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Situated balancing of dual identities in adolescence: the association between science and gender identities

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Introduction: Individuals employ two types of strategies to navigate conflicting identities and reduce dissonance, particularly in contexts where one identity is devalued. They may selectively distance themselves from a subset of traits associated with one group (e.g., gender) which are stereotypically devalued in a particular domain (e.g., science), or they may distance themselves from the devalued group altogether and align closely with the high-status group. Alternatively, individuals may choose to withdraw from the previously valued achievement domain in response to societal signals indicating that their identity is misaligned with success in that domain. Past research on managing dual identities has been on adults. Surprisingly little research has examined whether and how such strategies play out in adolescence. Adolescence represents a critical period for identity formation, during which youth actively construct their self-concept in response to salient societal expectations and emerging interests in academic and career domains. Are dissonance reduction strategies evident in early adolescence among girls seeking to balance their gender identity and science identity? Is this balance affected by situational threats that make the incompatibility of identities more salient?

Methods: We report a longitudinal study of adolescent girls recruited from 10 schools across the United States (N = 2,056) to investigate how adolescent girls balance two social identities that are culturally misaligned.

Results: Results showed that among adolescent girls who report strong science identity, belonging, and self-efficacy in science (i.e., strong science self-conceptions)-greater perceptions of threat in classroom settings were associated with a tendency to distance themselves from their gender. Situational threat was also associated with stronger implicit stereotypes about science as a male domain.

Discussion: These identity negotiations suggest that some girls cope with the misalignment between femininity and STEM by repositioning themselves as different from other girls, which reinforces, rather than disrupts, the stereotype that science is a male-dominated domain. Theoretical and practical implications of these findings are discussed.

KEYWORDS

adolescence, gender, identity, science education, social identity threat

1 Introduction

Every person belongs to multiple social groups—some of these group identities are assigned at birth based on biology (e.g., sex) or family and cultural geography (e.g., race, ethnicity, religion), while others are chosen based on socialization or personal interests and goals (e.g., gender roles, academic interest groups, professional groups). When individuals are able to harmoniously align their self-concept with multiple group identities, belonging to several groups feels subjectively easy and is associated with positive health and wellbeing (Easterbrook et al., 2025; Héliot et al., 2020; Jetten et al., 2015, 2017). However, when multiple identities are misaligned, individuals experience dissonance, resulting in difficulty adapting to varied social contexts, anxiety, frustration, avoidance, reduced satisfaction, and negative health outcomes (Anderson and Koc, 2020; Benet-Martínez and Haritatos, 2005; Diekman et al., 2017; Eccles, 1987, 1994; Markus, 2008; Schmader and Sedikides, 2018; Stephens et al., 2012; Syed and McLean, 2016). In social contexts with strong normative pressure, identity misalignment may lead individuals to sacrifice their chosen identities and conform to the expectations associated with their assigned identities at birth (see review by Van Veelen et al., 2020).

Adolescence is a critical period in human development during which young people begin to explore and navigate multiple social identities. They assess which identities feel most personally meaningful, how these identities fit in varied social contexts, and work to integrate them into a coherent self-concept (Hill and Lynch, 1983; Steensma et al., 2013). Adolescents also adopt traits, behaviors, interests, and gender roles that are normatively viewed as masculine or feminine and agentic or communal in their local context (Block et al., 2018; Brown and Tappan, 2008; Hannover, 2000; Klaczynski et al., 2020; Ojanen et al., 2005; Skinner and Wellborn, 2019). Boys who identify with masculine norms often perceive agentic professions—such as technology or engineering—as congruent with their gender identity. Girls who identify with feminine norms typically view communal careers—such as teaching or nursing—as a natural fit. However, for girls, choosing an identity or aspiring to professions that emphasize agentic qualities—such as becoming a scientist, surgeon, or inventor—sometimes feels incongruent with their gender identity. Adolescent girls whose interest and curiosity in science form a substantial part of their self-concept may experience tension between their chosen identity as budding scientists or technologists and the ascribed gender role expectations placed upon them. This conflict is likely to lead to dissonance between girls' science identity and their gender identity (Brotman and Moore, 2008; Settles et al., 2009; Orlandi, 2017; Tran et al., 2011).

Misalignment between ascribed and chosen identities presents a psychological dilemma, leading girls to adopt varied coping strategies. Some reduce dissonance by distancing themselves from their gender identity, whereas others disengage from their STEM aspirations (Dasgupta, 2011; Dasgupta and Stout, 2014; Wang and Degol, 2017). For example, many girls, despite their talent and interest in science, disengage and ultimately leave STEM pathways before high school (Clark Blickenstaff, 2005; Legewie and DiPrete, 2014; Kim et al., 2018), whereas other girls may distance themselves from their gender, reducing its importance to their self-concept, and keep persisting along STEM pathways. Surprisingly little research has empirically investigated how girls balance these two identities in adolescence, how social contexts impact multiple identity management, and the extent to which girls' interest and identification with STEM is associated with their gender identity, particularly in early adolescence. The goal of the present research is to address this gap in the literature by examining the association between girls' science identity and their gender identity and by investigating whether this association varies as a function of the social context, particularly in an educational context that elicits feelings of threat.

2 Identity development in early adolescence

Identity misalignment is likely to be particularly salient for girls in early adolescence (i.e., 12-14 years of age), a critical developmental period where they begin to navigate societally expected gender roles. Gender socialization in early adolescence is the process of being nudged to adopt gender role-consistent traits, behaviors, and interests, through a process of learning and negotiation with peers, parents, and significant others (Hill and Lynch, 1983; Steensma et al., 2013). Early adolescence is also marked by significant biological, psychological, and social role changes that shape girls' gender identity (Clemans et al., 2010; Rogers et al., 2020; Steensma et al., 2013). Notably, this period is characterized by an intensification of gender-related expectations, with the onset of puberty acting as a biological catalyst that can trigger increased self-consciousness and body insecurity as girls become more aware of their own sexuality (Clemans et al., 2010; Rosenbaum, 2014). With these bodily changes, girls face significant psychological and role shifts as they learn to navigate traditional gender norms and expectations after their onset of puberty because they are treated differently by people interacting with them (Rogers et al., 2020). They develop a deeper understanding of their place within the gendered social hierarchy, while facing varying degrees of pressure to conform to traditional gender roles from parents, teachers, and peers (Leaper et al., 2012). Navigating these changes is the process of gender identity development that has lasting consequences as girls approach adulthood.

Notably, adolescence is also a critical period for the development of science identity (Kang et al., 2019). Science self-concept has been examined through multiple theoretical lenses and is comprised of three key components: identification (or identity centrality), which emphasizes the importance of science to one's self-concept (Ramsey, 2013; Sandrone, 2022); self-efficacy, reflecting confidence in one's scientific ability (Dasgupta et al., 2022; Williams and George-Jackson, 2014); and belonging, highlighting feeling accepted in environments involving STEM learning (Dasgupta et al., 2022; Rainey et al., 2018). Difficulty comprehending science or math or heightened anxiety about these subjects in early adolescence has been found to have long-term consequences, influencing young people's academic trajectory in late adolescence and early adulthood, restricting opportunities in college and future STEM careers (Ainley and Ainley, 2011; Eccles et al., 2004; Loveless, 2013; Maltese and Tai, 2011; Maltese

and Cooper, 2017; Osborne et al., 2003; Simpkins et al., 2006). Foundational concepts in science and math are typically introduced in early adolescence in middle school classes in the United States (grades 7 and 8), and mastery of these concepts is crucial to understand more complex concepts encountered later in high school and college. Research shows that adolescents' academic interests in middle school strongly predict their persistence in STEM through high school and college (Ainley and Ainley, 2011; Eccles et al., 2004; Loveless, 2013; Maltese and Tai, 2011; Maltese and Cooper, 2017; Osborne et al., 2003; Simpkins et al., 2006). A national longitudinal study found that 13 and 14 year-old adolescents who expressed early interest in math and science in middle school were significantly more likely to choose and complete STEM degrees in college (Maltese and Tai, 2011). These findings underscore the importance of middle school as a formative stage for shaping long-term STEM trajectories.

As both STEM and gender identities develop concurrently in adolescence, this is a critical period to examine the trade-offs girls face as they navigate and balance their ascribed and chosen identities to develop a cohesive self-concept. Adolescent girls are often exposed to societal narratives that position these identities as conflicting rather than complementary. These messages suggest that they are less talented in science and mathematics than boys, which increases their awareness of their lower status in STEM fields (Breda et al., 2020; Bian et al., 2017; Dasgupta and Stout, 2014; Gunderson et al., 2017). These messages are sometimes reinforced by parents, peers, and media representations of "brainy" inventors that are disproportionately male (Ertl et al., 2017; Shapiro et al., 2015). Girls also receive messages suggesting the traits, behaviors, and roles appropriate for them involve nurturance, interdependence, empathy, and caregiving–all stereotypically feminine attributes.

In comparison, STEM fields are framed as requiring assertiveness, independence, logic, and dispassion, which seem misaligned with stereotypically feminine traits, behaviors, and roles, and better aligned with their masculine counterparts (Dasgupta et al., 2022; Miller et al., 2015). These societal stereotypes often influence the norms and expected behavior in STEM classrooms. Science classes also tacitly send the message that innate brilliance is required for stellar performance, and that brilliance is more likely to be a characteristic of male than female students (Bian et al., 2017, 2018; Leslie et al., 2015).

Given these gendered stereotypes about STEM, it is no wonder that science classrooms can be fraught spaces for girls, intensifying concerns about competence, especially as the subject matter gets difficult and students find themselves stretching and struggling to grasp the content. It is in these moments that they may attribute the struggle to an internal cause (inadequate talent) rather than an external cause (the content is difficult), thereby increasing threat and anxiety. This experience is a form of social identity threat, wherein girls may become concerned that their struggles in science could be taken as confirming the stereotype that their gender is devalued or perceived as less competent in the science domain (Branscombe et al., 1999; Shapiro and Neuberg, 2007; Steele et al., 2002). This specific form of identity threat is known as stereotype threat. Once stereotype threat is activated, the dissonance between girls' ascribed gender identity and their chosen STEM identity is likely to become salient. This heightened awareness can lead to internal conflict, prompting girls to question whether they can pursue STEM with confidence without compromising aspects of their gender identity. Some girls may feel discouraged from persisting in STEM-related pursuits despite their initial interest and aptitude. Others may adopt identity management strategies—for example, downplaying their gender, emphasizing individual traits over group membership, or aligning with masculine norms—to carve out a viable space for themselves within STEM fields.

2.1 Identity management strategies when experiencing dissonance

A substantial body of social psychological research has identified two primary strategies that individuals employ to navigate conflicts between social identities, particularly in contexts where one identity is devalued. The first strategy involves individuals choosing to stay in the achievement domain by using self-group distancing strategies such as identity bifurcation—selectively distancing themselves from traits or values associated with one social group (e.g., gender) that are stereotypically devalued in a particular domain (e.g., science; Betz and Sekaquaptewa, 2012; Pronin et al., 2004). For instance, in science classrooms, girls may avoid discussing interests culturally stereotyped as feminine, such as fashion or pop culture, or may choose clothing culturally perceived as feminine to reduce the salience of their gender identity. An alternative strategy is to align themselves more closely with the high-status identity group, strategically portraying themselves as prototypical members of that group (Van Veelen et al., 2019, 2020). For instance, in the classroom setting, girls might emphasize agentic traits such as competence, assertiveness, and independence (qualities culturally associated with boys) to align themselves with the prototypical science student. Both are examples of self-group distancing. Self-group distancing has been studied extensively among adult women in STEM. For instance, women pursuing STEM degrees often engage in subtle, strategic distancing from both feminine peers and stereotypically feminine traits that are perceived as incongruent with the masculine norms valued in STEM (Pronin et al., 2004; Bergsieker et al., 2021). For example, they are less likely to choose feminine clothing and hairstyles, discuss parenting, or shopping. By distancing themselves from stereotypically feminine behaviors, they reduce the salience of their gender in STEM contexts, mitigating the application of negative stereotypes to themselves, which would raise questions about their competence and belonging in these fields. Similar patterns are observed in other achievement domains, such as professional leadership, where agentic norms often conflict with the communal traits traditionally associated with women. Women applying for leadership positions frequently downplay stereotypically feminine characteristics—such as warmth or nurturance—while emphasizing agentic traits like competence and assertiveness. This identity management strategy helps counter persistent stereotypes that women lack the qualities associated with effective leadership (Ellemers, 1993; Faniko et al., 2016, 2017, 2021).

Self-group distancing strategies are often observed at the behavioral level; however, these strategies can also operate implicitly. Balanced Identity Theory (BIT) offers a framework for understanding how adolescents' self-concept, group identities, and attributes associated with STEM are interconnected within a coherent cognitive network. Conflicts among these associations may prompt cognitive adjustments (Cvencek et al., 2012; Greenwald et al., 2002). According to BIT, when inconsistencies—such as those arising from social identity threat or stereotype threat—emerge, the weakest association within the network is most likely to adjust in order to restore balance. In the context of science-gender conflict, a girl interested in science may experience an imbalanced triad: a positive self-science link, a positive self-gender link, and a negative science-gender link, due to stereotypical beliefs that science is associated with men more than women. BIT posits that the cognitive balance is restored by adjusting the association that offers the least resistance.

One commonly studied balance-restoring strategy has been the weakening of the self-science connection when faced with an imbalance of multiple identities, resulting in reduced interest in science and domain disidentification (Shapiro and Neuberg, 2007; Smith and White, 2022; Koenig and Richeson, 2010). But what if the self-science connection remains strong for some individuals? What other strategies are available to them to regain identity balance? Notably, BIT has rarely been applied to cases where the self-science link is strong to test how cognitive balance is regained.

While research on identity management strategies has yielded important insights, most of this work has focused on adult women at mature stages of identity actualization or professional life. There is a striking dearth of research examining whether and how such strategies emerge earlier in human development, particularly in adolescence (Van Veelen et al., 2020). The existing research is limited to a handful of small qualitative interview studies with three to 10 girls as cases (Archer et al., 2012, 2014; 2016; Francis et al., 2017).

Drawing on interviews with girls aged 10–14, these studies show that negotiating gender identity is a central theme for girls who are interested in science. Specifically, girls reported distancing themselves from traditional femininity and framed their aptitude for science as being different from their female peers, rather than seeing their gender group as collectively capable of success in science. Some adopted labels such as "tomboy" to signal this distancing. Girls who felt more belonging in science contexts saw femininity and science engagement as incompatible. In these cases, girls tended to prioritize their STEM identity over their gender identity, emphasizing that their passion for science reflected their authentic selves, even in environments that subtly implied otherwise.

While these findings suggest how science-interested girls manage dual identities, the conclusions are constrained by very small, non-representative samples. It remains unclear whether identity distancing will emerge with large samples of adolescent girls, and how situational threats in the classroom shape this process. This gap in knowledge is striking given that early adolescence is a critical developmental period in which gender identity becomes more salient, foundational STEM knowledge is acquired, and academic identities take shape. Addressing this gap is essential for understanding the developmental origins of gender–STEM identity tensions and for informing future interventions that support smooth identity integration and sustained engagement in STEM among girls.

2.2 Goals of the present study

Building on the identity management literature, the present study examines whether dissonance-reduction strategies are evident in early adolescence. Specifically, we search for the use of such strategies among adolescent girls in middle school who are seeking to balance their gender identity and science identity and investigate whether this balance is affected by perceived situational threats in science class that make the incompatibility of these identities more prominent. We hypothesize that among adolescent girls who report strong science self-conceptions—characterized by strong science identification, belonging, and self-efficacy in science—greater perceptions of threat in classroom settings will be associated with less closeness to their gender group, reflecting a tendency to distance themselves from their gender.

Adolescence represents a critical period for identity formation, during which youth actively construct their self-concept in response to salient societal expectations, gender norms, and emerging interests in academic and career domains. This stage is not only foundational for shaping long-term aspirations but also potentially marks the onset of tensions between ascribed and chosen identities—such as between one's gender and a potential interest in traditionally male-dominated fields like STEM. Investigating whether girls at this age already engage in identity distancing, suppression, or integration strategies can provide valuable insights into the early emergence of self-regulatory responses to threat. Because early adolescence is a pubertal developmental period during which gender identity develops and foundational knowledge in science and math is acquired, shaping nascent academic identities, it provides an opportunity to investigate how adolescents integrate dual identities, especially when they don't neatly align with gender role expectations. Studying these processes in middle school promises to inform the development of future theory-driven interventions to foster authentic identity development and sustained engagement in STEM in girls.

3 Materials and methods

3.1 Participants

Data were collected from eighth-grade students at 10 private middle schools across three geographic regions of the United States—the northeast (Pennsylvania, Delaware), west coast (California), and the south (Texas)—between 2014 and 2019. Five of the schools were coeducational, and the remaining five were all-girls schools. These data were part of a large study examining contextual factors and individual differences that influence adolescents' experiences in mathematics and science in

8th grade in middle school, the year before they transitioned to high school. The original dataset comprised a sample of $N = 2799$ students (2056 girls, 712 boys, 31 non-binary students). Given the research questions driving the present study, we extracted a subset of the original data that included only girls ($n = 2056$) and only used variables related to their experiences in science classes in the 8th grade. In terms of race and ethnicity, 60.9% of participants were White ($n = 1253$); 12% were Asian or Asian American ($n = 247$); 6.5% were Hispanic ($n = 150$); 5.3% were Black or African American ($n = 109$); 0.05% were Native American or Pacific Islander ($n = 1$); and 13.3% of participants identified as multiracial (n = 273), and 1.1% identified with other racial/ethnic groups ($n = 23$).

3.2 Procedure

With parental consent and participant assent, students completed an online survey self-reporting their experiences in 8th-grade science class. The survey was administered twice: once at the beginning of the school year (September-October; Time 1) and again at the end of the school year (March-May; Time 2). The survey assessed their experiences in the context of science class: whether they experienced positive motivation (approach orientation in science class) or anxiety (avoidance orientation in science class), as well as self-beliefs in relation to science, specifically, science identification, science self-efficacy, and a sense of belonging in science class. The survey also measured participants' strength of gender identification and the implicit and explicit stereotypes associating science with males.

3.3 Measures

Perceived Threat. Three items ($\alpha = 0.85$) were adapted from a study by Dennehy and Dasgupta (2017) to assess if students perceived their science classes as anxiety-provoking. Items included: "How stressed do you feel about your science class?," "How unsure do you feel about your science class?" and "How worried do you feel about your science class?" All items were rated on a 5-point scale anchored by "Not at All" (1) to "Very Much" (5), presented in random order, and responses averaged to create a composite measure.

Science Identification. Four items ($\alpha = 0.79$) were adapted from a study by Stout et al. (2011) to assess how strongly students identified with science. Items included: "How much do you care about doing well in science?," "How valuable is science to you for your future?," "How useful do you think the science you are learning now will be for you in high school?," and "How important is it for you to do well in science?" All items were rated on a 5-point scale anchored by "Not at All" (1) to "Very Much" (5), presented in random order, and responses averaged to create a composite measure.

Science Self-Efficacy. Four items ($\alpha = 0.77$) were adapted from a study by Stout et al. (2011) to assess students' appraisal of their science ability. Items included: "How confident do you feel about your science class?", "Do you think science is one of your strengths or weaknesses?", "Do you think you're talented in science?", and "Do you work hard to do well in science class?" All items were rated on a 5-point scale anchored by "Not at All" (1) to "Very Much" (5), presented in random order, and responses averaged to create a composite measure.

Belonging in Science Class. Six items ($\alpha = 0.84$) were adapted from the Sense of Belonging Scale (Good et al., 2012) to assess students' feelings of belonging in their science class. Items included: "I feel like I belong in this science class," "I feel a connection with this science class," "I feel like an outsider in this science class," (reverse coded) "I feel accepted in this science class," "I feel comfortable in this science class," and "I feel that I am inadequate in this science class" (reverse coded). All items were rated on a 5-point scale anchored by "Strongly Disagree" (1) to "Strongly Agree" (5), presented in random order, and responses averaged to create a composite measure.

Gender Identification. Six items ($\alpha = 0.87$) were adapted from the Collective Self-Esteem Scale by (Luhtanen and Crocker, 1992) to assess the extent to which students identified with their gender. Items included: "I feel close to other students of my gender," "I feel like I fit in with other students of my gender," "In general, my gender is an important part of my self-image," "I am happy with my gender," "I am proud of my gender," and "I feel good about my gender." All items were rated on a 5-point scale anchored by "Strongly Disagree" (1) to "Strongly Agree" (5), presented in random order, and responses averaged to create a composite measure.

Implicit Science-is-Male Stereotypes. The Implicit Association Test (IAT; Greenwald et al., 1998) was used to assess the degree to which students implicitly stereotyped science as a male domain and English language and literature as a female domain. Participants completed a computerized task that measured the relative strength of associations between two target concepts (e.g., science vs. English) and two attributes (e.g., male vs. female), with response latency serving as the operational measure of belief strength. Participants completed seven blocks of trials, consisting of three practice blocks and four data collection blocks. The order of data collection blocks, stereotype-compatible (science + male, English + female) vs. incompatible (science + female, English + male) was counterbalanced between participants (see Nosek et al., 2002). Implicit stereotypes linking science with males were assessed by measuring the speed with which participants paired science-related words (e.g., hypothesis, data, experiment) and English-related words (e.g., literature, grammar, essay, vocabulary) with either male vs. female (pro)nouns (e.g., he, male, boy vs. she, female, girl). Positive IAT scores indicate a stronger implicit association between male and science, zero scores indicate no association between subject and gender, and negative scores suggest a stronger implicit association between female and science.

4 Data analytical plan

Data analyses focused on three predictor variables measured toward the end of the school year (Time 2) once participants had been immersed in science class for several months: participants' science identification, self-efficacy in science, and belonging in science class. Two primary outcome variables were also measured at

Time 2: the degree to which gender was important to participants' self-concept (gender identification) and implicit stereotypes about science. To account for baseline individual differences, all these variables measured at the beginning of the academic year (Time 1) were included as controls in the statistical models.

Prior to testing our research questions, we first examined descriptive statistics and distributions for all study variables. Any variables that were not acceptably symmetrical (skewness of < 1 or > 1) were numerically transformed. Due to the nested structure of the data (students nested within classrooms nested within teachers) we employed multilevel structural equation modeling (MSEM; Preacher et al., 2010), to account for such nesting-related dependencies in the data, as estimated by the Mplus 8.4 program (Muthén and Muthén, 2017). Additionally, MSEM allows for the use of full information maximum likelihood estimation to address missing data, which enables us to retain all students with data on at least one of our study variables (Allison, 2009). We accounted for the nesting of student responses (Level 1) within teachers (Level 2) in all analyses. This choice aligns with prior work from this study, indicating that the nesting structure using teacher, rather than classroom, accounted for a greater proportion of level 2 variance (Dasgupta et al., 2022). The nesting of teachers within 10 distinct schools was accounted for with a standard error correction using TYPE = COMPLEX in Mplus.

To test our primary research questions, we estimated three models for each outcome variable at Time 2, controlling for the effects of all predictors and moderators at Time 1. All predictor variables and covariates were group mean-centered at level 2 to ensure effects represented student-level associations among the variables free of classroom-level differences. The first set of three models examined the degree to which the effect of perceived threat in the context of science class on participants' gender identification at Time 2 is moderated by their science identification (Model 1), science self-efficacy (Model 2), and sense of belonging in science (Model 3). Each model simultaneously controlled for perceived threat in science class, gender identification, and the respective moderator at Time 1.

The second set of three models assessed the degree to which the effect of perceived threat in science class on implicit stereotypes about science-as-male at Time 2 is moderated by the same three factors: science identification (Model 1), science efficacy (Model 2), and science belonging (Model 3). These models also controlled for perceived threat in science class, implicit stereotypes about science, and the respective moderator at Time 1.

5 Results

5.1 Effect of perceived threat activated in science class on gender identification, moderated by science identification, science efficacy & science belonging

A multilevel structural equation model revealed that the relation between experiences of threat activated in science class and the strength of girls' gender identification depended on their science identification ($B = -0.07$, $SE = 0.02$, $p = 0.001$) (see Figure 1). To disaggregate this effect, we conducted follow-up simple slopes analyses which revealed that girls whose self-concepts were strongly identified with science (defined as one SD above the mean on the science identification scale) reported significantly weaker identification with their gender when the science class evoked high threat and anxiety. However, girls whose self-concept were less strongly identified with science (defined as one SD below the mean), reported no significant change in the identification with their gender when science class evoked high threat and anxiety.

A similar pattern of results emerged when we tested the relation between perceived threat activated in science class and girls' gender identification moderated by science self-efficacy ($B = -0.06$, $SE = 0.02$, $p < 0.001$) (see Figure 2). Follow-up simple slopes analyses showed that girls who had stronger science self-efficacy (defined as one SD above the mean on the science efficacy scale) reported significantly weaker identification with their gender when science class evoked high threat. However, girls who had weaker science self-efficacy (defined as one SD below the mean), reported no significant change in the identification with their gender when science class evoked high threat.

Echoing the same pattern, the relation between perceived threat activated in science class and girls' gender identification also depended on their science belonging ($B = -0.12$, $SE = 0.03$, $p < 0.001$) (see Figure 3). Follow-up simple slopes analyses showed that girls who felt stronger belonging in science class (defined as one SD above the mean on the science belonging scale) reported significantly weaker identification with their gender when science class evoked high threat. In contrast, girls who felt weaker belonging in science class (defined as one SD below the mean), reported significantly stronger identification with their gender when science class evoked high threat.

5.2 Effect of perceived threat activated in science class on the alignment between implicit gendered stereotypes about science and science identification in girls

A multilevel structural equation model revealed that the relation between experiences of threat activated in science class and the strength of girls' implicit science-is-male stereotypes depended on their science identification ($B = 0.02$, $SE = 0.01$, $p = 0.045$) (see Figure 4). To disaggregate this effect, we conducted follow-up simple slopes analyses, which showed that girls whose self-concepts were strongly identified with science (defined as one SD above the mean on the science identification scale) showed stronger implicit science-is-male stereotypes when their science class evoked high threat and anxiety. However, girls whose self-concept was less strongly identified with science (defined as one SD below the mean) showed no significant change in their implicit stereotypes about science when science class evoked high threat and anxiety.

The relation between perceived threat activated in science class and the strength of girls' implicit stereotypes that science-is-male

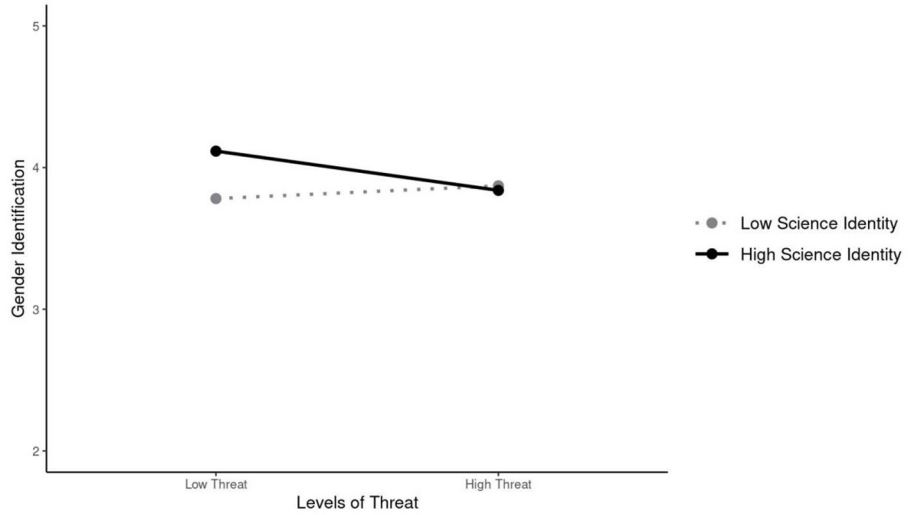

FIGURE 1
Effect of perceived threat activated in science class on the alignment between gender identification and science identification in girls. Gender identification and science identification were each rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science identification represents values 1 SD below the mean, and high science identity represents values 1 SD above the mean.

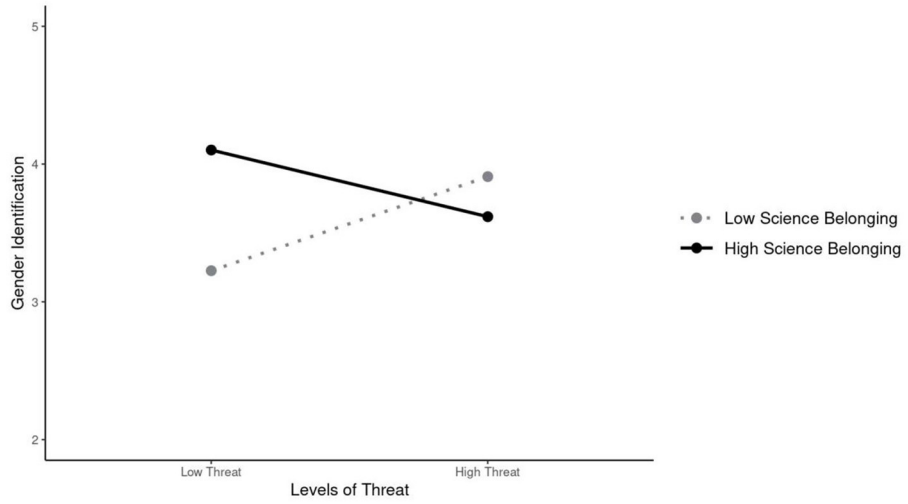

FIGURE 2
Effect of perceived threat activated in science class on the alignment between gender identification and science belonging in girls. Gender identification and science belonging were each rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science belonging represents values 1 SD below the mean, and high science belonging represents values 1 SD above the mean.

also depended on their sense of belonging in science class ($B = 0.03$, $SE = 0.01$, $p = 0.005$) (see Figure 5). Follow-up simple slopes analyses showed that girls who felt stronger belonging in science class (defined as one SD above the mean on the science belonging scale) showed stronger implicit science-male stereotypes when science class evoked high threat and anxiety. However, girls who felt weaker belonging in science class (defined as one SD below the mean), showed no significant change in their implicit stereotypes about science when that class evoked high threat and anxiety.

Another multilevel structural equation model revealed that the relation between experiences of threat activated in science class and the strength of girls' implicit stereotypes about science did not depend on their science self-efficacy ($B = 0.01$, $SE = 0.01$, $p = 0.191$) (see Figure 6).

6 Discussion

The present study sought to examine the identity management strategies employed by adolescent girls as they navigate their gender and science identities, particularly when they experienced academic threat in science classrooms. The present study

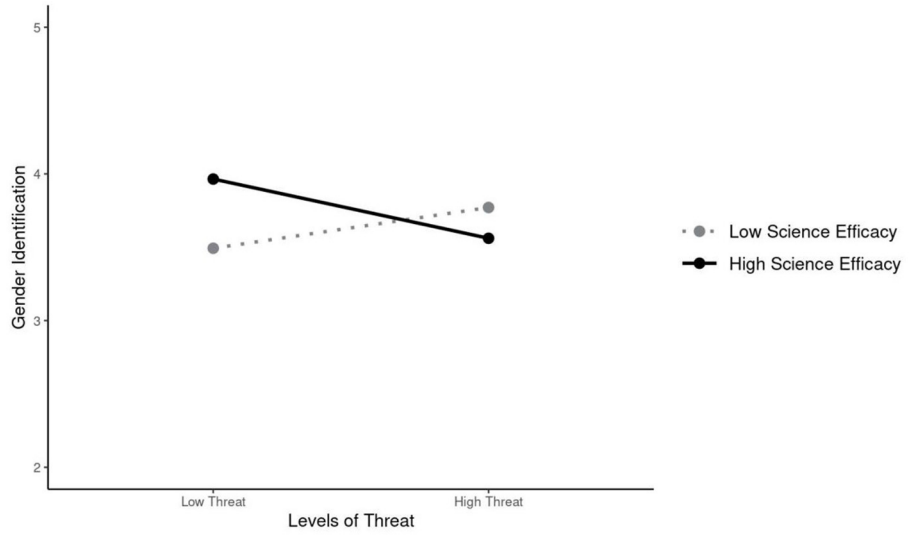

FIGURE 3
Effect of perceived threat activated in science class on the alignment between gender identification and science efficacy in girls. Gender identification and science efficacy were each rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science efficacy represents values 1 SD below the mean, and high science efficacy represents values 1 SD above the mean.

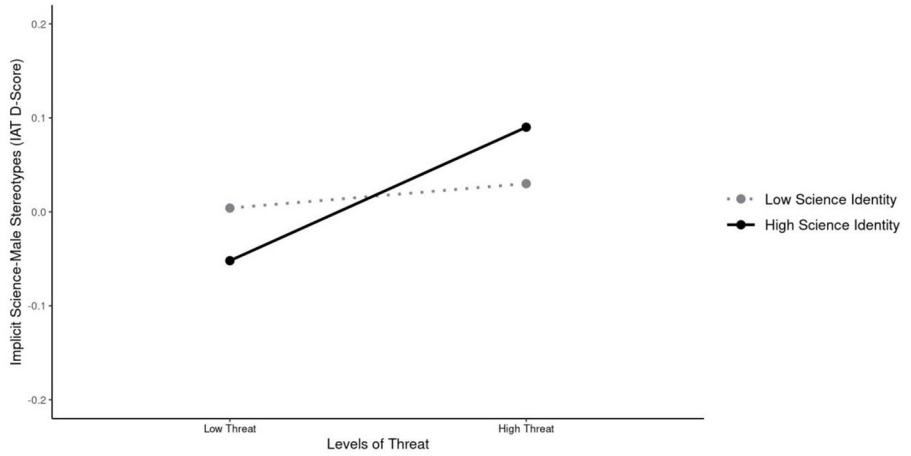

FIGURE 4
Effect of perceived threat activated in science class on the association between implicit stereotypes about science and science identification in girls. The y-axis represents IAT D scores, where positive values indicate stronger stereotypes associating science with males and English language and literature with females, and zero IAT scores indicates no gender stereotyping of science or English. Negative values indicate stronger counterstereotypes associating science with females and English with males. Science identity was rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science identity represents values 1 SD below the mean, and high science identity represents values 1 SD above the mean.

addresses a critical gap in the literature by shifting the focus of identity management strategies from professional women to adolescent girls.

Our study tested two key hypotheses concerning gender-STEM identity misalignment in adolescence, using a large sample of adolescent girls across the United States. Specifically, we examined whether girls with strong science self-concepts—defined by high levels of science identity, belonging, and self-efficacy—would express (1) decreased closeness to their gender group and (2) stronger implicit stereotypes associating science with males and English literature and language with females, particularly when they experience elevated levels of threat in science classrooms. Our findings represent two distinct yet complementary forms of identity management. Distancing from one's gender group reflects *affiliative distancing*, whereby individuals strategically weaken psychological ties to their stigmatized ingroup to

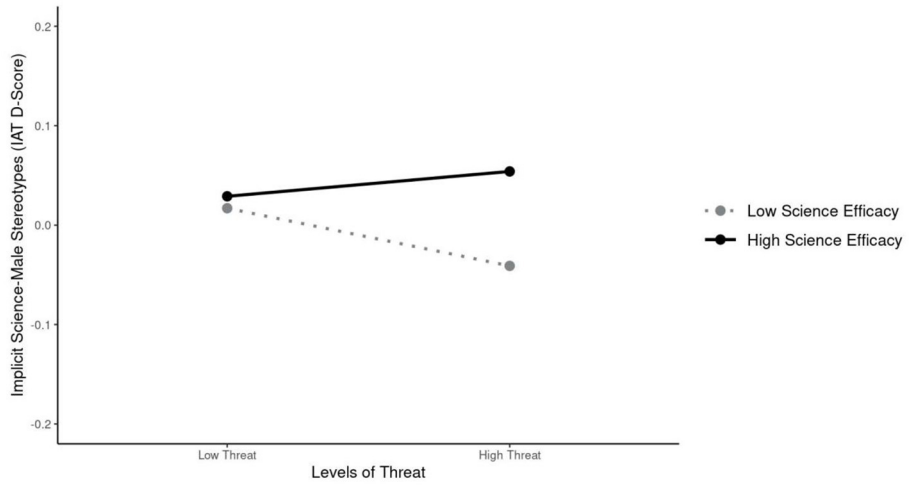

FIGURE 5
Effect of perceived threat activated in science class on the association between implicit stereotypes about science and science belonging in girls. the y-axis represents IAT D scores, where positive values indicate stronger stereotypes associating science with males and English language and literature with females, and zero IAT scores indicate no gender stereotyping of science or English. Negative values indicate stronger counter-stereotypes associating science with females and English with males. Science belonging was rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science identity represents values 1 SD below the mean, and high science identity represents values 1 SD above the mean.

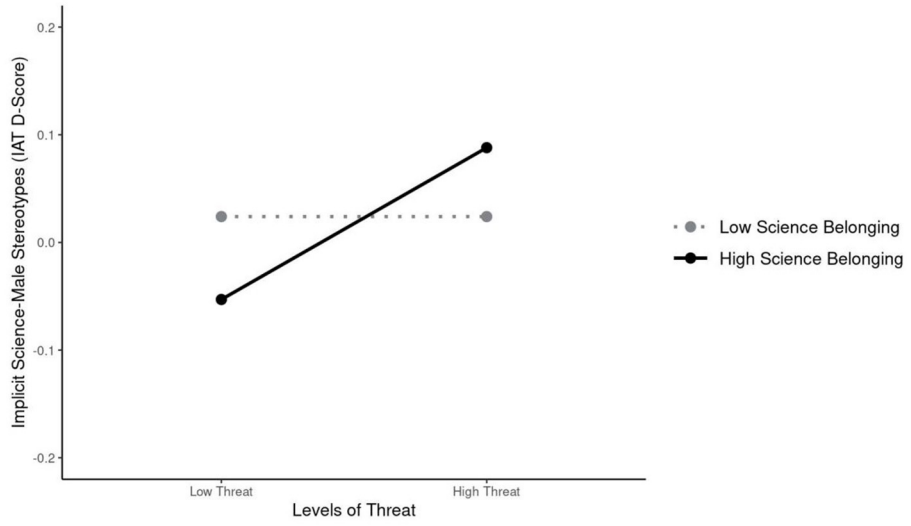

FIGURE 6
Effect of perceived threat activated in science class on the association between implicit stereotypes about science and science efficacy in girls. The y-axis represents IAT D scores, where positive values indicate stronger stereotypes associating science with males and English language and literature with females, and zero IAT scores indicates no gender stereotyping of science or English. Negative values indicate stronger counterstereotypes associating science with females and English with males. Science efficacy was rated on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). Low threat refers to the minimum level of threat perceived in the science classroom, whereas high threat refers to the maximum level of perceived threat. Low science identity represents values 1 SD below the mean, and high science identity represents values 1 SD above the mean.

protect themselves from being stigmatized (Derks et al., 2006), whereas expressing stronger implicit science-is-male stereotypes is a form of *cognitive distancing*, where individuals align themselves with dominant cultural narratives to reduce internal identity conflict. Unfortunately, those same narratives reinforce gender-based stereotypes (Pronin et al., 2004; Steele et al., 2002).

6.1 Affiliative and cognitive distancing under threat

We found that when science class evoked worry and anxiety, girls who were strongly science-identified engaged in affiliative and cognitive distancing. Specifically, girls with relatively strong science self-concepts—particularly those who strongly identified

with science, felt they belonged in science and felt strong science self-efficacy—reported weaker identification with their gender group under high threat, suggesting that distancing served as a coping strategy to manage identity conflict. These findings align with past qualitative interviews with adolescent girls aged 14–16, who describe science as a masculine and exclusionary domain (Archer et al., 2017; Carlone et al., 2014; Godec, 2020). In these interviews, girls aspiring to succeed in science often described distancing themselves from femininity to legitimize their place in science, expressing sentiments like "I'm not particularly feminine" or "I have more male friends than most of my friends do" (Archer et al., 2017, p. 106). These identity negotiations suggest that some girls cope with the misalignment between femininity and STEM by repositioning themselves as different from other girls (Archer et al., 2012; Archer and DeWitt, 2016; Archer et al., 2017; Francis et al., 2017).

Our findings are also consistent with the identity management literature on adult women in male-dominated fields. Multiple studies have shown that women in STEM sometimes distance themselves from their gender, particularly when they perceive that gender stereotypes undermine their credibility in STEM contexts (Derks et al., 2011, 2016; Pronin et al., 2004; Settles et al., 2016; Van Veelen et al., 2020). For example, some studies show that to enhance their perceived fit and legitimacy in these environments, women reported reluctance to form friendships with more traditionally feminine peers in STEM settings (Bergsieker et al., 2021; Pronin et al., 2004). Notably, our findings suggest that employment of such strategies may begin as early as middle school. During this period of intensified gender-role pressures, girls may modulate aspects of behavior in ways that are aligned with their science identity. These findings highlight the importance of examining identity management processes during formative years, rather than focusing solely on adulthood.

Additionally, our findings illustrated that among girls with relatively weak science identification and self-efficacy, there was no association between threat and gender identity. These finding highlights that for these girls, there is little to no identity conflict between being a science person and being a girl because science is not a core aspect of how they define themselves. As a result, a threat to *science* identity does not feel like a threat to *oneself* for these girls; thus, their reported gender identification remains unchanged. Interestingly, however, girls who reported lower levels of belonging in science classrooms showed increased identification with their gender group when they perceived a threat. In contrast to internal self-beliefs like self-efficacy or science identification, belonging is a contextual and relational experience reflecting a girl's sense of fit, acceptance, and inclusion among her peers within the science classroom (Good et al., 2012; Sandrone, 2022). When girls with low belonging in science encounter a threat, they may emphasize their gender group (and hence gender identity) as a source of affirmation and psychological safety at the expense of their identification with science. This heightened gender identification likely functions as a protective strategy, buffering against the social exclusion they perceive in science contexts. Rejecting a science identity that is misaligned with their gender identity might be a way of mitigating the impact of feeling marginalized in science (Branscombe et al., 1999; Spencer-Rodgers et al., 2016).

6.2 Implicit stereotypes as cognitive distancing

Supporting our second hypothesis, girls with relatively stronger science self-concepts (such as science identification and belonging) exhibited stronger implicit stereotypes associating science with males and English skills with females when they experienced higher levels of threat in classroom settings. While past research has shown that internalizing masculine stereotypes about STEM negatively predicts women's academic performance and increases the likelihood of leaving STEM fields (Cvencek et al., 2025; Block et al., 2018; Kiefer and Sekaquaptewa, 2007; Nosek et al., 2002), not much is known about implicit STEM stereotypes among girls who are highly identified with science and how social contexts shift their implicit beliefs. Our results provide novel evidence for Balanced Identity Theory (BIT) in adolescence. Among girls with strong science self-concepts, situational threat seems to result in a defensive adjustment strengthening the male-science link, thereby preserving coherence within the associative network. This implicit "cognitive distancing" maintains a strong science self-concept, showing that identity management happens at the implicit level during a critical period of adolescent development. In contrast, for girls for whom science self-concept was not central to themselves, they did not adjust their implicit gender–science stereotypes. These results extend the use of BIT in action by demonstrating how adolescents with strong science identities preserve that identity even under situational threat by weakening their association with their gender and at the same time implicitly strengthening male-science stereotypic associations.

6.3 Implications

The present findings offer important theoretical and practical insights into the early emergence of identity management strategies among girls in STEM. From a theory standpoint, the present study extends existing literature by demonstrating that distancing-based identity management strategies—previously documented among adult women in male-dominated fields—are observable in early adolescence. According to the Social Identity Theory, group memberships provide individuals with a sense of meaning, belonging, and psychological safety that positively contributes to their wellbeing (Tajfel and Turner, 2004; Jetten et al., 2017). However, when girls feel pressured to distance themselves from their gender to gain acceptance in science, these strategies may undermine their wellbeing by disrupting authentic identity development and creating internal conflict and emotional distress (2004; 2009; Schmader and Sedikides, 2018; Van Veelen et al., 2020). Additionally, the implicit association of science with males more than females, among girls interested in science, is particularly concerning: not only do some girls exit STEM when faced with identity threat, but even those who persist may implicitly believe that succeeding in science requires them to be an exception to the rule—someone who is "not like other girls." This mindset risks perpetuating the notion that scientific competence is inherently incompatible with being female, rather than challenging gender stereotypes that create that false dichotomy in the first place.

Additionally, individuals are naturally drawn to environments that afford a seamless alignment between their personal identity and the surrounding social context (Schmader and Sedikides, 2018). STEM settings, however, often conflict with the identity-relevant values and emerging professional aspirations of middle school girls, potentially undermining both belonging and engagement. This lack of fit may even motivate withdrawal from STEM, even among girls with strong science interests in the long term (Schmader, 2023). The societally induced tension between gender-science identities has significant long-term implications for adolescent girls' future engagement in STEM fields as well as their relationship with their gender identity over time (Moss-Racusin et al., 2018; Settles et al., 2009; Stout et al., 2016; Van Veelen et al., 2020). When girls in early adolescence experience pressure to downplay or compromise aspects of their gender identity during a period of rapid identity consolidation, they risk internal conflict and fragmentation, which may ultimately hinder authentic identity development and sustained engagement in STEM.

Recognizing how threat affects gender identity development can inform the design of more effective interventions aimed at reducing or preventing the need for such strategies—ultimately supporting more authentic and sustainable engagement in STEM. Our results highlight the need for STEM interventions that go beyond simply fostering interest or engagement. To be effective, interventions must also address the perceived incompatibility between gender and science. For example, framing science as a communal and interdependent endeavor, rather than one that emphasizes individualism and agency, may help reduce identity conflict (Dasgupta et al., 2022; Riegle-Crumb et al., 2019; Smith et al., 2015; Thiem and Dasgupta, 2022; Diekman et al., 2010). Additionally, providing role models and supportive mentors who discuss how they balance their gender and STEM identities through curricular and extracurricular activities in elementary and middle school and afterschool programs may prevent early disengagement from gender identity and promote the development of a more integrated and resilient self-concept among girls and the pursuit of science (Asgari et al., 2012; Dasgupta and Asgari, 2004; Lockwood, 2006; Stout et al., 2011; Dasgupta, 2011; Dennehy and Dasgupta, 2017; Wu et al., 2022). Specifically, this work enhances our understanding of how girls navigate gender–STEM identity conflict during a formative period of identity development that shapes their long-term approaches to managing social threats, reconciling competing identities, and pursuit of careers.

6.4 Limitations and future directions

One limitation of the current study is that perceptions of threat in science classrooms were measured at Time 1, early in the academic year, when students may not yet have experienced significant anxiety about their classes. To obtain a more robust indicator of threat, we used threat measured at Time 2—collected at the same time as the dependent variables—and controlled for Time 1 threat. However, because the key predictor and outcomes were measured simultaneously at Time 2, we cannot make strong causal inferences about the effect of threat on gender–science identity distancing.

Future research could address this limitation by assessing perceived threat at multiple time points across the school year to better test the causal pathway linking threat to identity misalignment more rigorously. Future studies could also examine, longitudinally, whether these implicit beliefs—such as implicit beliefs about science or distancing from one's gender identity at one time point—have long-term consequences for girls' wellbeing and their relationship with their gender group later. For instance, these beliefs may negatively impact gender-based self-esteem and contribute to internal conflicts that persist in adolescence and young adulthood.

A second limitation is the non-representative nature of our sample. Our data were collected exclusively from girls attending private schools who primarily come from upper-middle-class and affluent families. Moreover, these schools are predominantly located in large metropolitan areas. This homogeneity significantly limits the generalizability of our results, which may not extend to students from lower socioeconomic backgrounds or those attending public schools in less urban settings. However, one wonders if girls from private schools, who have access to a wealth of financial and educational resources, experience identity conflict, would girls with far less financial and educational resources also experience similar conflicts and engage in comparable strategies, or would they be more resilient given their life experience? It is important for future research to test the generalizability of these findings in public school samples. Furthermore, gender was operationalized categorically, which increases generalizability for individuals who identify as girls but limits our understanding of the experiences of non-binary individuals. Future research should incorporate continuous measures of gender to fully capture gender diversity and extend the applicability of these findings.

A third limitation is that our study focused on the conflict between two salient identities– gender and science identity–within the classroom context. Although our sample included students from diverse racial backgrounds, the relatively small number of students in several groups limited our ability to examine how gender-science identity conflict may vary across race or ethnicity. Future research should adopt an intersectional approach to examine how multiple, intersecting identities jointly shape girls' science-related self-conceptions in classrooms and, in turn, influence the identity management strategies they employ (Hsieh et al., 2021; Rainey et al., 2018). These strategies may differ substantially across racial, ethnic, and socioeconomic backgrounds.

Lastly, while the present study examined the identity management strategies adolescent girls use to balance conflicting gender and science identities in the face of situational threat, investigating the developmental origins of these science-self conceptions (such as parental education background, informal science learning through science camps or museums) was beyond the scope of the current work. The omission of these variables, however, limits our ability to fully model the causal pathways underlying why some girls entered the study with stronger science self-conceptions than others. Future research could address this gap by distinguishing the relative contributions of distal, structural factors (e.g., parental background) from more proximal, malleable psychological mechanisms (e.g., self-efficacy and belonging) that are activated by situational threat in classroom contexts.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://osf.io/xag7s/?view_only=88de5ef0c36240dc87a85d96692e67a4.

Ethics statement

The studies involving humans were approved by Institutional Review Board, UMass Amherst. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

AS: Conceptualization, Formal analysis, Investigation, Software, Validation, Visualization, Writing – original draft. TP: Writing – review & editing. HL: Formal analysis, Supervision, Writing – review & editing. ND: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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