Predictors and Outcomes of Parental Involvement with High School Students in Science

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Abstract

Demographic and psychological predictors of parent involvement with their children's science education both at home and at school were examined during high school. Associations between both types of parent involvement and numerous academic outcomes were tested. Data were collected from 244 high school students in 12 different science classrooms using surveys, the Experience Sampling Method (ESM), and school records. Results revealed low overall parent involvement. Demographic characteristics predicted parent involvement at school, but not at home, while student reported interest in science predicted both. Different dimensions of parent involvement affected outcomes differently. Among the most pronounced influences were those that parent involvement at home had with student efficacy, interest in science, and motivational states in science class.

Key Words: parental involvement, high schools, students, science, ESM, experience sampling method, parents, family, home, interest, efficacy, motivation, homework, predictors, outcomes

Introduction

Scholars and educators have directed far less attention toward parent involvement during high school than in the earlier grades, especially as it pertains

to specific subject areas. The present study focused on science classes. Although science education and achievement is currently a national priority, little is known about parental involvement with science education. Thus, it is important to describe parental involvement specifically as it relates to science.

First, this paper describes parental involvement with students enrolled in high school science classes. Second, parent and student characteristics expected to predict parental involvement with school are investigated. Finally, contributions of parental involvement to students' academic adjustment in science are examined controlling for characteristics related to parental involvement.

A national poll conducted by Public Agenda (2006) indicated that the vast majority of high school students' parents are content with their children's science education and are not concerned about it despite the substantial number of students who are "lukewarm" about science and struggle to succeed at it. Combined with parents' perceptions that they are unable to help their children with science (Barton, Drake, Perez, St. Louis, & George, 2004) and the fact that school science tends to be highly specialized and knowledge changes rapidly, parents might not be very involved in their children's high school science education.

It is important to recognize that parental involvement with schools is a multidimensional construct, which has made it difficult to compare studies and draw conclusions about it (Hill & Taylor, 2004). A number of scholars have identified parental involvement at home and at school as distinct dimensions of involvement (Jeynes, 2007), so both are considered in this study. Parental involvement at home includes help with and monitoring of homework as well as establishing rules and routines conducive to school success. Parental involvement at school includes interacting with teachers and attending events (Hill & Craft, 2003).

Possible predictors of parent involvement with their children's science education during high school are tested in this study. It is important to identify characteristics that predict parental involvement both at home and at school for both scholarly and practical reasons. Scholars have previously made cogent theoretically grounded arguments about why parents become involved based on either Bandura's (Hoover-Dempsey et al., 2005) or Bronfenbrenner's (Eccles & Harold, 1996) theories. In designing the present study, we drew upon Bronfenbrenner's (2005) ecological system theory which posits that parental and student demographics as well as psychological characteristics should predict parental involvement. Understanding what predicts parental involvement increases our understanding of how this important process operates. It also identifies which groups to target and which dispositions to encourage in efforts to increase parental involvement. Furthermore, in analyses examining the

contributions of parental involvement to student outcomes, background differences associated with parental involvement should be controlled.

In terms of parental demographic characteristics, we investigate parental education, low-income (free and reduced lunch), minority group membership, and immigrant status. Those with higher education might be more efficacious, knowledgeable, and intentional about being involved (Lareau, 2003; Shumow & Lomax, 2002). The increased difficulty of the high school curriculum may advantage more educated parents to assist directly with schoolwork at home (Patrikakou, 2004; Simon, 2001). According to Hill and Taylor (2004), parental involvement functions differently in different racial and ethnic groups. For example, African American parents often are more involved in school related activities at home than at school, whereas Euro-American parents often are more involved in the actual school setting than at home (Eccles & Harold, 1996). This tendency to be more involved at home than at school may be especially true for ethnic minorities whose primary language is not English (Garcia Coll et al., 2002). Native-born parents are likely to have greater knowledge of how the U.S. school system works so they may be better able to navigate at-school involvement. There is some evidence, though, that many immigrant parents of high school students have high expectations (Goldenberg et al., 2001) and are deeply involved at home in fostering and encouraging academic success (Strickland & Shumow, 2008), even though they tend to be minimally involved at school (Turney & Kao, 2009).

Student demographic characteristics investigated include gender and freshman status. At least two prior studies suggest that at-home and at-school parental involvement with science education is greater for boys (Carter & Wojtkiewicz, 2000; Miller, 1988), but those studies used data collected during a previous generation, and attitudes toward women in science have changed. Thus, we investigate gender as a possible predictor of parental involvement. Much attention has been focused recently on the serious difficulties many students experience during the transition to high school (Barber & Olsen, 2004; Taylor & Dounay, 2008; Wheelock & Miao, 2005). Although, overall, parents of high school students tend to be less involved during high school than the earlier grades, parents of freshmen might be more involved than parents of students in subsequent grades because of transition issues, or they might be less involved due to lack of familiarity with the school.

Possible psychological predictors of parental involvement in science include parental expectations for the student's educational attainment, student interest in science, and student's difficulty in learning science. Parents with high expectations are more likely to be involved than those with low expectations. Hoover Dempsey and colleagues (2005) have noted that students often initiate

parental involvement. Those students who are interested in science would seem to be more likely to instigate involvement, a conjecture we test. Rogoff (1990) has noted how difficult it is for parents to watch their children struggle, so students who are struggling might precipitate involvement. On the other hand, Shumow and Miller (2001) have found that parents of middle school students react to student success with more involvement at school and react to student struggle by more involvement at home, which suggests that those associations should also be tested for high school students.

Most studies of the effects of parent involvement have focused on achievement outcomes. Some have found that parents continue to have a significant positive impact on student achievement whereas others have found negative associations between student performance and parental involvement with adolescents. Type of involvement may be an important factor in explaining these contradictions. Studies with middle school students (Shumow & Miller, 2001) have found that at-school involvement is associated with positive outcomes whereas at-home involvement has been associated with lower achievement but greater school orientation. We extend those studies to high school and test the association between parental involvement and overall GPA and science grades, controlling for differences in characteristics that predict involvement.

We also test whether parental involvement predicts the amount of time students spend on their science homework because homework is related to their concurrent and future success. There is some evidence that parental involvement during high school is associated with an increase in the amount of time students spend on homework and the percentage of homework completed (Epstein & Sanders, 2002).

In addition, we investigate the impact of both dimensions of parental involvement on student motivation and attitude. Although many models of parent involvement assume that student motivation and attitude is a prime way that parents influence their children's school adjustment, relatively few studies examine that proposition. Only a few studies (Miller, 1988; George & Kaplan, 1998) have investigated parental contributions to adolescent students' attitudes toward and engagement with science. Gonzales and colleagues (2002) surveyed students about parental involvement and their motivation during high school. Results showed that when parents were involved, students were more likely to report seeking challenging tasks, persist through academic challenges, and experience satisfaction in their schoolwork. We examine the impact of parental involvement on students' motivation during science classes using students' in-the-moment reports of how skilled, hard working, interested, and invested they are in their class work using the Experience Sampling Method (ESM), a highly valid means of assessing student engagement and motivation

(Csikszentmihalyi & Larson, 1987; Hektner, Schmidt, & Csikszentmihalyi, 2007; Zuzanek, 1999). In addition, we test whether parental involvement predicts students' long-term academic expectations and sense of scientific efficacy.

Thus, in this study we consider students' demographic and psychological characteristics in relationship to two distinct dimensions of parent involvement in high school science, involvement at school and at home. Based on reviewed literature, we expect to see differences in patterns of involvement for males versus females and for freshmen. Further, we expect low income, minority group membership, and immigrant status to negatively predict parent involvement at school while more parent education, high expectations for the student's educational attainment, student interest in science, and student's success in learning science to positively predict parent involvement. Different patterns of association between parent involvement at home and at school and a number of achievement and motivational outcomes in science are expected to emerge.

Method

Context and Participants

Data were collected in 2008-2009 in 12 science classrooms in a single comprehensive high school serving students from a diverse community located on the fringe of a large metropolitan area. Thirty-three percent of students in the school were considered "low income." The school serves 9th–12th graders and had an enrollment of approximately 3,300 in 2009. Average class size was 23.6 students, and teachers in the school district had an average of 11.5 years' experience. The graduation rate was 74%.

The sample consisted of students from 3 general science, 3 biology, 3 chemistry, and 3 physics classrooms (n = 244 students; some, n = 12, did not complete the school year). These classes were drawn from the "average" or regular track. The study was designed to oversample students in the 9th grade: 43% were in the 9th grade, 21% in the 10th grade, 34% in the 11th grade, and 2% in the 12th grade. The overall student participation rate across all classrooms was 91%, with half of the classrooms studied having complete (100%) participation. The sample was 53% male and 47% female. The student sample was 42% White, 37% Latino, 12% African American, 2% Asian, 1% Native American, and 6% multiracial. According to school records, 43% of students in the sample were eligible to receive free or reduced lunch.

Procedure

Researchers visited each classroom for 5 consecutive days in both fall 2008 and spring 2009. Data used in this study were collected from surveys, the Experience Sampling Method (ESM), and school records.

Student Surveys

Students completed one-time surveys during both the fall and spring data collection periods pertaining to student characteristics (grade, age, gender, ethnicity); family background; educational background as well as students' future academic aspirations; science beliefs and learning; homework completion; and parental involvement in science education.

Experience Sampling Method

During two waves of data collection, students' subjective experience in each science classroom was measured repeatedly over a period of 5 consecutive school days using a variant of the Experience Sampling Method (Csikszentmihalyi & Larson, 1987). Participants wore a vibrating pager which was used to signal them unobtrusively using a remote transmitter at 2 randomly selected time points during each day's science class. To minimize the disruption to class flow and maximize the variety of classroom activities recorded, the pool of participants in each classroom was divided in half, with each half following a different signal schedule. In response to each signal, students completed an Experience Sampling Form (ESF) in which they briefly recorded their activities and thoughts at the time of the signal, as well as various dimensions of their subjective experience. The ESF took approximately 1-2 minutes to complete. In an open-ended format, students provided brief descriptions of their thoughts and activities at the time of the signal. Responses were coded by trained coders using detailed coding schemes. Inter-rater reliability on these items was high with percent agreement between 2 independent coders at 91.8% for primary activity, 89.3% for secondary activity, and 90% for thoughts.

Using Likert scales, students used the ESF to report on multiple dimensions of their subjective experience. By the completion of the study, each participant had reported on multiple aspects of subjective experience on as many as 20 separate occasions. In total, 4,136 such responses were collected. In the fall semester, 2,139 responses were collected, for an average of 9.2 responses per participant (92% signal response rate). In the spring semester, 1,997 responses were collected, for an average of 9.1 responses per participant (91% signal response rate). Participant non-response was nearly entirely attributable to school absence.

The method has a high degree of external or "ecological" validity, capturing participants' responses in everyday life. There are indications that the internal

validity of the ESM is stronger than one-time questionnaires as well. Zuzanek (1999) has shown that the immediacy of the questions reduces the potential for failure of recall and the tendency to choose responses on the basis of social desirability (see Csikszentmihalyi & Larson, 1987, and Hektner, Schmidt, & Csikszentmihalyi, 2007, for reviews of validity studies).

School Records

Pubic records describing the school organization and curriculum were collected by the researchers. A school employee with access to student's individual records provided a file with students' science grades and "free lunch" status.

Measures

Parental Involvement

The student survey, completed in the Spring of 2009, included 14 items pertaining to parents' involvement with participants' schooling and their science education. Principal components factor analysis with varimax rotation indicated that there were four factors which accounted for 59% of the variance. One of the factors had four dichotomous items pertaining to *parent involvement at school* (Cronbach's alpha = .77): attending school events, coming to school to watch them perform, talking to their science teacher at school, and knowing their science teacher. Another factor was comprised of four items pertaining to *parent involvement at home* (Cronbach's alpha = .75): checking science homework, helping with the science homework, finding someone to help with science homework, and limiting the amount of time the student watches TV or plays video games. Students reported the extent of parent involvement at home on a four point scale from 0 = never to 3 = often. The other two factors, *parent involvement in educational planning* (two items) and *parent student discussion about science topics* (four items) are not included in the present study.

Predictors of Parent Involvement

Family income was estimated from the report of free and reduced *lunch* obtained from official school records. Parent education (*Pared*) was the highest level of education of either parent. It should be noted that 17% of the students did not know either parent's level of education (all analyses reported in this paper were done with the parent education variable in the model because it is such an important factor. Analyses also were done without parent education because of the missing data; the relationship between other variables and parental involvement and outcomes were unchanged on a practical level). Those who reported being born outside the test country and/or having one or both parents born outside the test country were considered *immigrants*. *Academic*

expectations of mother were assessed by asking the students how far in school their mother wants them to go (a separate item asked about father's expectations; there was high agreement with mother's expectations and more missing data from fathers, so the mother's expectations were used in analyses). Two variables: *student finds science fun and interesting* and *student reports difficulty with science* were measured by asking students to respond on a scale from 1 = strongly disagree to 4 = strongly agree. *Freshman* indicated that the student was in the 9th grade vs. another grade.

Academic Adjustment

There were multiple indicators of student's school adjustment. The first indicators were obtained from the ESF average from the days signaled. Students indicated how they felt about themselves and their activities at the moment when they were signaled. On a 4-point scale (0 = not at all, 1 = a little, 2 = somewhat, 3 = very much) students indicated "how skilled you felt at what you were doing" (*skill*), "how important that activity was to you" (*imp you*), "how interesting the activity was to you" (*interest*), and "how hard you were working on the activity" (*hard work*).

The second set of indicators was obtained from student surveys. *Science Efficacy* came from four items on the survey (Cronbach's alpha = .93). Students rated their level of agreement on a 7-point Likert scale with the following statements "I feel confident in my ability to learn this material," "I am capable of learning the material in this course," "I am able to achieve my goals in this course," and "I feel able to perform well in this course" (1 = not at all true to 7 = very true). *Total hours spent on homework* is the cumulative number of hours students reported doing science homework in and outside of school. *Student academic expectations* (*StAcadExp*) was a one-item student report of how much education the student expected to attain. The third indicator was the student grades obtained from official school records.

Results

Table 1 displays the average parental involvement at home and at school for the entire population and by characteristics investigated. Overall, the level of parent involvement is low. Parent involvement at school and at home are correlated .28.

Demographic characteristics, such as income, level of education, immigrant status, and race were associated with parental involvement at school but not at home in univariate analyses. Parents of those students who received free or reduced lunch were significantly less likely to be involved at school than those of the students who do not qualify for free or reduced lunches. Further, there

was an important trend in the relationship between parent education level and parent involvement at school—a gradual increase in parent involvement at school with the increase in parent education level. Significant gains in at-school involvement appeared when comparing those parents who did not finish high school with high school graduates and with college graduates. Finally, immigrant parents as well as non-White parents were less likely to be involved at school when compared to non-immigrant and White groups, respectively.

Table 1. Parental Involvement at Home and School by Predictors of Involvement

	Involvement at Home Mean (SD) Significance	Involvement at School Mean (SD) Significance
All	.94 (.78)	.45 (.38)
Free or Reduced Lunch	*t* = .19 NS	*t* = 5.6***
No	.95 (.78)	.58 (.37)
Yes	.93 (.79)	.30 (.34)
Parent Educational Level	*F* = .19 NS	*F* = 9.3***
< HS Graduate	.92 (.77)	.17 (.31)
HS Graduate	.82 (.76)	.37 (.33)
Some College	.87 (.78)	.48 (.40)
Undergraduate Degree	.89 (.72)	.66 (.36)
Advanced Degree	1.01 (.80)	.62 (.35)
Immigrant	*t* = -.08 NS	*t* = 5.1***
Yes	.96 (.84)	.30 (.35)
No	.95 (.76)	.50 (.37)
White	*t*= .00 NS	*t* = -5.9***
Yes	.94 (.75)	.65 (.36)
No	.94 (.80)	.33 (.35)
Gender	*t* = .54 NS	*t* = 1.1 NS
Male	.97 (.79)	.48 (.38)
Female	.94 (.80)	.42 (.39)
Freshman	*t* = -2.1*	*t* = 1.8^
Yes	1.1 (.82)	.40 (.37)
No	.85 (.75)	.49 (.39)
Acad Expectations Mom	*.94 (.78)* *F* = .56	*.45 (.38)* *F* = 3.7**
Sch Science Fun, Interesting	*F* = 5.9**	*F* = .62 NS
Strongly Disagree	.46 (.77)	.37 (.33)
Disagree	.64 (.55)	.43 (.39)
Agree	.99 (.78)	.50 (/38)
Strongly Agree	1.3 (.76)	.54 (.41)
Science is Difficult to Learn	*F* = .81 NS	*F* = .11 NS
Strongly Disagree	.95 (.75)	.53 (.39)
Disagree	.97 (.77)	.47 (.37)
Agree	.84 (.78)	.47 (.39)
Strongly Agree	.77 (.70)	.44 (.41)

Note. Standard deviations are presented in parentheses; NS = not significant, ^$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

There were no demographic characteristics that predicted parent involvement at home. The only factor that had bearing on parent involvement at home was student's reported interest in science. Those who agreed with the statement "I find school science fun and interesting" also reported higher levels of parent involvement at home than those who disagreed.

Table 2 displays the OLS regressions predicting parental involvement at school and at home. Each equation explained a significant amount of the variance. Parent education, academic expectation, and students' interest in science positively predicted and receiving free or reduced lunch and immigrant status negatively predicted parental involvement at school in these multivariate analyses. Mothers' academic expectations, student interest in science, and being a freshman student were the only predictors of parental involvement at home. Importantly, lunch status, parent education, immigrant status, and student report of difficulty with science did not predict at-home involvement. Gender and race were not predictors of parental involvement.

Table 2. OLS Regressions Predicting Parental Involvement at School and at Home from Parental and Student Characteristics

	Parent Inv School	Parent Inv Home
Lunch	-.16*	-.03
Parent Education	.20**	.03
Gender	-.05	-.07
Immigrant	-.17*	.04
White	.13	-.03
Academic Exp Mom	.20**	.17*
Stdnt Sci Fun & Interesting	.17*	.30***
Stdnt Report Sci Diff for Me	-.03	.06
Freshman	-.04	.14^
R^2	.34***	.15***
Adj R^2	.30	.11

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

The OLS regressions presented in Table 3 test the relationship between parent involvement at home and at school with student outcomes, controlling for background characteristics associated with parent involvement. As can be seen, each equation explains a significant amount of the variance. Controlling for the predictors of parent involvement, at-home and at-school involvement have different patterns of association with outcomes.

Parent involvement at home is related positively to students' interest and hard work in class, to how important students think the science work is, and to

Table 3. OLS Regressions Predicting Student Outcomes from Parent Involvement and Predictors of Parental Involvement

	Feel Skillful in Class	Science Class Import to You	Interest During Class	Hard Working During Class	Science Grade	Cumulative GPA	Student's Academic Expectation	Student's Science Efficacy	Hours Science HW
Lunch	.03	.12	.15^	- .03	-.10	-.18*	-.10	-.21**	-.06
Parent Ed	- .11	-.20	.11	- .11	.09	.08	.17*	-.19*	-.03
Immigrant	- .04	-.06	-.01	- .11	.09	.06	-.17^	-.08	-.08
Academic Exp Mom	.03	.04	.16*	.08	-.01	.05	.16^	-.02	.13
Student Sci Interest	.32***	.41***	.30***	.33***	.08	.10	-.06	.51***	.07
Freshman	-.16*	- .14^	-.10	-.10	.13	.03	.03	-.04	-.22*
P Inv Home	.05	.16*	.25***	.16*	-.10	-.10	-.17*	-.03	.18*
P Inv School	.30**	.10	- .01	.03	.26**	.27**	.17^	.17*	-.32**
R^2	.23***	.29***	.26***	.17**	.11*	.17***	.14**	.31***	.13*
Adj R^2	.19	.25	.22	.13	.06	.13	.09	.28	.08

Note. ^$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

the hours of homework they do. At-home involvement is negatively related to students' academic expectations. At-school involvement is related positively to how skilled students feel during class, to their grades and long-term academic expectations, and their science efficacy. Parent involvement at school is negatively related to the hours spent doing homework.

Discussion

Based on the students' reports, overall, parents of high school students were minimally involved in their high school students' science education. This is consistent with the body of research literature showing that the level of parent involvement declines by secondary school (Dornbusch & Glasgow, 1996; Eccles & Harold, 1996; Patrikakou, 2004; Simon, 2001). Nevertheless, based on our findings, parent involvement remains an important multidimensional factor contributing to students' adjustment during high school.

Differentiating between parent involvement at school and at home is useful in order to build a more nuanced understanding of characteristics associated with parental involvement and of the ways in which parental involvement contributes to students' school experiences. We found that demographic and psychological factors influence parent involvement in different ways.

The way in which parents' demographic characteristics such as income, level of education, immigrant status, and race influence parent involvement during high school depended on the type of involvement. Parents with lower incomes and education levels as well as those from immigrant and minority groups were less likely to be involved at school. This finding is aligned with previous research findings that parents from non-majority backgrounds often do not feel comfortable enough to be actively involved at school. Low academic efficacy, a sense of alienation, as well as language and cultural barriers have been suggested as factors that are likely to prevent these parents from participating in school events or communicating with the teachers at school (Eccles & Harold, 1996; Garcia Coll et al., 2002; Patrikakou, 2004; Simon, 2001). Conversely, higher income, White, native-born parents and those who have higher levels of education are more likely to interact with teachers, volunteer at school, and attend school events. Numerous studies have shown that parents who are familiar with and have been successful at school feel more comfortable, efficacious, and affiliated with educators (Hoover-Dempsey et al., 2005; Lareau, 2003). Educators should make efforts to understand reasons for differences in parent involvement and consider ways to encourage parent involvement in high school science education with a special focus on those groups who are not fully involved. Other studies have shown that invitations

from teachers have a considerable impact on parent involvement at school during the high school years (e.g., Simon, 2001).

Parent demographic characteristics, however, have little bearing on parent involvement at home. Parents from traditionally marginalized groups are involved at home to a very similar extent as are parents who are White, native-born, and relatively more affluent and educated, a pattern that also has been observed among parents of middle and high school students in studies using a large national data set (Shumow & Miller, 2001; Strickland & Shumow, 2008). These findings are extremely important to communicate to educators who are likely to think that those parents who are not involved at school are not engaged or interested in their children's education.

Parents of freshman were marginally more involved at home than parents of students in higher grades. This might reflect parental awareness of the increased academic pressure that students encounter in transitioning to high school (Akos & Galassi, 2004). Together with the fact that parents of freshman were less likely to be involved at school, this suggests that parents of freshman might need more encouragement to become involved at school and guidance about the ways in which they can be involved.

Gender of the student did not predict parent involvement with science education. Several studies conducted with data collected from a previous generation found that parents were more involved with the science education of their sons (Carter & Wojtkiewicz, 2000; Miller, 1988). Our findings suggest that the current generation of parents do not perceive science to be more important for their male children.

The only psychological factor that predicted involvement was student reported interest in science. It was a strong predictor of parent involvement at home and also predicted parent involvement at school. Interestingly, and against our expectations, students' reported difficulty with science did not predict parent involvement. Hoover Dempsey and colleagues' (2005) model of parent involvement predicts that students exert considerable influence on parents' decisions and actions regarding involvement. Our findings indicate that the parents of these high school students responded more to the positive (interest) than to the negative (difficulty) response of their children to science. Using a more robust measure of academic adjustment, Shumow and Miller (2001) found that parents of middle school students who struggled in science and mathematics were more involved at home than parents of successful students. It may be that parents think that high school students should be focusing more on their interests and on subjects that come easy to them during high school as preparation for choosing their postsecondary path. Given the difference in measures, however, we do not know whether our finding indicates

a development or grade related change in parental decision making about involvement or whether parents respond more to behavioral than attitude cues that their child is struggling. The finding needs to be explored in future studies.

Overall, judging from the percent of the variance explained, parent involvement at home appears to be understood to a lesser extent than parent involvement at school. This warrants further study to identify other potential factors affecting parent involvement at home.

Parent involvement at home and parent involvement at school predicted student outcomes differently. What is most intriguing is that whereas parent involvement at school predicts academic success as measured by student's science grades and overall GPA, it is parent involvement *at home* that is positively associated with students' interest, perceived value of the activity, and diligence during science class, as well as the time that students spend doing homework.

Few studies have examined whether or what type of parent involvement is associated with student motivation in science and fewer still have investigated that issue with high school students. Our finding aligns with that of Gonzales and colleagues (2002), who found that parenting style during high school predicted motivation as measured through survey items. The use of the ESM in the present study allowed us to examine how parent involvement influences student motivation and engagement during class. This connection between parent involvement with in-the-moment attitudes about science while the students are in class establishes an important empirical connection that has previously been assumed but not tested.

Interestingly, controlling for background factors including the parent's academic expectations for the student (as reported by the student), parent involvement at home was associated with lower long-term student academic expectations and was not significantly related to school success. This may suggest that parents are more involved at home when students are struggling academically and/or that students interpret parents' at-home involvement during high school as a sign that they are not on a successful path. Future studies should attempt to ascertain the meaning that students attribute to different types of parent involvement during high school and the messages or reasons that parents might be communicating to the student. For example, perhaps parents warn their children about possible failure when they help with homework or restrict their media use. The fact that parent help with homework did not pay off in better grades has been found in numerous studies, suggesting that parents might be able to provide more effective help with homework. Educators, who hold professional knowledge about teaching, could provide guidance for parents about homework help.

The association between parent involvement at school and grades may suggest that parents who establish better relationships with teachers and who

come to school positively influence teachers' opinions of their children's performance. Standardized science test scores were not available in the present study so it was not possible to test the association between parent involvement and achievement, but at least one other study (Miller & Shumow, 2001) with middle school students showed that parent involvement at school predicts grades but not achievement test scores. Parent involvement at school also might expose them to the expectations and standards of the teacher(s) which, in combination with their own cultural capital (since the social backgrounds of those who are more involved suggest they have more experience and knowledge about succeeding in school), is information that they can then use in providing guidance to their children.

Even though the evidence from this study is not conclusive, the observed powerful contribution of students' interest in science to parent involvement and to positive students' experiences in the science classrooms suggests that fostering student interest in science might be a promising undertaking. When controlling for characteristics that predicted parent involvement, student general interest in science remained a strong predictor of students' in-the-moment feelings about their science experiences in the classrooms and their global sense of efficacy. Student expressions of interest did not, however, predict success in class as measured by grades. Teachers might enlist parent involvement by working to pique student interest and parent partnerships by providing resources, opportunities, and suggestions that would contribute to academic success for those parents whose children are especially interested in science. It has been previously suggested, for example, that establishing a collaboration with a local university or trained professionals from local industry can enhance the enthusiasm and experimental design of science fair projects, thus stimulating participation and the scientific thought process of high school students (DeClue et al., 2000). Schools could also alert parents about opportunities for families or students to participate in activities at local museums, nature centers, or with community groups related to science. Providing resources, opportunities, and suggestions that would contribute to academic success for those parents whose children are especially interested in science will likely strengthen teacher–parent partnerships.

Science education has been a national priority, yet there has been little focus on how parents are and might be involved in promoting science learning. This study suggests that pursuing a deeper understanding of parents' involvement in and contribution to their children's science learning will help teachers in finding creative ways to establish more fruitful partnerships with parents in science. Science teacher educators will be able to use that understanding during teacher preparation programs in order to promote parent involvement in science education.

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