Based on feedback from the expert panel and from the middle school students, the decision was made to drop the four avoidance items since avoidance is not an overt behavior and is difficult for students to pick up on in the classroom setting. The final 16 items corresponding to cooperation, praise, criticism and help were then piloted on a survey with a separate sample of 130 seventh and eighth grade math students at a different middle school. Students responded on a scale of 1 to 5 for how often (1 = never, 3 = sometimes, 5 = often) they experienced the following with their peers in math and science class

Cooperation. Four items were used to assess cooperation, which refers to the perception that students want to work with them in class. Sample items for cooperation include: *Other students*… "Wanted to hear my thoughts about our math/science work" and "listened to what I had to say about our math/science work."

Help exchanges. Four items assessed help exchanges. These items pertain to whether a student gets asked for help by their peers, as well as the type of help that they are asked for (i.e., adaptive vs. expedient help). Sample items for help exchanges include: *Other students…* "Asked me for the answer on our work" and "Asked me to explain how to solve a problem."

Praise. Four items assessed praise, which refers to positive feedback from other students about one's ideas or abilities. Items assessing praise include: *Other students…* "noticed when I did something well on our math/science work" and "said positive things to me about my work in math/science."

Criticism. Criticism refers to negative comments from peers, and was assessed with four items. Sample items are: *Other students…*" laughed when I made a mistake in class" and "made fun of my ideas."

Analysis Plan

First, I used exploratory factor analysis to examine the nature of peer communication of expectancy cues in the classroom and whether students perceive distinct types of expectancy cues. Reliability was established in my sample for the factors that emerged in the exploratory factor analysis. Next, the expectancy cues factors were correlated with students' peer academic reputations and academic self-concept. Fisher r-to-z transformations for independent correlations were applied to examine gender differences. In the second portion of the analysis, I used Structural Equation Modeling to examine the association of three types of peer reputations with academic self-concept, and the mediating role of the expectancy cues factors. A multigroup model was used to examine differences between boys and girls the association between PARs, expectancy cues, and self-concept.

Results

Exploratory Factor Analysis

Principal Axis Factoring with Oblimin Rotation was conducted for the final list of 15 expectancy cues items was conducted with the whole sample ($N = 124$) in math, and then again in science. Factors whose eigenvalues exceeded 1 were extracted. In both subjects, the analysis yielded three factors that accounted for 60% and 67% of the total variance in math and science, respectively (see Tables 2.1 and 2.2).

Three factors emerged from the exploratory factor analyses. These are conceptualized as Praise, Criticism and Help. The Praise expectancy cues factor was comprised of 7 items about receiving praise from classmates and feeling that classmates listen to their ideas and respect their opinions (e.g., "my classmates liked my ideas about our math work"; "my classmates listened to what I had to say about our math work"). The initial list of cooperation items included 8 items but one of them was removed ("my classmates wanted to work with me on math…") due to a weaker factor loading on the primary factor and loading above .3 on another factor. Criticism expectancy cues included 4 items that assess how frequently students receive criticism from peers about one's academic ability or performance (e.g., "my classmates said negative things about my work"; "my classmates laughed when I made a mistake"). Help exchanges consisted of 4 items about how often students are asked by classmates for help with an academic task. These items assessed both adaptive help (e.g., "other students asked me to show them how to solve a problem) and expedient help seeking from peers (e.g., "other students asked me for the answer"). All factor loadings on the scale were greater than .45 on their primary factor in both math and science, and no items loaded on another factor at greater than .20.

Reliability. Reliability of each of the three expectancy cues scales was assessed separately in math and science. In both subjects, the scales demonstrated good internal consistency. Cronbach's alphas were between .80 and .89 for each scale in math and science, with one exception: In math class, the alpha for the criticism expectancy cues factor was somewhat lower at .65, but this level still demonstrates acceptable internal consistency (Cicchetti, 1998), and given the high reliability of the same scale in science class, this lower alpha coefficient was not a major concern. Results from the exploratory factor analysis are presented along with the reliability coefficients in Tables 2.1 and 2.2.

Descriptive statistics. Next, means and standard deviations were calculated for the three factors. These statistics are reported in Table 2.3 and are described below. Mean levels showed that praise expectancy cues were the most frequently reported of the three types of cues by students in math as well as science (M math = 3.77, M science = 3.94). Help exchanges were reported somewhat less often (M math = 3.19, M science = 3.23) and negative expectancy cues were reported least often (M math = 1.42, M science = 1.56).

Gender differences. T-tests were used to examine gender differences in mean levels of expectancy cues. Gender differences emerged in students' perceptions of criticism and help exchanges, but not praise. Boys tended to report more criticism from peers than girls in both subjects, but the gender difference was significant only in science (M boys = 1.77, M girls = 1.42; t = -2.41, p = .018). Girls reported more help expectancy cues than boys in math (M boys = 2.99, M girls = 3.37; t= 2.22, p < .001), but there was not a significant difference in help exchanges in science.

Correlations. To examine the nature of students' perceptions of expectancy cues in the classroom, correlations were calculated among the three expectancy cues factors, academic self-concept, PAR, and peer nominations of academic behavior. To examine gender differences in associations, correlations were calculated separately for boys and girls. Correlations for the whole sample, as well as correlations broken down by gender, can be found in Table 2.4. First, I describe overall patterns followed by gender differences in the associations of expectancy cues, academic self-concept, and PARs.

Associations among expectancy cues. As expected, there was a negative association between students' perceptions of praise expectancy cues and criticism expectancy cues (r math =-.19, p < .05; r science = -.27, p < .01). Praise expectancy cues and help exchanges were significantly positively related in both math and science (r math = .45, p < .01; r science = .62, p < .01). There was no association between help exchanges and criticism in either math or science

($r$math = .02 p = >.05; r science = .05, p >.05). The magnitude and direction of associations among the three expectancy cues factors was similar for boys and girls.

Association of expectancy cues with academic self-concept. I next examined correlations among the three expectancy cues factors and students' academic self-concept in math and science (Table 4). I anticipated that praise expectancy cues and help expectancy cues would be positively related to students' academic self-concept, while criticism expectancy cues would be negatively related to self-concept. Results partially supported this hypothesis. Praise expectancy cues were positively related to academic self-concept in math and science ($r$math = .19 $p < .05$; $r$science = .42, $p < .01$). In other words, when students receive compliments or praise from peers regarding their academic ability, they tend to have higher academic self-concept at the end of the school year. Similarly, help expectancy cues were positively related to students' academic self-concept in both subjects ($r$math = .36, $p < .01$; $r$science= .52, $p < .01$). That is, when students are frequently sought out for academic help by their classmates, this has a positive effect on their own self-perception of their academic ability.

Association of expectancy cues with PAR. Next, correlations between expectancy cues, PAR, and peer nominated academic behavior, were examined. In line with prior theory and research, it was expected that PAR (being known as "smart") would be positively related to positive expectancy cues and help, and negatively related to negative expectancy cues. Correlations generally supported my hypothesis about associations of PAR with positive expectancy cues and help, but my hypothesis was not supported about criticism.

Specifically, I found that having a reputation for being "smart" was positively related to positive expectancy cues from peers in both subjects ($r$math = .31, $p < .01$; $r$science = .24, $p < .05$). Thus, when students have a higher PAR, they are more likely to receive recognition or praise from peers about their academic ability. Furthermore, correlations showed that students who are known as "smart" were more likely to be approached for help by their peers ($r$math = .30, $p < .01$; $r$science

$= .33$, $p < .01$.) Interestingly, contrary to our expectations, perceived criticism from peers was not associated with PAR in either math or science. Thus, being the recipient of negative comments was unrelated to being known as "smart" among peers.

Association of expectancy cues with peer nominated academic behavior. As a contrast to PAR, I also assessed peer nominations for "who do you want to work with?" and "who tries really hard?" in relation to expectancy cues and academic self-concept. I did not make a specific hypothesis regarding the two measures of academic behavior as these constructs have not been used widely in the literature and our investigation was exploratory in nature.

Trying hard. Having a reputation for "trying hard" was positively related to students' perceptions of positive expectancy cues from peers in both math and science ($r_{math} = .26$, $p < .01$; $r_{science} = .23$, $p < .05$). Furthermore, being known as someone who tries hard was positively related to being sought out for help in math ($r_{math} = .26$, $p < .01$) but not science ($r_{science} = .15$, $p > .05$). As with PAR, there was no association of "trying hard" with criticism expectancy cues from peers.

Like to work with. For peer nominations of "like to work with", a slightly different pattern emerged compared to PAR and "trying hard". Being a student who others like to work with was positively related to perceptions of praise from peers in science ($r = .24$, $p < .01$) but not in math. Also, in science but not in math, being someone who others "like to work with" was positively related to help expectancy cues ($r = .19$, $p < .05$) and negatively related to criticism expectancy cues ($r = -.21$, $p < .05$).

Gender Differences. Correlations among study variables were calculated separately for boys and girls, and Fisher r- to-z transformations were used to examine whether there were gender differences in the associations among expectancy cues and academic self-concept for boys and girls. The associations among praise, criticism, and help expectancy cues were similar in direction for boys and girls in both math and science. Some gender differences emerged in the magnitude of the association of expectancy cues with academic self-concept. In math, the association of help expectancy cues with academic self-concept was stronger for boys than girls (r_{boys} = .61; r_{girls} = .33; z= 1.98; p <.05). In other words, being sought for help is positively related to students' beliefs of their own competence, but this is especially true for boys. In science, the relationship between praise and academic self-concept was stronger for boys than girls (r *boys*= .57; r *girls*=.27; z =2.01, p <.05). When boys perceive that their classmates recognize their ability or praise their work, this feedback may be especially salient for boys' self-perceptions of their ability. The association of criticism with academic self-concept was not statistically significant for boys or girls with one exception: in science criticism was marginally negatively associated with academic self-concept for boys (r = .24, p = .07).

Comparing PAR with Peer Nominated Academic Behavior. The next aim of my analysis was to compare PAR with two other ways of assessing students' peer reputations for academic behavior in the classroom. PAR was assessed using peer nominations of "who is really smart?" This was contrasted with two other measures: "who tries really hard?" and "who do you most like to work with?" Descriptive statistics and correlations were calculated for the three measures. Gender differences in mean levels were assessed using independent samples t-tests. Correlations were calculated separately for boys and girls (see table 2.4), and gender differences were evaluated using Fisher r-to-z transformations. When gender differences emerged, I describe the trends for boys and girls separately, and when there was no gender difference I report overall trends.

Mean levels of PAR and the two academic behavior reputations were similar in math and science, and for boys and girls. Although girls had somewhat higher average levels of PAR, reputation for trying hard, and reputation for like to work with, gender differences in mean levels were not significant.

The three measures were moderately positively correlated with one another (correlation range overall $r = .37\text{-}.48$). In math class, PAR was positively related to being known as "trying hard" and being a student who others "like to work with." When broken down by gender, trends for boys and girls were in a similar direction but differed somewhat in magnitude.

For PAR, being known as "really smart" among peers was positively associated with students' academic self-concept in both math and science (r math = .36, $p < .01$; r science = .23, $p < .05$). For the other indicators of academic behavior, being known as someone who "tries hard" was not related to students' academic self-concept during the school year. Interestingly, being a student who others "like to work with" was negatively related to girls' academic self-concept in science ($r = -.37$, $p < .001$), but not boys' in science ($r = .02$, p = n.s).

Structural Equation Model

Mplus 6.11 (Muthén & Muthén, 2007) was used to evaluate the mediating role of praise, criticism and help expectancy cues in the association between peer academic reputation and academic self-concept. Multigroup SEM analyses examined whether the strength of associations differed between boys and girls by using the chi squared difference test. Maximum-likelihood estimation was used to generate all model estimates and full-information maximum likelihood covariance estimators were applied to account for missing data.

There were two steps to my analysis. In step 1, a baseline model was estimated which included the three peer nomination measures for PAR, tries hard, and like to work with as predictors of academic self-concept in math and science. In step 2, three expectancy cues (praise, criticism, and help) were added to the model. The baseline model was estimated separately for boys and girls. To determine if the paths differed for boys and girls, the model was specified as a two- group model initially forcing each path between peer reputation, expectancy cues, and academic self-concept to be equal between boys and girls. For each coefficient at a time, a model was run without the equality constraint. The chi squared-difference test with df = 2 was used to determine if the magnitude of association/path differed. The final model left all those coefficients constrained to be equal across grades that did not significantly improve the fit when allowed to differ. Coefficients from the final model are presented in Table 2.3 and are discussed below.

Association of PAR and academic behavior with self-concept.

The first portion of the SEM analyses concerned associations of PAR, tries hard, and like to work with (measured at Time 2) with academic self-concept (at Time 3). All three peer reputation measures were entered into the model simultaneously. I expected that being known as “smart” (PAR) would be positively related to academic self-concept across the school year. I made no specific hypothesis regarding being a student who “tries hard” and who others “like to work with”; these were examined as exploratory variables to distinguish between different dimensions of academic reputation.

Results supported my hypothesis regarding PAR. Being known as someone who is “smart” in math and science in the middle of the year was positively related to academic self-concept at the end of the year. With the two other peer nomination measures, findings were mixed. Being known as a student who “tries hard,” interestingly, was not related to academic self-concept. This pattern was similar for boys and girls. Thus, putting forth a lot of effort in class is not necessarily associated with a higher self-perception of ability. Furthermore, being someone who others like to work with is negatively related to self-concept at the end of the year in science, for both boys and girls alike (*B* boys = -.25; *B* girls = -.36). This pattern did not emerge in math class; being someone who others like to work with was unrelated to academic self-concept for both boys and girls in math (*B* boys = -.10; *B* girls= -.16).

Examining expectancy cues as mediator.

Next, the mediating role of expectancy cues was examined by entering the three factors (Praise, Criticism, and Help) into the structural equation model along with PAR and peer nominated academic behavior. To test for mediation, I first assess whether the different types of expectancy cues predict academic self-concept. Then, I compare the β coefficient for PAR in the baseline model with the β for PAR in the final model. If the slope decreases significantly for PAR from the baseline model to final model, this suggests mediation.

After adding the three types of expectancy cues in the final model, help expectancy cues showed the most robust associations with academic self-concept for both boys and girls in math and science. In contrast, the associations of praise and criticism with academic self-concept were mixed and the patterns varied somewhat by gender. I tested for mediation by examining the β for PAR in the initial model and comparing it to the β for the final model. I found the strongest support for help mediating the association of PAR and academic self-concept. That is, being sought for help by peers accounted for a significant portion of the variance in the association of being "smart" with academic self- concept. Regarding gender, Chi squared difference tests revealed that the association of help and academic self- concept was stronger for boys than girls. Figure 4 illustrates this interaction. While there was some support for the mediating role of praise expectancy cues as well, the associations varied by subject and gender. I did not find evidence of the mediating role of criticism in either subject.

Discussion

Academic self-concept is an important factor in students' learning and achievement in the short-run and to their choices and achievement in STEM courses and careers over time (Maltese & Tai, 2010; Simpkins et al., 2006). Academic self-concept is dynamic and sensitive to the social context (Wigfield et al., 2015). Peers are a salient part of the social context in classrooms, and socialize each other's self-beliefs through different patterns of feedback and interactions in the classroom. One aspect of classroom peer relations concerns peer academic reputations, or PAR. Past research has shown that PAR is related to change in students' self-perceptions of ability, but the current study advances our understanding of the mechanism through which peers affect students' academic self-concept in math and science.

In the current study, I developed and validated a survey assessment to measure peer communication of praise, criticism and help expectancy cues. I assessed the relationship between expectancy cues from peers, peer academic reputation, and academic self-concept concurrently and over time using structural equation modeling. Furthermore, I contrasted peer academic reputation with two other types of classroom reputations- "like to work with" and "tries hard". Taken together, the current research advances our understanding of how and why peers matter for students' adjustment at school.

The first aim of the study was to develop a survey assessment to measure how students perceive their peers communicating expectancy cues in the classroom. Results from exploratory factor analysis of the expectancy cues items revealed that students perceive distinct types of expectancy cues from their peers in the classroom, and these expectancy cues are differentially related to students' academic self-concept and peer reputations.

When students have a reputation for competence, peers are more likely to recognize them for doing well, ask for and receive help from them, and respond to them with praise rather than criticism. Taken together, these interactions and experiences serve to bolster students' self-concept over time (Altermatt, 2012; Newman, 2000; Wentzel et al., 2007). In line with this conceptualization, I found that PAR was positively associated with praise and help, and negatively associated with criticism.

Another key contribution of the current study was the comparison of PAR with two other peer nominated academic behaviors. PAR was assessed using peer nominations of "who is really smart?" which is like measures used in past research (e.g. Gest et al., 2008; North & Ryan, 2018; Hughes et al., 2010). The two academic behaviors were assessed using peer nominations of "who do you most like to work with?" and "who tries really hard?"

Results showed that there was modest overlap between PAR and the academic behavior measures (correlations around ~.45), indicating that these measures represent distinct components. Furthermore, there were differences in how PAR was related to expectancy cues and academic self-concept compared to "tries hard" and "like to work with". Being 'smart' (e.g., having a high PAR) was most strongly and consistently associated with perceptions of expectancy cues and students' academic self-concept. In contrast, being a student who others "like to work with," and being seen as "trying hard," showed mixed associations with students' PARs and self-concept. Furthermore, the strongest evidence of the mediating role of expectancy cues was found for PAR, but not for "tries hard" or "like to work with".

By distinguishing between PAR and other classroom behavioral reputations, the current work provides new insight into the multidimensionality of students' reputations in the classroom. In prior research the most common way of assessing peer academic reputation was through asking students to nominate classmates who "get good grades" or are "really smart." However, it is likely that students view both ability and effort as important for success in school. Taking a nuanced approach and teasing out these different components of classroom peer reputations contributes important information regarding how PAR operates for boys and girls.

Somewhat different patterns were found for "being smart" (ability) and "trying hard" (effort) for boys and girls, which may be indicative of differences in how girls and boys approach achievement situations (Leaper, 2015). 'Trying hard' had positive implications for girls' academic self-concept, while for boys, this behavioral reputation tended not to relate to academic self-concept. Further, the association between expectancy cues and academic self-concept was stronger for boys than for girls. Despite reporting a lower frequency of expectancy cues overall, it seems that such occurrences are especially salient for boys' beliefs about their ability.

The current study is situated in the domains of math and science. Results show that peer expectancy socialization plays out somewhat differently for boys and girls against a backdrop of peers' widely acknowledging girls as the high achievers in math and science. It may be the case that recognizing girls as the high achievers does not mean that young adolescents do not hold stereotypical views about girls' math and science ability (Leaper, 2015; Steele, 2010).

My findings seem to suggest that boys and girls may interpret the meaning of their academic reputations differently. For girls, both being known as "smart" and "trying hard" had similar implications for academic self-concept, but among boys, "smart" was the strongest predictor of academic self-concept. These findings can be contextualized by prior research on gender differences in classroom social interactions.

First, boys may be more likely to engage in competition among peers in the classroom and thus be less likely to approach one another for help, or to outwardly show effort and engagement. Specifically, Rodkin & colleagues (2000) found that competitiveness was related to high status among peers in the classroom. Thus, boys may be more likely to downplay their effort and engagement, and focus on bolstering their own performance rather than supporting their peers through positive comments or helping interactions. Second, girls tend to be more concerned with pleasing others, which may translate to greater cooperation and willingness to give help to one's peers. Girls may downplay their own ability to facilitate more positive peer relationships in the classroom. They may not be as concerned about possible social costs of appearing to "try hard" in the classroom, since on-task and effort behavioral is more common and more likely to be accepted among girls than boys. Third, girls are more sensitive to feedback than boys. Girls tend to view feedback as diagnostic of their ability whereas boys tend to adopt a confident approach and deny the informational value of feedback. Both girls' wanting to please others and their attunement to feedback may increase their positive interactions with peers, as well as their effort and achievement, but at the same time girls may not reap the same confidence benefits as boys do from such interactions (Pomerantz et al., 2002).

Examining how PAR relates to expectancy cues and academic self-concept, and comparing these patterns to other reputations for academic behavior, is a first step in understanding the nuance behind the effect of PAR. Along these lines, future work investigating which peers have a reputation for “who enjoys the work I do in math/science” might tap into a different facet of classroom reputations which matter for student development of value or interest. Just as motivation and engagement are multi-dimensional (Wigfield et al., 2016), it is possible that PAR encompasses both expectancy and value components. However, it could also be the case that students may not be attuned to their peers’ academic enjoyment and interest with as much nuance as their own beliefs and behaviors. Future work addressing this issue could be informative about the nature and consequences of PAR for academic self-concept.

References

Altermatt, E. R. (2012). Children's achievement-related discourse with peers: Uncovering the processes of peer influence. In A. M. Ryan and G. W. Ladd (Eds.), Peer relationships and adjustment at school (pp. 109-134). Charlotte: Information Age Press.

Altermatt, E. R., & Brody, E. F. (2009). Coping with achievement-related failure: An examination of conversations between friends. Merrill-Palmer Quarterly, 55(4), 454–487.

Altermatt, E. R., & Kenney-Benson, G. A. (2006). Friends' influence on school adjustment: A review of three perspectives. In A. V. Mitel (Ed.), *Trends in educational psychology* (pp. 137–153). New York: Nova Science Publishers.

Altermatt, E. R., & Pomerantz, E. M. (2005). The implications of having high-achieving versus low-achieving friends: A longitudinal analysis. *Social Development, 14,* 61-81.

Altermatt, E. R., Pomerantz, E. M., Ruble, D. N., Frey, K. S., & Greulich, F. K. (2002). Predicting changes in children's self-perceptions of academic competence: A naturalistic examination of evaluative discourse among classmates. *Developmental Psychology, 38,* 903-917.

Anderman, E. M., & Maehr, M. L. (1994). Motivation and schooling in the middle grades. *Review of educational Research*, *64*(2), 287-309.

Eccles (Parsons), J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75-146). San Francisco, CA: Freeman.

Eccles, J.S., Jacobs, J.E., & Harold, R.D. (1990). Gender role stereotypes, expectancy effects, and parents' socialization of gender differences. Journal of Social Issues, 46, 183-201.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual review of psychology*, *53*(1), 109-132.

Frome, P. M., & Eccles, J. S. (1998). Parents' influence on children's achievement-related perceptions. *Journal of Personality and Social Psychology, 74*(2), 435-452.

Gest, S. D., Domitrovich, C. E., & Welsh, J. A. (2005). Peer academic reputation in elementary school: Associations with changes in self-concept and academic skills. *Journal of Educational Psychology*, *97*(3), 337-346.

Gest, S. D., Rulison, K. L., Davidson, A. J., & Welsh, J. A. (2008). A reputation for success (or failure): The association of peer academic reputations with academic self-concept, effort, and performance across the upper elementary grades. *Developmental Psychology*, *44*(3), 625-636.

Gillies, R. M. (2004). The effects of cooperative learning on junior high school students during small group learning. *Learning and Instruction 14* (2) 197-213.

Harter, S., Stocker, C., & Robinson, N.S. (1999). The perceived directionality of the link between approval and self-worth: The liabilities of a looking glass self-orientation among young adolescents. *Journal of Research on Adolescence, 6*(3), 285-308.

Hughes, J. N., Dyer, N., Luo, W., & Kwok, O. (2009). Effects of peer academic reputation on achievement in academically at-risk elementary students. *Journal of Applied Developmental Psychology*, *30*(2), 182-194.

Kuklinski, M. R., & Weinstein, R. S. (2001). Classroom and developmental differences in a path model of teacher expectancy effects. *Child development*, *72*(5), 1554-1578.

Leaper, C. (2015). Gender and social‐cognitive development. In R. M. Lerner, L. S. Liben, & U. Mueller (Eds.), *Handbook of child psychology and developmental science* (7th ed.) (Vol. 2, pp. 806-853). Hoboken, NJ: John Wiley & Sons, Inc.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, *32*, 669-685.

Marsh, H. W., & O ‘Mara, A. J. (2008). Reciprocal effects between academic self-concept, self- esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality and Social Psychology Bulletin*, *34*, 542-552.

Marsh, H. W., & Martin, A. J. (2011). Academic self-concept and academic achievement: Relations and causal ordering. *British Journal of Educational Psychology, 81,* 59-77.

Martin, A. J., Way, J., Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle years of school. *The Journal of Early Adolescence, 35*(2), 199-244.

McKown, C., & Weinstein, R. S. (2008). Teacher expectations, classroom context, and the achievement gap. Journal of School Psychology, 46(3), 235–261

National Research Council. (2010). Rising above the Gathering Storm Revisited: Rapidly Approaching Category 5. Washington, DC: National Academies Press.

Newman, R. S. (2000). Social influences on the development of children's adaptive help seeking: The role of parents, teachers, and peers. *Developmental Review, 20*, 350-404.

North, E. A., & Ryan, A. M. (2018). The Association of Peer Academic Reputations in Math and Science with Achievement Beliefs and Behaviors During Early Adolescence. Journal of Early Adolescence, 38(6), 772–794.

Pomerantz, E. M., Altermatt, E. R, Saxon, J. L. (2002). Making the grade but feeling distressed: Gender differences in academic performance and internal distress. *Journal of Educational Psychology, 94*, 396-404.

Pomerantz, E. M., Grolnick, W. S., & Price, C. E. (2005). The role of parents in how children approach achievement. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 259-278). New York: Guilford.

Robnett, R. D. & Leaper, C. (2012). Friendship groups, personal motivation and gender in relation to high school students' STEM career interest. *Journal of Research on Adolescence, 23*(4), 652-664.

Rodkin, P.C., Farmer, T.W., Pearl, R., & Van Acker, R. (2000). Heterogeneity of popular boys: Antisocial and prosocial configurations. Developmental Psychology, 36, 14-24.

Ryan, A. M., & Ladd, G. W. (Eds.). (2012). Peer relationships and adjustment at school. Charlotte, NC: Information Age Press.

Schwartz, F. (1981). Supporting or subverting learning: Peer group patterns in four tracked schools. *Anthropology and Education Quarterly*, *12*, 99-121.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, *42*(1), 70-83.

Steele, C. M. (2010). *Whistling Vivaldi: How stereotypes affect us and what we can do.* New York, NY: Norton & Co.

Wentzel, K. R., Filisetti, L., & Looney, L. (2007). Adolescent prosocial behavior: The role of self-processes and contextual cues. *Child Development, 78,* 895-910.

Wentzel, K.R., & Muenks, K. (2016). Peer influence on students' motivation, academic achievement, and social behavior. In K.R. Wentzel & G.B. Ramani (Eds.), *Handbook of social influences in school contexts: Social-emotional, motivation, and cognitive outcomes* (pp. 13-30). Charlotte, NC: Information Age Press.

Wigfield, A., Eccles, J. S., Fredricks, J., Simpkins, S. D., Roeser, R., & Schiefele, U. (2015). Development of achievement motivation and engagement. In R. Lerner, M. Lamb, & C. Garcia Coll (Eds.), *Handbook of child psychology (7th ed., vol. 3).* New York: Wiley.

Table 2.1

Summary of Exploratory Factor Analysis Results for Expectancy Cues Measure in MATH Using Maximum Likelihood Estimation (N = 124) and Oblimin Rotation

	Factor Loadings			
<u>Items</u> My classmates…	Factor 1 (Praise)	Factor 2 (Criticism)	Factor 3 (Help)	
…noticed when I did something well in math.	0.85			
….said positive things to me about my work in math.	0.75			
… were interested in my ideas about our math work.	0.72			
…liked my ideas about our math work.	0.69			
…listened to what I had to say about our math work.	0.57	α = .85		
…respected my opinion.	0.49			
… wanted to hear my thoughts about our math work.	0.48			
…made fun of my ideas.		0.68		
…said negative things to me about my work in math.		0.66		
…doubted my ability to do our math work.		0.46	α = .63	
…laughed when I made a mistake on our math work.		0.43		
…asked me for help with math.			-0.76	
…asked me to explain how to do our math work.			-0.75	
…asked me to show them how to solve a problem.			-0.62	α = .80
…asked me for the answer on our math work.			-0.57	
Eigenvalues	5.05	2.24	1.54	
% of variance explained	33.68	14.93	10.28	

Table 2.2

Summary of Exploratory Factor Analysis Results for Expectancy Cues Measure in Science Using Maximum Likelihood Estimation (N = 124) and Oblimin Rotation

	Factor Loadings			
Items My classmates…	Factor 1 (Praise)	Factor 2 (Criticism)	Factor 3 (Help)	
… Respected my opinion.	0.79			
…wanted to hear my thoughts about our science work.	0.75			
…were interested in my ideas about our science work.	0.68			
…liked my ideas about our science work.	0.66	α = .90		
…noticed when I did something well	0.65			
…said positive things to me about my work in science.	0.65			
…listened to what I had to say about our science work.	0.59			
…laughed when I made a mistake on our science work.		0.86		
…said negative things to me about my work in science.		0.77		
…doubted my ability to do our science work.		0.75	α = .84	
…made fun of my ideas.		0.66		
…asked me to show them how to solve a problem.			-0.80	
…asked me for help with science.			-0.79	α = .87
…asked me to explain how to do our science work.			-0.79	
…asked me for the answer on our science work.			-0.76	
Eigenvalues	6.13	3.04	1.11	
% of variance	40.8	20.24	7.42	

Table 2.3
Means, standard deviations for study variables in math and science overall and broken down by gender

Measure	**Math**	*M*(SD)		**Science**	*M*(SD)	
	Girls	Boys	Overall	Girls	Boys	Overall
1.Academic Self Concept	3.98(.69)	4.03(.68)	4.00(.69)	3.91(.64)	3.89(.64)	3.91(.68)
2. "Who do you like to work with?"	.03(.02)	.02(.01)	.02(.02)	.02(.02)	.01(.01)	.01(.02)
3. PAR ("who is really smart?")	.03(.03)	.02(.02)	.02(.03)	.02(.02)	.01(.01)	.02(.02)
4. "Who tries really hard?"	.02(.01)	.01(.01)	.01(.01)	.02(.02)	.01(.01)	.01(.02)
6. Praise Expectancy Cues	3.79(.77)	3.76(.75)	3.77(.76)	4.04(.70)	3.84(.97)	3.94(.81)
7. Help Expectancy Cues	3.37(.97)	2.99(.86)	3.19(.93)	3.38(.99)	3.07(1.07)	3.23(1.04)
8. Criticism Expectancy Cues	1.34(43)	1.51(.58)	1.42(.51)	1.42(.69)	1.77(.90)	1.56(.81)

Table 2.4
Correlations, means and standard deviations for study variables in math and science.

Peer Nominations	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1.Math “Like to work with”													
2. Math PAR (“really smart”)	.47**												
3. Math “Tries really hard”	.41**	.44**											
4. Sci “Like to work with”	.76**	.40**	.37**										
5. Sci PAR (“really smart”)	.39**	.73**	.39**	.48**									
6. Sci “Tries really hard”	.40**	.28**	.41**	.43**	.37**								
Student Self-Reports													
7. Math Self Concept	.05	.36**	.18	-.01	.17	-.03							
8. Math Praise	.18	.31**	.26**	.31**	.31**	.16	.19						
9. Math Criticism	-.08	-.14	-.17	-.11	-.14	-.23*	-.14	-.19*					
10. Math Help	.12	.30**	.26**	.12	.15	-.04	.44*	.45**	.02				
11. Sci Self Concept	-.07	.20*	.11	-.11	.23*	.12	.45*	.19	-.18	.21*	.		
12. Sci Praise	.13	.17	.23*	.24**	.24**	.23*	.18	.68**	-.23*	.26**	.42**		
13. Sci Criticism	-.13	-.13	-.24**	-.21*	-.16	-.18	-.17	-.18	.54**	.04	-.16	-.27**	
14. Sci Help	.17	.23*	.25*	.19*	.33**	.14	.18	.45**	.05	.50**	.52**	.62**	.05

Table 2.5.

Correlations among study variables broken down by gender

Measure	1.	2.	3.	4.	5.	6.
Math						
1. Academic Self Concept						
2. "Like to work with"	.06(.09)					
3. PAR ("Really smart")	.49**(.25)	.31*(.67*)				
4. "Tries really hard"	.36**(.04)	.36**(.27*)	.37**(.49**)			
5. Praise EC	.17(.22)	.18(.20)	.39**(.20)	.39**(.10)		
6. Help EC	.33*(.61**)	.14(-.06)	.38**(.13)	.40**(-.13)	.53**(.36**)	
7. Criticism EC	-.19(-.13)	-.06(.02)	-.21(-.01)	-.21(-.04)	-.23*(-.15)	-.04(.15)
	7.	8.	9.	10.	11.	12.
Science						
7. Academic Self-Concept	--					
8. "Like to work with"	-.21(.03)					
9. PAR ("Really smart")	.28*(.18)	.37**(.59**)				
10. "Tries really hard"	.01(.30*)	.49**(.16)	.37**(.26)			
11. Praise EC	.27*(.57**)	.06(.41**)	.12(.36**)	.25*(.16)		
12. Help EC	.51**(.54**)	.10(.22)	.37**(.23)	.15(.04)	.60**(.63**)	
13. Criticism EC	-.07(-.24)	.03(-.37**)	-.03(-.24*)	-.02(-.29**)	. -26**(-.24)	.06(.12)

Note. Values for girls (N = 67) are displayed first, followed by boys (N= 57) in parentheses

*p <.05 **p < .01 ***p <.001

Table 2.6.

Standardized estimates from structural equation models with peer academic reputations and expectancy cues predicting academic self-concept among boys and girls in math and science.

	Math		Science	
Boys N = 57 Girls N = 67	Boys	Girls	Boys	Girls
<u>Model 1 Paths</u>	β	β	β	β
PAR ("Really smart)" → self-concept	.34***	.46***	.28***	.40***
"Like to work with" → self-concept	-.10	-.16	-.25**	-.36***
<u>Model 2 Paths</u>				
PAR ("really smart") → praise	.21*	.25*	.07	.12
PAR ("really smart") → help	.26**	.28**	.20	.29*
Praise → self-concept	-.04	-.05	**.34***	**-.06**
Help → self-concept	**.58*****	**.21**+	.43**	.47**
PAR ("really smart")→ self-concept	.24**	.33**	.16*	.22*
"Like to work with"→ self-concept	-.05	-.09	-.27***	-.38***

Note. Estimates are for multigroup structural equation models (labeled step 1 and step 2). In step 1, PAR along with "like to work with" and "tries really hard" were entered as predictors of academic self-concept for boys and girls. In step 2, praise, criticism, and help were added to the model as additional predictors of academic self-concept. Paths that were significantly different between boys and girls (based on X^2 difference tests) are displayed in bold. Pathways that were not significant for boys and girls in either subject are not displayed.

**p* < .05, ***p* <.01 ****p* < .001; +denotes marginally significant value p = .07

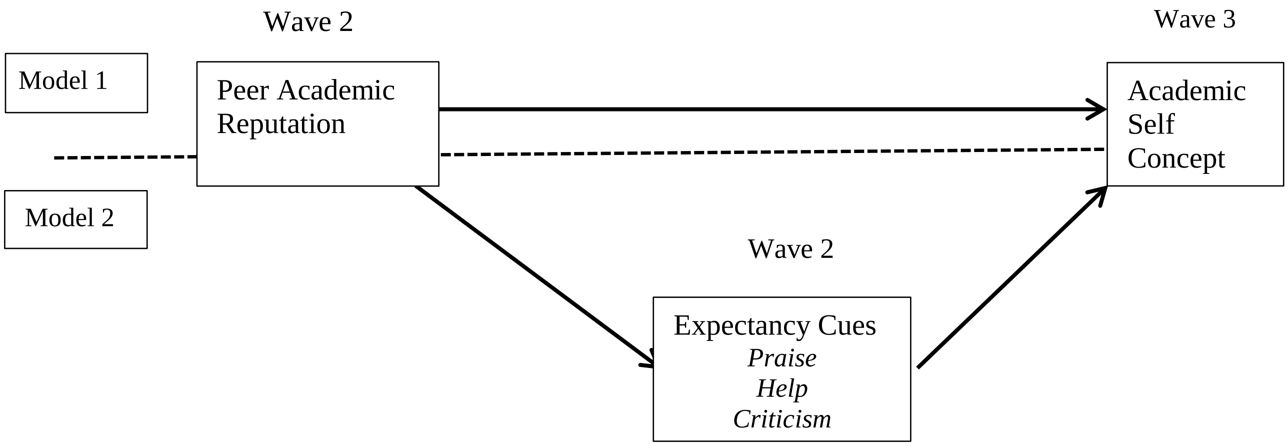

Figure 1. Conceptual model for testing the mediating role of peer expectancy cues in the association of PAR with academic self-concept among adolescents (N = 124) in math and science. PAR, along with “like to work with” and “tries really hard” reputations, were entered simultaneously into the initial model. Help, praise, and criticism expectancy cues were added in model 2 as predictors of academic self-concept.

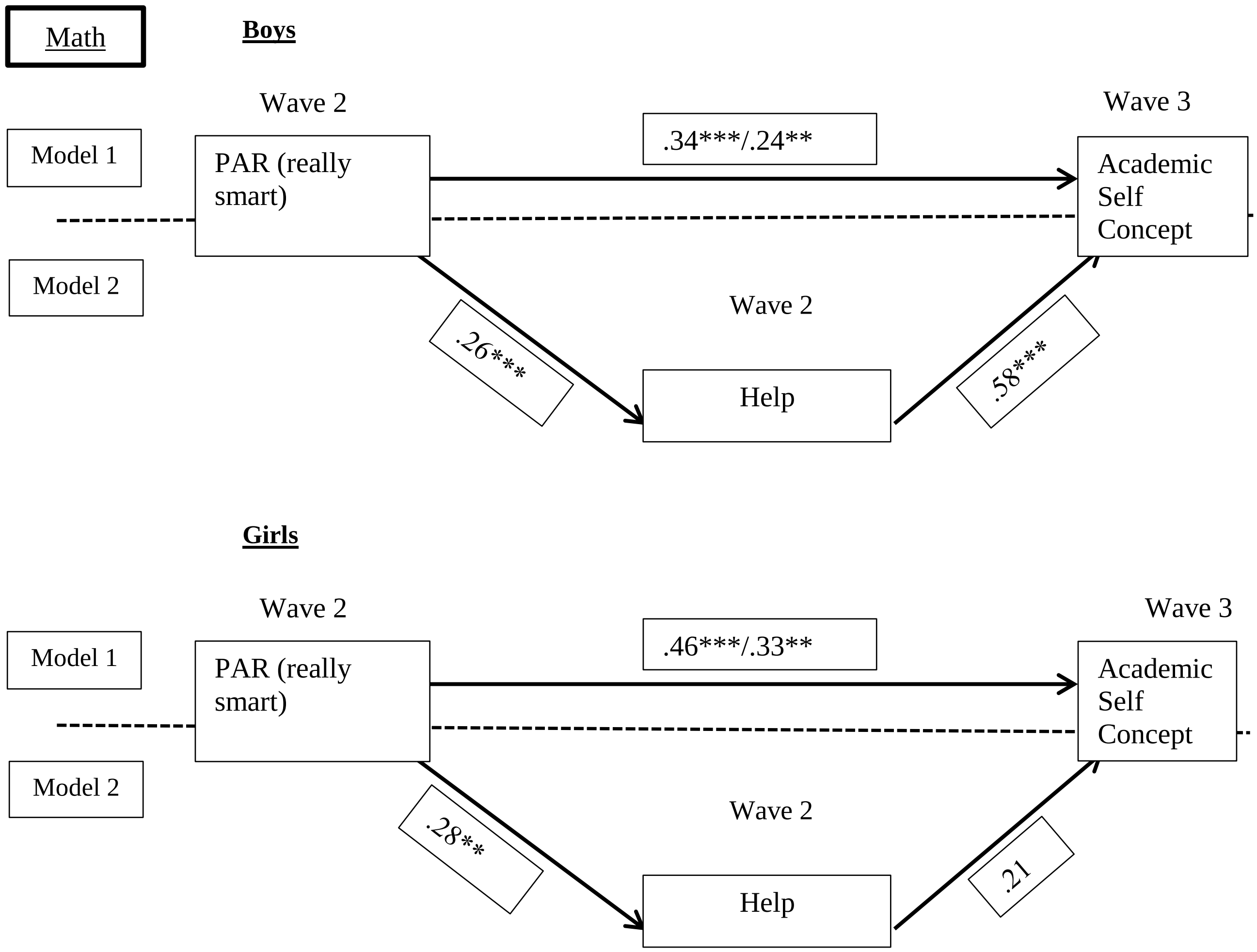

Figure 2. Standardized coefficients are shown for structural equation model with PAR predicting ASC and mediated by Help, separated by boys (above) and girls (below). Help expectancy cues partially mediate the association between PAR and Academic Self Concept in math. There is a significant Help x Gender interaction; illustrated in Figure 3.
Note. *p <.05 **p < .01 ***p <.001.

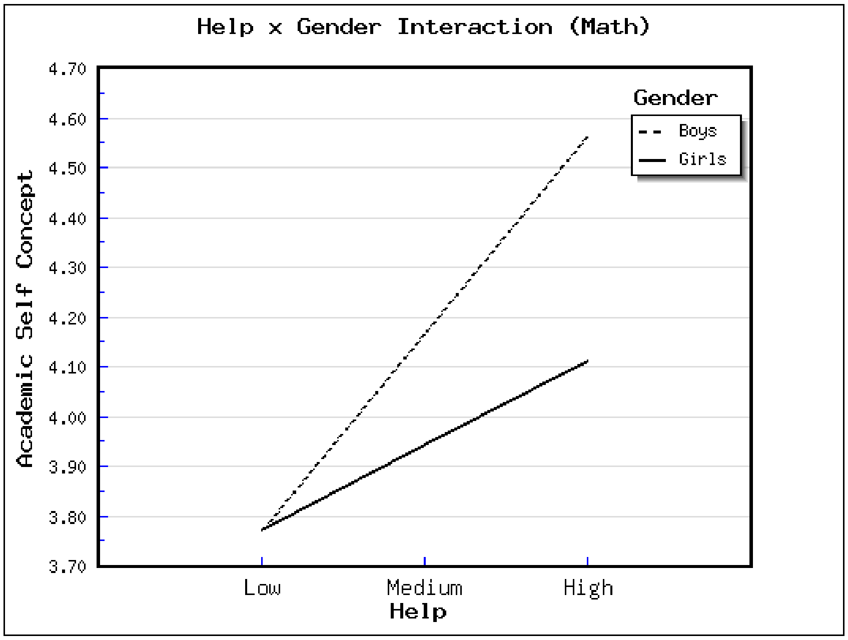

Figure 3. Depicts the gender x help interaction in math class. The relationship between praise and academic self-concept differs for boys and girls. Being asked for help by peers more strongly relates to academic self-concept for boys than girls.

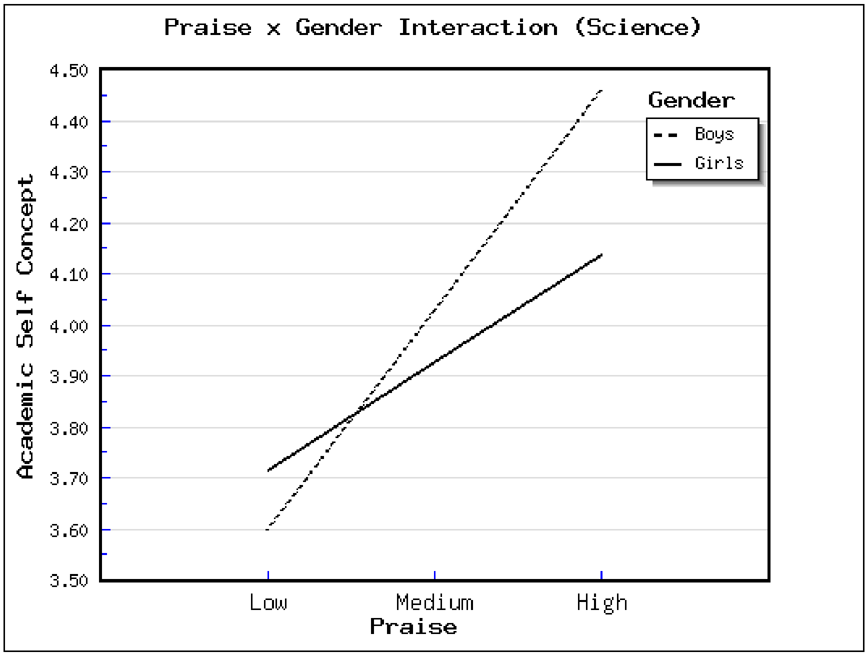

Figure 4. Depicts the gender x praise interaction in science class. The relationship between praise and academic self-concept differs for boys and girls, such that receiving praise from peers is related more strongly to academic self-concept for boys than girls.

APPENDIX

Supplemental Analyses: Perceived Peer Academic Reputation

Background: In studies 1 and 2, I used peer nominations of academic ability. Asking students directly about how they think their classmates would rate their academic ability is another way to measure how peer reputations are internalized over time. In line with social learning theory (Schunk, Meece, & Pintrich, 2014), adolescents look to their peers for information about how to act and how to interpret their academic success (e.g. Prinstein & Dodge, 2008; Dijkstra, Cillessen, & Lindenberg, 2010). Through daily interactions in the classroom it is likely that students become aware of their peers' opinions and expectations. Harter (1996) notes that "reflected appraisals" matter for how individuals see themselves. In other words, how you think about your own ability depends on how you perceive others' opinions and expectations of your ability. Thus, it is important to consider how students' perceptions of their own academic reputation affects their self-beliefs and behaviors in the classroom.

I assessed perceived peer academic reputation with the following self-report item, adapted from Eccles et al., (1989):

> "How do you think your classmates would rate your ability in math/science?"
>
> *1 = not at all good, 5 = very good*

I calculated descriptive statistics of perceived peer academic reputation (Table 2.a) and correlations with the other types of peer nominated reputations ("like to work with"; "really smart"; "tries hard"), expectancy cues, and academic self-concept (Table 2.b). In general, youth perceive that their peers have a relatively high opinion of their academic ability (*M* for perceived PAR approximately 3.8 overall). Interestingly there were no gender differences in mean levels of perceived PAR. That is, girls and boys do not differ in how they think others view their academic ability.

Perceived academic reputation was similar to PAR in terms of the direction of association with academic self-concept and expectancy cues. Compared to the three peer nominated indicators, Perceived PAR was more strongly related to students' academic self-concept from winter to spring.

Table 2.a

Means, standard deviations and gender differences for peer nominated and perceived academic reputations in math and science

	Math		Science	
Measure	Girls	Boys	Girls	Boys
	M(SD)			
"Like to Work With"	.03(.02)	.02(.01)	.02(.02)	.01(.01)
"Really smart"	.02(.03)	.02(.02)	.02(.02)	.01(.01)
"Tries hard"	.01(.01)	.01(.01)	.01(.01)	.01(.01)
Perceived PAR	3.85(.86)	3.88(.85)	3.76(.76)	3.75(.79)
Overall Mean (SD)	"Like to Work With"	"Really Smart" (PAR)	"Tries hard"	**Perceived PAR**
Math	.02(.02)	.02(.03)	.01(.01)	3.86(.85)
Science	.01(.02)	.02(.02)	.01(.02)	3.75(.85)

Table 2.b

Correlations among study variables broken down by gender

Measure		1.	2.	3.	4.	5.	6.	
Math								
1.	Academic Self Concept							
2.	“Like to Work With”	.06(.09)						
3.	“Really Smart” (PAR)	.49**(.25)	.31*(.67*)					
4.	“Tries hard”	.36**(.04)	.36**(.27*)	.37**(.49**)				
5.	**Perceived PAR**	.66**(.59**)	.14(.17**)	.60**(.25)	.27*(-.10)			
6.	Praise	.17(.22)	.18(.20)	.39**(.20)	.39**(.10)	.23(.32*)		
7.	Help	.33*(.61**)	.14(-.06)	.38**(.13)	.40**(-.13)	.30*(.47**)	.53**(.36**)	
8.	Criticism	-.19(-.13)	-.06(.02)	-.21(-.01)	-.21(-.04)	-.37**(.04)	-.23*(-.15)	.04(.15)
Science		9.	10.	11.	12.	13.	14.	
9.	Academic Self Concept	--						
10.	“Like to Work With”	-.21(.03)						
11.	“Really Smart” (PAR)	.28*(.18)	.37**(.59**)					
12.	“Tries hard”	.01(.30*)	.49**(.16)	.37**(.26)				
13.	**Perceived PAR**	.55**(.60**)	-.06(.06)	.38**(.07)	.22(.11)			
14.	Praise	.27*(.57**)	.06(.41**)	.12(.36**)	.25*(.16)	.08(.15)		
15.	Help	.51**(54**)	.10(.22)	.37**(.23)	.15(.04)	.01(.24)	.60**(.63**)	
16.	Criticism	-.07(-.24)	.03(-.37**)	-.03(-.24*)	-.02(-.29**)	-.19(-.02)	-.26**(-.24)	.06(.12)

Note. Values for girls (N = 67) are displayed first, followed by boys (N= 57) in parentheses
**p* <.05 ***p* < .01 ****p* <.001

Chapter 4

Conclusion

Peers at school are thought to play an important role in the development of students' self-beliefs and behaviors during adolescence. Much research has shown that adolescents' academic self-concept is vulnerable to declines during this stage of life (Marsh & O'Mara, 2008). Thus, it is critical for research to examine the nature and implications of classroom peer relations for to support students' motivation and engagement over time. This dissertation extends our understanding of how PAR operates among older adolescents in middle school, which represents a stage of life where peers and the opinions and feedback of others are particularly important. I examined links between PAR and changes in students' motivational beliefs and behaviors over time in math and science class during adolescence. Furthermore, I sought to elucidate one possible underlying mechanism of the PAR effect through developing and validating a scale to assess peer communication of expectancy cues. This research is situated in the domains of math and science to understand how these processes play out in the context of specific school subjects.

Based on prior research and theory, I expected that PAR would lead to positive changes in students' self-beliefs, and that the communication of expectancy cues from peers would help explain this effect. Results from Study 1 showed that students' peer academic reputation during early adolescence predicts changes in students' academic self-concept, academic worry, and engagement over time among 5th and 6th graders. However, this study did not examine how expectancy socialization plays a role in the effect of PAR.

Thus, in Study 2, I sought to elucidate the expectancy socialization process that is thought to underlie the effect of PAR. I expected that PAR would lead to different patterns of expectancy cues from peers in the form of more praise and fruitful help exchanges, and less criticism from peers

(Altermatt, 2012; Gest et al., 2008). After developing a face-valid measure of 20 items measuring expectancy cues, exploratory factor analyses showed that students perceived different types of expectancy cues from peers in the form of praise, criticism, and help expectancy cues. Furthermore, these expectancy cues were related to students' PAR and academic self-concept in the classroom; students with high PAR were more likely to receive praise and be sought for help from peers, and were less likely to receive criticism from peers. Structural equation modeling revealed some evidence for the mediating role of expectancy cues in the relationship between PAR and academic self- concept. Taken together, these findings suggest that PARs emerge among adolescents in the classroom context, operate through expectancy socialization, and play out in the form of different patterns of peer interactions that reflect students' PARs and affect their self-beliefs over time.

The two standalone studies in this multiple manuscript dissertation extend our understanding of how and why PAR matters by providing new information about how expectancy socialization plays out among youth in the context of math and science classes. Although there is much research supporting the idea that PAR matters for student beliefs and behaviors, typically the focus is not specific to math and science (for a recent review see Ryan & Shin, 2018). However, given that students' beliefs, behaviors and classroom experiences can vary by subject, it is important to investigate subject-specific peer processes. Studies have shown that peer attitudes and social support specific to STEM affect students' own attitudes about STEM over time (Bissell-Havran & Loken, 2009; Rice, Barth, Guadagno, Smith & McCallum, 2013; Robnett & Leaper, 2013). Our results show that students develop distinct PARs in the classroom and that these PARs relate to students' self-beliefs in math and science.

Furthermore, given that math is a subject where gender stereotypes may be particularly salient for peer interactions and girls' motivational self-beliefs (e.g., Simpkins et al., 2006; Leaper, 2015), the current investigation also examined gender differences in PARs, expectancy cues, and self- concept in middle school math and science classrooms. Results from Study 1 indicated that

PAR is related to changes in students' self-concept in a similar way for boys and girls. That is, for both genders, PAR was positively related to academic self-concept and engagement, and negatively related to academic worry over time. Some nuances regarding gender differences were revealed in Study 2. Specifically, I found that expectancy cues were more strongly related to PARs and academic adjustment for boys than girls. While boys reported a lower frequency of expectancy cues than girls overall, instances of peer communication of expectancy cues may carry more weight. However, the mediating role of expectancy cues in the relationship between PAR and academic self-concept played out similarly for boys and girls. Future research into such gender differences is warranted, particularly in the domains of math and science, given these mixed patterns.

This dissertation contributes to a growing body of research showing that peer dynamics matter for students' adjustment at school in general, and in the context of specific subjects. This work furthers our understanding of the links between classroom peer processes and academic adjustment during adolescence, as well as the mechanism that underpins the effect of PAR. I found that reputations among peers emerge in the classroom context in middle school and are linked to different patterns of peer interactions. One direction for future research is to begin to integrate teacher and peer influences on student motivation and engagement in the classroom.

There has been growing recognition in recent years about the important role that teachers play in peer dynamics and relations in the classroom setting (Cappella & Neal, 2012: Gest & Rodkin, 2011; Farmer, Lines & Hamm, 2011; Ryan, Kuusinen, & Bedoya-Skoog, 2015). Relevant to PAR, Cohen (1986) has described how teachers can promote positive classroom social dynamics through designing group work and collaborative tasks. Although teacher and peer factors are intertwined, they are often examined separately rather than in conjunction. Consideration of how these different processes work together would advance current theory and knowledge on the socialization of achievement-related beliefs and behaviors during adolescence. This may be particularly important for students who have low or negative PAR. Students with a negative PAR are vulnerable to declines in motivation and engagement over time. Are there actions a teacher can take to prevent such declines? Can a teacher manage students' reputations in class and support more positive expectancy cues among peers? Research in this vein would be informative about how to leverage the classroom peer ecology to support all students' motivation and engagement.

References

Altermatt, E. R. (2012). Children's achievement-related discourse with peers: Uncovering the processes of peer influence. In A. M. Ryan and G. W. Ladd (Eds.), Peer relationships and adjustment at school (pp. 109-134). Charlotte: Information Age Press.

Bissell-Havran, J. M., & Loken, E. (2009). The role of friends in early adolescents' academic self competence and intrinsic value for math and English. Journal of Youth and Adolescence, 38, 41–50.

Cappella, E., & Neal, J. W. (2012). A classmate at your side: Teacher practices, peer victimization, and network connections in urban schools. *School Mental Health, 4,* 81-94.

Cohen, E. G. (1986). *Designing groupwork: Strategies for the heterogeneous classroom*. New York: Teachers College Press.

Farmer, T.W., Lines, M.M., & Hamm, J.V. (2011). Revealing the invisible hand: The role of teachers in children's peer experiences. (Introduction to the special issue*). Journal of Applied Developmental Psychology, 32*(5), 247-256.

Gest, S. D., & Rodkin, P. C. (2011). Teaching practices and elementary classroom peer ecologies. *Journal of Applied Developmental Psychology*, *32*(5), 288-296.

Gest, S. D., Rulison, K. L., Davidson, A. J., & Welsh, J. A. (2008). A reputation for success (or failure): The association of peer academic reputations with academic self-concept, effort, and performance across the upper elementary grades. *Developmental Psychology*, *44*(3), 625-636.

Marsh, H. W., & O'Mara, A. J. (2008). Reciprocal effects between academic self-concept, self-esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality and Social Psychology Bulletin, 34,* 542-552.

Rice, L., Barth, J.M., Guadagno, R.E., Smith, G. P. A., & McCallum, D.M (2013). The role of social support in students’ perceived abilities and attitudes toward math and science. *Journal of Youth and Adolescence, 42*, 1028-1040.

Robnett, R. D., & Leaper, C. (2013). Friendship groups, personal motivation, and gender in relation to high school students' STEM career interest. *Journal of Research on Adolescence, 23*(4), 652-664.

Ryan, A. M., Kuusinen, C. M., & Bedoya-Skoog, A. (2015). Managing peer relations: A dimension of teacher self-efficacy that varies between elementary and middle school teachers and is associated with observed classroom quality. *Contemporary Educational Psychology*, *41*, 147-156.

Ryan, A. M. & Shin, H. (2018). Peers, academics and teachers. In W.B. Bukowski, B. Laursen & K. H. Rubin (Eds.) Handbook of Peer Interactions, Relationships and Groups (pp. 637-646). New York, NY: Guilford Press.

Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, *42*(1), 70-83.