High School Girls' Negotiation of Perceived Self-Efficacy and Science Course Trajectories

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Sustainability issues have led to increased demands for a STEM-literate society and workforce. Potential contributors need to be competent, have an understanding of earth and physical sciences, and be willing to pursue such fields. High school girls, however, remain underrepresented in physical science course enrollments (College Board, 2014). This qualitative case study examined how gender informs girls' efficacy-activated processes related to their perceptions of potential science course pursuits. From a feminist, social cognitive theoretical framework, it sought to understand how various factors, including gender, interplay in girls' determinations of their perceived STEM self-efficacy and potential science course trajectories. Findings illuminated how gender role socialization, particularly career orientations and competitive norms, threatens girls' participation in physical sciences. Implications for policy, research, and practice are discussed.

Keywords: *science education, social processes/development, gender*

Global sustainability issues that have arisen due to imbalances between natural and social systems threaten human welfare (Mora et al., 2013) and raise questions about the sufficiency of our own and future generations' preparation to be capable and willing to manage and address those issues. In response, many states are adopting the Next Generation Science Standards (NGSS) in part or whole. These standards increase expectations for earth sciences at the middle and high school levels. As Wysession (2013) explained, where earth, life, and physical sciences were previously equally prioritized at the middle school level, the NGSS raised earth sciences' performance expectations to equal those of life and physical sciences combined, equaling half of the middle school curriculum. At the high school level, where traditionally biology, chemistry, and physics are prioritized, earth science expectations were raised to equal those of chemistry and physics combined, equaling approximately an additional course requirement.

The increased expectations assume that many physical science topics may be taught through earth sciences (Wysession, 2013). Students would still need exposure to crosscutting concepts, the broader transdisciplinary themes identified in the NGSS, through their other educational experiences with physical sciences to achieve the NGSS expectations. Yet, to date, there are no Advanced Placement courses in earth science and gender inequalities persist in high school advanced physical science course participation, particularly in physics (College Board, 2014). A second year of chemistry or the taking of one or two years of physics in high school is related to future STEM career interests when controlling for prior interests and experiences (Sadler, Sonnert, Hazari, & Tai, 2014). Thus, the underrepresentation of girls in high school physical science courses denies them the opportunity to develop the STEM-related knowledge and competencies needed to pursue future related educational and career trajectories. The time, then, is opportune to use the discourses surrounding the NGSS as opportunities to address inequities in our science education programs that may be perpetuating these inequality trends.

The purpose of this qualitative case study was to investigate how high school girls make sense of their future science course pursuits. Grounded in a social cognitive theoretical framework with an embedded feminist lens, it sought to illuminate how gender interplays with other environmental, behavioral, and personal factors related to high school girls' perceptions of viable science course pursuits.

Literature Review

Literature has clearly established that both external and internal factors influence girls' persistence in STEM domains (e.g., Hill, Corbett, & St. Rose, 2010). Gender differences in STEM participation were most often attributed to external environmental and situational factors including less guidance toward STEM educational and career trajectories (Chhin, Bleeker, & Jacobs, 2008; Ing, 2014), gender-biased parental, teacher, and peer influences (Gunderson, Ramirez, Levine, & Beilock, 2011; Riegle-Crumb, Farkas, & Muller, 2006), and the lack of experience or exposure to STEM fields and related skills development (Hill, Corbett, & St. Rose, 2010; Wai, Lubinski, & Benbow, 2009).

Internal factors, like perceived self-efficacy, also influence perceived scope of viable educational and career trajectories (MacPhee, Farro, & Canetto, 2013; Saucerman & Vasquez, 2014; Smeding, 2012). Environmental, behavioral, and internal factors influence an individual's determination of perceived self-efficacy levels (Bandura, 2001). As perceived self-efficacy was found to be domain-specific (Usher & Parajes, 2008), environmental factors, such as gender stereotypes, gender role socialization, and gendered science constructs may negatively influence perceived self-efficacy. In fact, studies have found girls perceive their academic self-efficacy lower in comparison to equally-abled boys (Dweck, 2007; MacPhee et al., 2013), particularly in STEM domains (Brotman & Moore, 2008). Likewise, girls tend to have lower perceived self-efficacy for careers with a strong masculine gender construct orientation, like math and science careers (Howard et al., 2011; Lane, Goh, & Driver-Linn, 2012). This review continues with a focus on gender constructs and role socialization in relation to educational and career trajectories.

Gender Constructs

Traditionally, gender stereotypes associate men with science and women with humanities (Lane et al., 2012; Nosek et al., 2009). Even though more women are working and entering traditionally male-associated careers, reproductive demands or residual stereotypes may dissuade initial pursuit or continuation in science fields (Tai, Lui, Maltese, & Fan, 2006). Continued observation of gender inequalities in course enrollments may also dissuade women from considering male-dominated STEM courses as viable options in the first place (Spencer, Logel, & Davies, 2016). Implicit biases of gendered science constructs, viewing life sciences as more feminine and physical sciences as more masculine (Cervoni & Ivinson, 2011), may persist. High school girls have been found to associate math and physics negatively with the female gender (Makarova & Herzog, 2015; Steffens & Jelenec, 2011). Likewise, girls who have a stronger female identity are less likely to consider future academic and career plans that do not conform to trajectories related to gender constructs (Howard et al., 2011; Lane et al., 2012). While questions remain about how exactly implicit biases interplay with other environmental and behavioral factors girls consider when deciding science educational and career trajectories, observed gender inequality trends in STEM fields suggest their continued influence.

Gender Role Socialization

Gender role socialization in childhood may further inform what educational and career trajectories girls perceive as appropriate. In fact, STEM-related career interests remain fairly constant throughout high school, with boys inclined toward engineering and girls toward medicine (Sadler, Sonnert, Hazari, & Tai, 2012). Parental influence, particularly the mothers' gendered beliefs, was associated with science and mathematics academic achievement and persistence (Ing, 2014) and even predicted girls' STEM-related career interests (Chhin et al., 2008). Likewise, girls' participation in social groups and with peers who share a strong gender identity may serve to perpetuate stereotypes about those who maintain gender roles and those who challenge them (Leaper, Farkas, & Brown, 2012). In turn, socialized academic and career interests and expectations may influence perceived appropriateness of course trajectories.

In adolescence, habits of mind, an individual's "beliefs about the nature of intelligence and academic ability", play a stronger role in girls' STEM participation than in early childhood (Saucerman & Vasquez, 2014, p. 52). The way in which people are socialized to perceive the type of talent needed for various disciplines, whether it is perceived as an innate ability or as developable, may further inform perceptions of potential success and likelihood of pursuing various disciplines (Dweck, 2007; Leslie, Cimpian, Meyer, & Freeland, 2015). As many in the STEM career field may hold the belief that talent in physical sciences and math are innate, particularly with respect to the male-gendered preference for systemizing over empathizing, girls may be less likely to consider or participate in such fields (Leslie et al., 2015; Penner, 2015). While these biases may not always correlate with achievement scores (Kiefer & Sekaquaptewa, 2007; Smeding, 2012), the role of gender in determining potential science course trajectories is evident.

Theoretical Framework

This research is grounded in a social cognitive theoretical framework. Theoretically, efficacy or agency beliefs are associated with increased academic achievement, persistence, and pursuit of future opportunities (Bandura, 1977). Efficacy beliefs achieve their influence on an individual's perceived scope of potential paths and actual pursuance of those paths as they "influence how people think, feel, motivate themselves, and act" (Bandura, 1995, p. 2). Widely cited are Bandura's (1977) four efficacy sources: mastery experiences, vicarious experiences, social persuasion, and physiological responses. He found that mastery experiences, past successes in related tasks, were the most predictive of self-efficacy in a future related task.

Efficacy sources are not inherently good or bad. It is the individual's perceived self-efficacy, the resulting valuation of her interpretations of sources in relation to potential future actions, that determines the scope of trajectories to pursue. Perceived self-efficacy, then, is an individual's dynamic interpretation of the varying sources of self-efficacy being filtered through various efficacy-activated processes, identified as cognitive, motivational, affective, and selection processes (Bandura, 1995). Ultimately, this resulting perceived self-efficacy in a given context will relate to the type of agency, the subsequent action or behavior, that an individual is most likely to enact.

The scope of potential agentic trajectories is further determined as a result of negotiating personal factors with other behavioral and environmental factors (Bandura, 2001). Consequently, related interpretative processes are vulnerable to the influence of gender constructs and role socialization (Bussey & Bandura, 1999). To those points, this study aimed to examine the interplay of gender, perceived STEM self-efficacy, and scope of likely science course pursuits. As such, a feminist lens was embedded in this theoretical framework.

Methods

This qualitative case study sought to describe how high achieving, high school girls are making sense of their potential science course trajectories. It explored participants' "lived experiences," discovering the "*meanings* people place on the events, processes, and structures of their lives and for connecting these meanings to the *social world* around them" (Miles, Huberman, & Saldaña, 2014). The research sought to answer the following questions: (a) How do high school girls decide the likelihood of taking AP Biology, AP Chemistry, and Physics?; and (b) What factors do high school girls identify as informing their decisions?

Context and Participants

This study took place in a New Jersey suburban high school. This school was chosen because it has a strong reputation statewide and nationally for its STEM educational program but gender inequalities are observed year after year in the advanced science courses, particularly in the physical science fields. After IRB approval, a purposive, criterion sampling strategy was used to select participants via a 29 Likert scale item survey. Specific sampling criteria included: (a) mid to high perceived STEM self-efficacy level and (b) low to mid perceived likelihood of taking AP Chemistry and/or Physics. Criteria were chosen to identify potential participants who, theoretically, had the perceived STEM self-efficacy levels to widen the scope of potential science course trajectories but instead expressed potential science course trajectories that were narrower than expected.

In total, 16 high school girls participated in the study. Demographically, 13 participants were sophomores and three were juniors. Of those participants, one was White, one was Black, and 14 were Asian, primarily of Indian decent with two being of Chinese decent. Despite racial and ethnic differences, the girls in this study exhibited striking similarities in their perspectives and experiences.

Data Collection

Data were collected using focus groups, interviews, and field notes. Focus groups provided insight into perceptions and feelings, understandings of an experience from a specific population's viewpoint, and deeper understanding of factors that influence behaviors (Krueger & Casey, 2009). In total, four focus groups were conducted, each having four participants and lasting an average of 50 minutes each. The semi-structured design included seven fixed questions and allowed time for probe questions and emergent topics. As sampling sought to increase the homogeneity of participants' characteristics of interest in this study, data analyses and the point of saturation (Miles et al., 2014) determined the sufficient number of focus groups to be conducted.

Follow-up individual, face-to-face interviews were conducted to delve further into the perspectives of each participant. In total, 16 interviews were conducted with an average duration of 45 minutes each. The semi-structured interview protocol included six fixed questions and opportunities for probe questions for clarification, elaboration, and pursuit of emergent topics (Rubin & Rubin, 2005). The use of participants' perspectives as data is a valuable method because "individuals' consciousness gives access to the most complicated social and educational issues, because social and educational issues are abstractions based on the concrete experience of people" (Seidman, 2006, p. 7).

Field notes, a way of "documenting observation" (Tjora, 2006, p. 429), were recorded during focus groups and interviews in a field notebook (Glesne, 2006). The researcher recorded facial expressions, pauses, movement, and other observed behavior that could potentially provide more context and insight into the transcriptions during analyses (Glesne, 2006).

Data Analysis

Qualitative data were initially transcribed and coded using a priori, descriptive, and in-vivo coding strategies. A priori codes were based on social cognitive theory's assumptions of self-efficacy, using each of the sources as a code. Process coding was then performed as the initial a priori codes began to suggest other related processes. Pattern coding was used as a second coding cycle strategy to group the codes into categories. These categories were then used to create themes through strategies like looking for similarities, differences, and repetitions (Miles et al., 2014). Strategies to increase credibility, transferability, dependability, and confirmability of qualitative data analyses and interpretations included bracketing, purposive sampling, multiple coding iterations, and triangulation of qualitative data sources (Anfara, Brown, & Mangione, 2002). In addition, this study employed member checks to increase the rigor of its findings (Lather, 1986).

Positionality

The researchers in this study operated from a broad feminist perspective that informed the conceptualization of this study and its analysis. The researchers sought to understand the challenges these young women encountered as high-performing, accomplished students in science, disrupting the victimizing, deficit perspective inherent to the discourse on women, and on women in STEM in particular. Indeed this work is inherently moral, seeking to challenge discourse, systems of privilege, and interactions that trouble women's lives. Moreover, the analysis sought practical outcomes, commensurate with feminist fieldwork analysis that would benefit both the participants, through conscientization, and practitioners, through new lenses and practices (Kleinman, 2007).

Findings

Three major themes emerged from qualitative, thematic analyses: (a) *strategic intentionality*, (b) *emotional toll of competition*, and (c) *obligatory goal setting*. There is considerable overlap between findings; while they are presented separately as is the fashion, they are not clearly delineated and are inherently interrelated. See Appendix A for a matrix of themes and related significant statements and formulated meanings.

Theme 1: Strategic Intentionality

The girls consistently described the competitive culture of their school. As one participant stated:

> Well, we're not like a typical high school where everyone is chill, chill about their grades. But, here, you have to get an A, if you don't, you're not considered one of the smart ones, or the normal ones. So, that's, since you want to keep up with everyone else, you want to try harder and that's the competitiveness.

As a result, girls identified their peers as competition, particularly with respect to college admissions candidacy. As one participant remarked:

> I guess it's kind of a shallow perspective, but you know these are the people that colleges are going to be looking at, too, and in life, I mean, they're your friends, which is the hardest part, 'cause you're friends with all of them but then, at the same time, you want whatever the grade is… you want to be the person who's the best in the class and people think of you as an intelligent person.

As peers were observed as competition, participants consistently expressed a desire to be the best in the class to maximize their college admissions candidacy.

The girls became very intentional regarding the courses they were going to take. Strategic considerations included grade expectancy outcomes, course levels, career alignment, and observed trends. With respect to grade expectancy outcomes, the girls favored courses they felt would result in higher grade point averages. With respect to course levels, the girls expressed pressure to take Honors and Advanced Placement (AP) courses. As one participant described:

> There are people in my grade who took AP Chemistry as a freshman; they took Chemistry over the summer between eighth and ninth grade. And now, sophomore year, they're taking AP Biology. So, I'm two years behind, that's definitely a pressure, I'm competing with these people in this school itself who have already taken these courses.

Due to their perception of their peers as competitors for college admissions, the girls felt even more pressure to maximize the amount of AP courses in their schedules to prove that they, too, could take advanced courses. Participants therefore tended to reserve non-AP or other elective courses for senior year. When coupled with grade expectancies, the participants expressed a preference for Honors and AP courses, regardless of whether or not they felt they were prepared to be successful in those courses. As one participant stated, "Sometimes I think I would fit better in regular, but since, for the future, honors would be a better choice." On the other hand, participants expressed avoidance or hesitation with taking Physics due to their fear of getting a lower grade in the course as a result of the course's perceived difficulty. As illustrated in one participant's rationale for not taking Physics:

> I heard that Physics was a super hard subject and I was, I am totally scared of taking it… My senior friends say that they really enjoy Physics but I am so scared of taking it

> because I've heard the stereotypes that it's really hard, even if it's honors, it's equivalent to an AP course.

Participants shared that if they were to take Physics, they would reserve the course for senior year when it had less of an impact on their college admissions transcripts or would take a general level of the course in lieu of the Honors or AP option.

The girls also prioritized courses that they self-identified as associated with pursuit of certain careers. For example, the majority of the participants had career aspirations in medical fields. As the girls consistently associated AP Biology and AP Chemistry with pursuit of medical careers, those interested in medicine expressed higher likelihoods of taking those courses. Physics was not prioritized as relevant to career goals.

Lastly, the girls looked to common trends to determine courses they should take. They often looked to their peers, particularly those they thought had the appearance of smartness as they were their competition for college admissions, and tended to express a higher likelihood of pursuing commonly taken course trajectories. While observations of common trends most commonly encouraged participants to take AP Biology and AP Chemistry, they often dissuaded the girls from taking Physics. As one participant stated, in defense of taking AP Chemistry and not Physics, "Chemistry is what most people choose. People don't really feel comfortable to take Physics." Participants, then, in acknowledgement of their school's competitive culture, viewed commonly pursued courses as those most appropriate to maximize college admissions candidacy.

Theme 2: Emotional Toll of Competition

The girls monitored their progress and position among their peers for college admissions candidacy through peer comparisons. They particularly focused on grades, classroom participation, and the appearance of smartness. With respect to grades, low grades or the possibility of earning low grades elicited negative emotional responses including self-doubt and insecurity. Participants consistently expressed the desire, generally referred to as "pressure," to earn high grades for college admissions. For example, one participant mentioned, "an average (school name removed) student, if they get a bad grade, their first thought is I won't get into college." In fact, many participants expressed concern over how their achievement would be viewed inside and outside the school building. A negative social stigma was also attached to lower grade achievement. One participant described, "Especially in this community, I feel like being successful is only defined as oh you have an A or oh you have a B." Further, participants' observations of higher success levels, often measured through the use of grades, discouraged them and lowered their sense of progress toward their career goals. As one participant's comments illustrated:

> You know, the comparing can really bring you down. You could think that someone is not as bright as you and then in your class you see they're scoring higher than you on a bunch of tests, and like, if I can't do better than this person, why am I even thinking about applying to this college.

As these comments illustrated, the perceived influence of grades on college admissions and their appearance of smartness in comparison to others heightened emotional responses of self-doubt and insecurity regarding their ability to achieve in the future.

These emotional responses were also elicited when participants observed higher frequency or stronger evidence of classroom behaviors, such as participating often, having the right answers, and the appearance of learning as effortless, that they associated with smartness. As one participant explained her self-doubt:

> I have to work a lot harder than some of my friends and, I don't know, they're good and they understand, but for me, I don't really understand science. It's usually that I sit at home and memorize everything the night before and I don't understand it while everyone else is talking about it and seeming like they're understanding it and saying the class is so easy.

In response to these comparison criteria, participants initially felt "inferior" to others. This feeling led them to limit their participation in class and not ask for additional help or support. They felt that "you'll be judged if you ask." It was not uncommon for participants to express hesitation in asking for help because of their insecurities, as illustrated by this participant:

> When I get that support, I utilize it, but I'm not always quick to ask for it. I guess I feel, I don't know, self-conscious. If I ask for help, you know, then I'm not good enough or something like that.

As evident in these data, the adoption of these classroom behaviors have a limiting effect on the amount of help participants received, which could present future struggles with respect to grades and subsequent advanced course enrollments.

Theme 3: Obligatory Goal Setting

The girls consistently expressed that parental pressure further exacerbated grade and course level expectations. While the girls internalized school pressures as a sense of responsibility and intentionality to maximize college admissions candidacy, they internalized parental pressures as a sense of obligation. One participant's comment typified this feeling:

> My parents have been through a lot for me to go to this school… it's a lot of pressure because you feel bad if you don't do something with your life or something valuable because they want to see me succeed.

Participants' repeated comments about making their parents "happy" or "proud" fueled the pressure they put on themselves to be successful. Participants often characterized this sense of giving back as being successful professionally.

The majority of participants had career goals in medical fields. Participants adopted career goals primarily through social persuasion, that is, from what others suggested they do. Parental advice was based on their concepts of appropriate career trajectories for their children, which could serve as encouragement or discouragement. As one participant explained her choice to pursue a career in medicine, "I've been told my whole life that it's great to become a doctor. You're a highly valued member of the community, of any community in the world." On the other hand, this participant's comments provided evidence of how her parents' experiences in science fields or advice could dissuade pursuit of certain trajectories: "I look at my mom sometimes… she would always be so stressed out… she's basically told me her whole life to not do that." Participants, whether persuaded or dissuaded, consistently felt pressure to identify a career path.

For those less clear on their career goals, the sense of urgency and emotional responses to pressure often led to the consideration and adoption of career goals that supplanted personal interests. As one participant stated, "You might not be interested in something, but if your parents want you to be interested in something then you have to take it to make them happy." Another participant further described this pressure:

> But my grandma puts so much pressure on me. I guess cause like, 'oh, how can you have a B, we need A's you should work and have A's in all classes and you should take science because I want you to be a doctor,' but I don't want to be a doctor, but she does not care about that. So, maybe that's why I feel I should be a doctor because she pushes, pushes me to do it, but I don't like it.

Not all participants felt pressure, per se, but they all received career advice from their parents. One participant explained, "My parents want me to go into something medical. They're not forcing me, but, because I don't know where to go yet, that's where they want me to go." Nonetheless, social persuasion from home regarding career trajectories has the potential to expand or narrow participants' scope of potential science course trajectories as a result of the identified career field and their connection to course selection strategies. See Appendix A for a summary of the influencing factors identified throughout the themes and their directional influence on decisions about the likelihood of pursuing AP Biology, AP Chemistry, and Physics.

Discussion

The research questions asked how high school girls decide the likelihood of taking AP Biology, AP Chemistry, and Physics, and what factors influence their decisions? Specific factors included past experiences in related courses, grade and course level expectancies, course enrollment trends, peer comparisons, parental pressures, and career orientation. As seen throughout the qualitative findings, the girls decided the likelihood of taking certain courses by negotiating these factors in the context of a competitive school culture. They accomplished this by adopting a competitive mindset, prioritizing science course pursuits that they believed would best support their college admissions candidacy and give them a competitive edge over their peers.

To maximize their college admissions candidacy, the qualitative themes of *strategic intentionality* and *emotional toll of competition* further depicted girls as competitors that weighed their perceived position among their peers with perceived science course pursuits. Parental pressure and the girls' resulting sense of obligation, as seen in the qualitative theme of *obligation-driven goal setting*, further informed the girls' perceptions of potential science course pursuits through a sense of urgency to identify career goals. While the adoption of career goals lessened some of the negative emotions due to competition by providing the girls with more direction and intentionality to their strategies to maximize their college admissions candidacy, the lack of guidance heightened the girls' doubt and insecurities once again. Their preferred science course pursuits, then, were those that they self-identified as best supporting their likelihood of meeting their college and career goals, balancing both internal and external pressures. This, however, often led to hesitation toward or avoidance of Physics out of concern that taking it would negatively impact their transcripts and college admissions candidacy.

Biology or Physics?

A major finding of this study was that the girls consistently expressed a higher likelihood and confidence level with respect to taking AP Biology and/or AP Chemistry, and a lower likelihood and level for Honors or AP Physics. This finding confirms gender inequality trends regarding girls' course preferences toward biology over physics. These girls had little to no exposure to physics prior to the study and, as such, may not have had the opportunity to develop the necessary efficacy beliefs to pursue related courses (Britner & Parajes, 2006; Kiran & Sunger, 2012). These results complement research that supports early exposure to physical sciences (e.g., Baker, 2013; DeJarnette, 2012). Furthermore, research has found that girls tend to have lower self-efficacies for science, with the exception of biology, than boys, and the lowest self-efficacies toward physics (Uitto, 2014). This tendency may account for the girls' higher perceived efficacy toward biology in comparison to other physical science courses regardless of other grade, course level, or career goal considerations.

Psychologically, the study found that participants' determinations of self-efficacy and perceptions of STEM self-efficacy are made with a heightened sense of self-doubt and insecurity. This finding complements other research findings that girls make efficacy determinations in heightened states of emotional responses (Kiran & Sunger, 2012; Schunk & Meece, 2005). More specifically, girls tend to more often exhibit signs of depression and anxiety (Kiran & Sunger, 2012) and, particularly in male-stereotyped tasks, tend to have higher stress levels (Spencer et al., 2016). In turn, these emotional responses may lead to girls’ hesitation toward or avoidance of certain educational trajectories.

In this study, the girls, however, were able to overcome these emotional responses and pursue AP Biology and AP Chemistry. One explanation is that girls experience higher levels of science anxiety, regardless of efficacy levels (Mallow, 2006; Udo, Ramsey, & Mallow, 2004). Science anxiety occurring regardless of efficacy levels could, then, account for these participants’ tendency to stay enrolled in courses rather than drop out, despite these initial, negative physiological responses. However, this explanation fails to account for why the participants continued to express hesitation toward or avoidance of physics. The continued influence of gendered science course appropriateness, then, may account for why the participants were able to overcome science anxiety and persist in biology and chemistry, but not for physics (Makarova et al., 2015). Girls, for example, may act differently upon their perceived self-efficacy levels, making determinations of how much energy or extra effort they are willing to expend to overcome, or, at the very least, not confirm, their own or others’ gender-biased success expectations (Shapiro & Williams, 2012). Adoption of gendered beliefs about physics, then, could lead to the avoidance of such courses.

Career Orientation

Another explanation for why girls in the study were able to overcome emotional responses to AP Biology and AP Chemistry, but not for Physics, is their career orientation. This study's findings indicated that the girls consistently associated taking AP Biology and AP Chemistry with an interest in pursuing medical fields. This supports literature that has found that professional reference tends to be associated with advanced course and degree enrollments, regardless of other efficacy considerations (Teppo & Rannikmae, 2003). This fails, though, to account for the girls' perceived irrelevance of physics in connection to their medical career goals.

Existing research may help to explain this limited school-based and parental guidance as a result of capital, referring to cultural and gendered assumptions of appropriate career trajectories (Schunk & Meece, 2005). Another explanation may be that girls' and women's acknowledgement and continued observance of gendered science participation trends and stereotypes perpetuate lower efficacy beliefs toward actual pursuit of those types of fields (Hill, Corbett, & St. Rose, 2010). Continued observance of gendered science participation trends within and outside of the school environment may confirm cultural and gendered assumptions of appropriate educational and career paths and, in turn, further perpetuate gendered guidance that girls receive regarding their potential science educational and career options.

Gender & Competition

Study findings further suggest that gender role socialization regarding how men and women perceive, interpret, and act in competitive situations influenced the girls' perceptions of potential science course pursuits. Research surrounding gendered competition is primarily limited to the field of marketing. Literature has found that women are equally competitive as men when competing against other women in competitive situations (Niederle & Vesterlund, 2008). However, when competing against men, they become less competitive (Niederle & Vesterlund, 2008). Performance and participation differed when men and women competed in gender-stereotyped tasks (Dreber, von Essen, & Ranhill, 2014; Schmader, 2002). For example, men were more likely than women to compete in math tasks in comparison to equal willingness of each gender to compete in verbal tasks (Dreber et al., 2014). In competitive situations, women were more likely to decrease performance on a math task if they had a strong female gender identity, while men, regardless of the strength of their male gender identity, performed at the same level (Schmader, 2002). As competition and the school's competitive culture were prevalent across themes, this study's findings illuminate yet another way that gender role socialization influences how girls perform in the science and math classroom settings, how they interpret their competencies in male-gendered fields, and, in turn, how they determine their perceptions of potential science course pursuits.

Implications

This study's findings have implications for policy, research, and practice. Current educational policies that seek to increase girls' participation in STEM and, more specifically, in physical sciences, fail to consider the interrelatedness of the various environmental, behavioral, and personal factors that inform girls' efficacy and subsequent science course and career trajectories. Current federally funded STEM educational programs encompass a wide variety of objectives related to increasing both competency and availability of a STEM-literate workforce. According to the National Science and Technology Council's Committee on STEM Education 2013 report, these objectives included developing students' STEM skills, increasing interest in STEM fields, providing professional development to teachers, supporting STEM degree and career pursuits, establishing partnerships, and promoting research opportunities on STEM best practices. However, a more integrated approach is suggested as these policies in isolation are not having their desired effect on increasing girls' participation in STEM, as evident in persisting gender inequality trends.

Likewise, research has identified several instructional approaches to increase students' interest in STEM. For example, provision of authentic learning experiences (Dijkstra & Goedhart, 2011), creation of partnerships between schools and professions in the industry (Ejiwale, 2012; Watters & Diezmann, 2013), and use of field tools (Baloian, Pino, & Hardings, 2011) have all been found to increase students' interest and attitudes toward STEM fields. However, like policy efforts, this research often fails to consider how girls, from a social cognitive perspective, perceive, interpret, and, subsequently, act upon such learning opportunities in a given context. An integrated approach to research, one that examines not only the instructional practice's impact on girls' interest and attitudes toward STEM, but also the internal, efficacy-activated processes in relation to other environmental factors that are associated with their change in interest and actions, is suggested to better understand how gender influences their experiences with those instructional practices. In doing so, we may better understand the internal mechanisms and external conditions most associated with narrowing or expanding girls' perceived scope and actual pursuit of STEM educational and career trajectories.

With respect to practice, this research suggests that schools place a stronger emphasis on providing information to all stakeholders involved in the course and career decisions of students regarding college admissions, science course requirements, and STEM career fields. In light of competitive norms, schools might consider non-competitive extracurricular activities and employ instructional strategies like personal and collective goal setting to reduce the competitive norms of the learning environment. An integrated approach, addressing the environmental, behavioral, and personal factors highlighted in this study's findings, is needed to address the issue of girls potentially opting out of traditionally male-dominated courses like physics.

To accomplish a more integrated approach to efforts to increase girls' participation in physical sciences, continued research regarding the specific environmental, behavioral, and personal factors of the studied population are needed. A multilevel case study design may provide deeper understandings of how others involved in girls' course pursuit decisions are supporting or discouraging their participation in physical sciences. Such a design would allow for the examination and integration of the perspectives of teachers, parents, and other stakeholders into our current understandings of how girls are making sense of their potential science course pursuits. Multiple cases would also allow for deeper explorations of how culture, socioeconomics, and other factors intersect with gender to inform efficacy beliefs and perceived and actual course pursuits.

Increasing girls' participation in high school advanced physical sciences courses is a necessary step to provide all students the opportunities to develop the foundational knowledge and skills required for further development in all science domains. Without these experiences, how can we expect girls to have the needed STEM literacy, particularly with an understanding of the earth as a system, to combat sustainability threats through personal and professional actions? Moreover, without dismantling barriers to girls' exposure to these learning opportunities, how can we expect them to develop the necessary agency beliefs to consider actual pursuit of STEM-related education and careers?

Conclusion

Findings suggest that perceived self-efficacy in STEM domains alone is insufficient to promote equity and justice in high school girls' science course participation, particularly in physics. With the understandings gleaned from this study, we must consider the multiple efficacy-related environmental and behavioral factors that influence girls' determinations of potential science course paths. The study participants were high achieving and had high perceived STEM self-efficacy, yet expressed hesitation toward or avoidance of physics. At the same time, they exhibited a strong awareness of and intentionality about their decision-making processes. In light of persisting gender inequality participation trends in advanced physical science courses, their self-created and self-adopted strategies may be prematurely narrowing their potential science course and career trajectories. While we must still consider the external factors and structures that are inhibiting girls from reaching their full potential, we must also consider the internal processes and intentional decisions that girls are making. In doing so, we may provide girls with the necessary tools and resources to make informed decisions to reach their full potential in all areas of STEM.

Future research in the area of examining girls' efficacy-activated processes should, first, consider the intersectionality of gender and other factors such as socioeconomic status and ethnicity. Second, related case studies that put this research focus in the context of a specific instructional practice or program would contribute to a more comprehensive view of the interplay among environmental, behavioral, and internal factors that influence girls' perceived self-efficacy and, ultimately, their decisions of which science educational and career paths to pursue. Longitudinal case studies, in particular, would allow for further exploration of girls' perceived self-efficacy development over time in relation to actual educational and career paths pursued.

This study's findings are timely because the NGSS recently increased expectations for all students to have an understanding of the earth as a system. That understanding requires foundational skills and knowledge of physical sciences, necessitating the need for gender equality regarding access to and participation in advanced physical science courses. The NGSS movement is more than a set of standards; it is a call to action. It is a call to ensure equitable access to learning opportunities to build all students' knowledge of earth as a system and of related physical science principles to meet demands for a STEM-literate society and workforce. Promoting gender equality in science educational trajectories is one way that we may, collectively, better promote sustainability, human welfare, and social justice.

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Appendix A

Sample Significant Statements and Formulated Meanings by Theme

Theme	Significant Statements	Meaning
Strategic Intentionality	"You're expected to take harder courses." (P2) "My GPA and I need to show university that I'm able to take honors and AP." (P3) "Sometimes I think I would fit better in regular, but since, but for the future, honors would be a better choice." (P6) "Junior year is a really important year for college… would be the best year to take the hardest work." (P13) "That put even more pressure on me to take honors class then because the highest you could go was a 4.3 [in honors] and it would be like a 3.7 [in regular]." (P15) "An A or a B is good, but it depends on what college I go to." (P16)	Grade and course level expectancy
	"There are only like two more years before college… If you know you like a specific subject, you can go into a college that's good in that specific subject area." (P1) "If you really want to take medicine, you'll really want to take AP Bio or Chem." (P4) "To become a veterinarian doctor, then, I know the grades I need to get to get into the courses I want." (P7) "[Taking physics], I don't think it's related." (P9) "I have to take the right courses… to be a pediatrician." (P10)	Alignment to career goals
	"I think most people they, like, do like Chemistry and then Biology, and then APs are junior year." (P5) "These are the people that colleges are going to be looking at too and in life, I mean, they're your friends." (P8) "You want to be able to say, I got a 100… what did you get?" (P11) "You have to work a lot harder to like make yourself noticed in this school." (P12) "I think most people from this school go to, they do really well in, and go to like good colleges and it's competitive." (Participant 14)	Position among peers

Emotional Toll of Competition	"There are some really smart people who ask interesting questions, so I was like debating with myself if I should drop it or something." (P2)	Doubt, insecurity
	"When I saw how they were doing this, I thought I was stupid." (P3)	
	"[After comparing a grade] I feel disappointed in myself for not being able to do something that I knew I could have done." (P5)	
	"Sometimes I don't feel as confident." (P6)	
	"When you see someone getting stuff right… you start wondering if it's the right course for you." (P10)	
	"You worry if colleges only take two students from your school, you're not going to be one of them." (P11)	
	"[When] everyone else around me has the answer right there and sometimes I feel I'm behind other kids." (P12)	
	"I look at my friends, the friends I have that already took AP Bio and AP Chem, I think, do I actually have a chance at life?" (P13)	
	"You could think that someone is not as bright as you and then in your class you see they're scoring higher than you on a bunch of tests, and, like, if I can't do better than this person, why am I even thinking about applying to this college?" (P14)	
	"If I compare myself with my other friends, it will put me down." (P15)	
	"Based on what I know I like Bio more than Physics. Obviously since I haven't done Physics yet I don't have a good understanding on it." (P1)	Fear or avoidance of the unknown
	I have a friend, he takes AP Physics and he says it's really hard so I'm not so sure [if I would be successful in it]." (P4)	
	[In response to what she's heard about Physics] "I'm definitely staying away from Physics if I can help it." (P7)	
	"I've heard from other students that it's the hardest course you could take… I don't think I'm going to go into it." (P8)	
	"If I get a single bad grade… there's a lot of unknown. You don't know if you'll get into college or the right college." (P9)	
	"I haven't tried Physics yet, but from what I've heard, right now I'm not very interested in it." (P16)	
	"But, my grandma… she thinks that I need to have A in every course,	Family

and be smart, and go to the best university." (P3) "If I get an A, they're like 'good job' and then if I get a B, they're, like, 'you need to get an A'." (P5) "I actually was going to choose regular Chem, but then my parents told me to take honors." (P6) "They have really high standards." (P9) "Parents are a factor in that they think you have to take an honors class because everyone's taking an honors class." (P10) "My parents insist that I have to know what I want to do now." (P12)	pressure
"My parents want me to go into something medical." (P1) "Very few girls are extremely, they may not be averse to Physics, but they're not really interested in it either." (P7) "My sister is currently in a medical school so she definitely has set some standards for me." (P8) "My aunt's a neurologist... So, when I visit her I see whatever she does." (P9) "I've been told my whole life that it's great to become a doctor, you're a highly valued member of the community." (P11) "It gives me some reassurance, that there's someone in my family who has been successful going down that [career] path." (P16)	Socialized career paths
"I think it's because they've sacrificed so much for like… I want it to have a good outcomes and make them feel like it was worth it." (P2) "They lecture me to do better and stuff so I feel disappointed." (P4) "My parents have been through a lot for me to go to this school… You feel bad if you don't do something with your life." (P13) "I want to give back to my parents." (P14) "I think a lot of people in this school are like first generation here and they also have that pressure." (P15)	Sense of obligation

Note. P=Participant. Each theme includes one representative significant statement from each of the 16 participants.