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Examining adolescent daughters' and their parents’ academic-gender stereotypes: Predicting academic attitudes, ability, and STEM intentions

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ABSTRACT

Introduction: Women continue to be underrepresented in Science, Technology, Engineering, and Mathematics (STEM) and research suggests that academic-gender stereotypes can be a contributing factor. In the present research, we examined whether adolescent daughters' and their parents' gender stereotypes about math and liberal arts would predict the academic orientation of daughters at a critical time of career related decision-making. Methods: Participants included girls in late adolescence ($N = 185$, $M_{age} = 17$) and at least one parent ($N = 230$, $M_{age} = 49$), resulting in 147 mother-daughter dyads and 83 father-daughter dyads. Implicit academic-gender stereotypes were measured using an Implicit Association Test (IAT) and explicit stereotypes, academic attitudes, academic ability, and daughters' intentions to pursue a degree in STEM were measured using self-reports. Results: Neither mothers' nor fathers' implicit or explicit academic-gender stereotypes predicted adolescent daughters' implicit stereotypes; however, fathers' explicit stereotypes predicted daughters' explicit stereotypes. In addition, daughters' academic orientation, a latent variable composed of adolescent girls' academic attitudes, academic ability, and intentions to pursue a degree in STEM, was predicted by daughters' own implicit and explicit stereotypes. This was the case for relative orientation toward math versus liberal arts, as well as math (but not liberal arts) orientation. Conclusions: These findings suggest the importance of challenging academic-gender stereotypes during adolescence and suggest that at this stage in development, mothers' and fathers' academic stereotypes might have limited relation to daughters’ own implicit associations with academic domains.

Women continue to complete university degrees in Science, Technology, Engineering, and Mathematics (STEM) at lower rates than men, leading to their continued underrepresentation in STEM careers (Statistics Canada, 2015). Considering the prestige, high pay, and demand for qualified personnel in STEM (Jacobs, 2014; Smith, 2014), this gender disparity has the potential to place women at an ongoing financial disadvantage. Research further suggests that women who pursue STEM careers can face additional barriers

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relative to equally qualified men, including lower pay, fewer full-time positions, and reduced funding (Shendruk, 2015; TD Economics, 2017). Many factors contribute to women's underrepresentation in STEM fields; however, research suggests that innate gender differences in ability is not one of them (Spelke, 2005). Instead, there is mounting evidence to suggest that stereotypes and discrimination have the potential to influence not only how girls and women are treated and differentially encouraged in STEM fields, but also their self-perceptions, attitudes, and performance (Kiefer & Sekaquaptewa, 2007; Lane et al., 2012; Nosek et al., 2002; Nosek & Smyth, 2011; Ramsey & Sekaquaptewa, 2011; Schmader & Sedikides, 2018; Spencer et al., 2016).

For example, according to the State Authenticity as Fit to Environment (SAFE) model (Schmader & Sedikides, 2018), people strive for a sense of authenticity or "fit" and seek out environments where "valued aspects of one's identity are aligned with, if not validated by, the situation" (p. 228; see also Cvencek et al., 2012; Eccles, 1987; Eccles & Wigfield, 2020; McPherson et al., 2018). Encountering negative stereotypes about STEM fields can challenge young women's sense of authenticity and lead to psychological disengagement and avoidance of these stereotyped domains. This can be particularly detrimental during late adolescence when important aspects of identity are solidifying, and career-related decisions are being made. Importantly, theory and research also suggest that parents can serve as socializing agents for these stereotyped beliefs, at least throughout childhood (Bhanot & Jovanovic, 2005; Eccles, 1987; Eccles & Wigfield, 2020; Jacobs & Eccles, 1992; Simpkins et al., 2005; Tomasetto et al., 2015; Yee & Eccles, 1988).

The goal of the present research was to examine daughters' and their parents' implicit and explicit academic-gender stereotypes during a developmental period of transition and career-related decision-making: late adolescence. As adolescents transition to university, decisions about academic courses and programs not only shape their identity, but ultimately impact important career-related opportunities and outcomes. Given that math courses serve as gatekeepers to STEM majors, in the current research we examined gender stereotyping in math versus liberal arts among adolescent girls who were in the process of making decisions about their post-secondary academic pursuits. In addition, we were interested in extending previous findings by examining implicit stereotypes that might operate outside of people's conscious awareness and that can be less susceptible to socially desirable responding. Finally, given the potential influence of parents on children's gender-related associations and beliefs (Croft et al., 2014; Endendijk et al., 2018; Gunderson et al., 2012; Leaper, 2015; Martin & Ruble, 2010) and the lack of research examining the relation between children's and parents' implicit academic stereotypes in adolescence, in the current research we also examined parents' stereotypes. Specifically, we aimed to determine (a) whether parents' implicit and/or explicit academic-gender stereotypes and their explicit academic self-concept predict their daughters' implicit and/or explicit stereotypes and (b) whether daughters' own implicit and/or explicit academic-gender stereotypes predict their academic orientation, including their academic attitudes, self-reported ability, and intentions to pursue a career in STEM.

1. Parental influence on children's academic-gender stereotypes

Research suggests that parents can be a significant source of gender-related information for their children, particularly in early childhood (Endendijk et al., 2018; Gunderson et al., 2012; Leaper, 2015; Martin & Ruble, 2010; Simpkins, Fredricks, & Eccles, 2015). Parents can transmit stereotypes to children in numerous ways, including through the gender norms they endorse or the activities in which they engage (Croft et al., 2014; Endendijk et al., 2013; Hart et al., 2016; Leaper, 2015; Simpkins et al., 2006). Research further suggests that parents' math-related behaviors and attitudes are often consistent with academic-gender stereotypes (del Río et al., 2019; Galdi et al., 2017; Tomasetto et al., 2015) and there is some research to suggest that there can be gendered differences in the ways that mothers and fathers treat their daughters and sons (Bhanot & Jovanovic, 2005; Herbert & Stipek, 2005; Simpkins et al., 2005). For example, parents have been found to support the view that boys are better than girls at math, to have higher expectations of success in math from their sons, to encourage math activities more often for boys, and to expect their daughters to require more assistance and effort to succeed in math (Bhanot & Jovanovic, 2005; Eccles, 1987; Jacobs & Eccles, 1992; Simpkins et al., 2005, 2006; Tomasetto et al., 2015; Yee & Eccles, 1988). Parents have similarly reported that science is more difficult and less interesting for girls (Tenenbaum & Leaper, 2003).

According to the Situated Expectancy-Value Theory (SEVT; Eccles & Wigfield, 2020; Wigfield & Eccles, 2020; see also the Expectancy-Value Model of Achievement, Eccles, 1987), achievement-related decisions, such as deciding whether to pursue a degree in STEM or a degree in liberal arts, is shaped by a variety of factors, and socialization by parents can play an important role. As Eccles and Wigfield (2020) outline, parents can influence their children's outcomes through the family climate that they create, their role-modeling behaviors, and activity-specific behaviors (e.g., encouraged activities, teaching strategies used, career guidance) that they engage in with their child. These behaviors are influenced by a number of parent and child characteristics and beliefs, including parents' gender-role stereotypes, beliefs about their own efficacy in these academic domains, and their values. Furthermore, both theory and research suggest that these family factors have the potential to shape young children's gendered beliefs about, and associations with, academic domains.

Consistent with this theorizing, research has found evidence that mothers' math anxiety is negatively associated with children's, and particularly daughters', math motivation and math outcomes; mothers with higher math anxiety had children who reported greater math anxiety, lower motivation, poorer math skills, and more negative math attitudes (Casad et al., 2015; Cohen & Rubinsten, 2017). Mothers' emotional reactions to math homework have also been found to influence their children. Else-Quest et al. (2008) found that within mother-child dyads, emotions were often mirrored during math activities, such that if mothers displayed more positive emotions, their children were likely to as well. Moreover, when children and their mothers displayed more positive emotions during a math activity, children's math performance was higher. These findings suggest that parents' math behaviors and emotional reactions may indirectly socialize attitudes toward, and anxieties about, math. Considering that mothers are often the primary caregiver responsible for helping their children with homework and math activities (del Río et al., 2019; Schieman et al., 2018), if children observe this anxiety more often from mothers, this also has the potential to influence children's general beliefs about women's abilities in math.

Studies with young children have also sought to establish a relation between parents' and children's academic stereotypes, with more recent studies examining stereotyping using both explicit (i.e., self-report) and implicit measures. Implicit stereotypes have been defined as cognitive associations between a social group and specific attributes which “are inferred from indirect, performance-based procedures … that avoid direct influence of deliberative processing” (p. 1369, Hahn et al., 2014; see also Gawronski et al., 2006; Kiefer & Sekaquaptewa, 2007; Ranganath et al., 2008). Unlike explicit measures, implicit measures have the benefit that they are less susceptible to socially desirable responding and can estimate people's spontaneous associations between academic domains, including math and arts, and social groups, like male and female.

Implicit math-gender stereotypes have been most commonly estimated using the Implicit Association Test (IAT; Greenwald et al., 2003), a computer-based task that can be used to assess the speed with which people associate math with male and liberal arts (or arts/language) with female, as compared to the reverse pairing (i.e., math with female and liberal arts with male; for examples see Cvencek et al., 2011; Nosek et al., 2002; Steffens et al., 2010). If children have acquired academic-gender stereotypes, we would expect them to be faster at pairing math with male and liberal arts with female, relative to the reverse pairing. If parents' academic-gender stereotypes have been transmitted to their children, we would expect parents' academic-gender stereotypes to predict children's stereotypes, or possibly other important math-related attitudes. As these stereotypes can be conveyed and measured indirectly, parents' implicit stereotypes might be better predictors of children's attitudes and stereotypes than their parents' self-reported stereotypes, as the latter are more susceptible to socially desirable responding.

Although there is research to suggest that parents' attitudes and behaviors in math can be gender-stereotype consistent, research that has included both implicit and explicit measures has provided mixed support for the possibility that mothers' stereotypes predict children's attitudes toward math or children's own academic stereotypes in early childhood. In one study, Italian mothers' explicit academic-gender stereotypes negatively predicted their six-year-old daughters' self-reported math ability (Tomasetto et al., 2015). However, in a different sample of Italian families with 6-year-old children, mothers' implicit and explicit stereotypes did *not* predict their children's stereotypes (Galdi et al., 2017). Similarly, in a sample of Chilean families with 5-year-old children, no direct relation was found between mothers' and children's implicit or explicit academic stereotypes; however, mothers were found to identify less with math (relative to language) than fathers on both implicit and explicit measures (del Río et al., 2019; see also; del Río et al., 2020). In addition, mothers' implicit math (versus language) self-concept predicted their daughters' implicit math self-concept, but not their sons' (del Río et al., 2019). Additional research suggests that mothers who report higher levels of explicit math-gender stereotypes have young daughters, aged 5–7 years, whose math performance decreases under stereotype threat (Tomasetto et al., 2011), suggesting these young girls were already aware, on some level, of the negative math-gender stereotype that their mothers endorsed (see also Muzzatti & Agnoli, 2007).

Only a few studies have examined whether fathers' implicit and explicit academic-gender stereotypes predict their young children's math attitudes and stereotypes, however, the studies that exist have provided similarly inconsistent results. In the study by del Río et al. (2019), Chilean fathers' implicit and explicit stereotypes did not predict their 5-year-old children's implicit or explicit stereotypes, however, fathers' math self-concept negatively predicted their daughters' math self-concept (del Río et al., 2019). Similarly, Italian fathers' explicit academic-gender stereotypes were unrelated to their young daughters' (ages five to seven years) stereotypes; unlike mothers' stereotypes, fathers' endorsement of academic stereotypes were unrelated to their daughters' susceptibility to stereotype threat effects (Tomasetto et al., 2011). While this might suggest that fathers have less of an influence on children's stereotypes at this age, in a different study, Italian fathers' (but not mothers') implicit (but not explicit) stereotypes predicted 6-year-old children's implicit and explicit stereotypes (Galdi et al., 2017).

Notably, past research examining parents' and their children's implicit math-gender stereotypes has focused specifically on the stereotypes of young children (aged five to seven years), who are only beginning their academic journey. It remains less clear whether parents' academic-gender stereotypes would serve as better predictors of their daughters' own stereotypes by adolescence. At this late stage in development, adolescent daughters have had more opportunities to discuss academics with their parents, including course selections and career-related decisions, which could lead to a deeper understanding of their parents' attitudes and beliefs. However, this is also a time in development when children's own attitudes and associations with math might be more likely to be shaped by peers and by broader norms within society (Elizaga & Markman, 2008; Gottfried et al., 2017; Riegle-Crumb et al., 2017; Simpkins, Fredricks, & Eccles, 2015).

Researchers have not examined whether mothers' and fathers' implicit academic-gender stereotypes predict their adolescent daughters' stereotypes. However, research does suggest that parents who express higher academic expectations, more positive perceptions of their children's math ability, have greater involvement, show less math anxiety, and play a greater role in their child's future college plans have adolescents with more positive math attitudes and greater representation in, or intentions to pursue, math courses (Casad et al., 2015; Froiland & Davison, 2016; Gottfried et al., 2017; Jacobs et al., 1998; Leaper et al., 2012; Ma, 2001; Rozek et al., 2017; Simpkins, Price, & Garcia, 2015; see also Gniewosz et al., 2014). Findings from longitudinal research are also consistent with the possibility that mothers' early gender stereotypes can predict their children's later math beliefs and career choices into adolescence and beyond (Bleeker & Jacobs, 2004). In addition, Hoferichter and Raufelder (2019) found that German girls in early adolescence who reported more support from mothers performed better in math, while girls who reported more pressure from mothers performed worse. In their study, fathers' support and perceived pressure was not related to their children's performance in math, suggesting that at least in early adolescence, perceptions of fathers' support and pressure may play a less central role in girls' math performance. Although the direction of many of these relationships is not clear, the findings are consistent with the possibility that parents can continue to be an important influence, at least into early adolescence.

2. Academic-gender stereotypes and academic outcomes

Researchers have also examined whether a direct relationship exists between girls' own implicit and/or explicit stereotypes and girls' orientation toward math, with the majority of this research focused either on childhood and early adolescence (e.g., ages five to thirteen years) or on university students (e.g., ages 18–20). Some of this research builds from Balanced Identity Theory (Cvencek et al., 2012, 2021), which suggests that people's academic self-concept, stereotypes, and attitudes are related. According to this theory, girls or women who identify more strongly with their female identity, but who also associate math with males, should have a harder time associating themselves with math (Cvencek et al., 2012) and this can have negative consequences for their academic orientation. Consistent with this theorizing, research examining the relationship between academic stereotypes and outcomes in childhood suggests that implicit stereotypes may already negatively predict academic outcomes from a young age.

For example, Cvencek et al. (2011) examined implicit and explicit math-gender stereotypes and math self-concepts in a sample of American children (ages six to ten years). Children associated math with boys more than with girls, on both implicit and explicit measures, suggesting the early presence of the math-gender stereotype. In addition, boys demonstrated a stronger math (versus reading) self-concept than girls on both implicit and explicit measures, suggesting that relative to boys, girls are beginning to associate themselves more with reading than math in early elementary school (see also Cvencek et al., 2021). Further support was provided by Cvencek et al. (2015), who examined the implicit and explicit math-gender stereotypes and math self-concepts in a sample of children from Singapore (ages seven, nine, and eleven years). They found that children demonstrated math-gender stereotypes on both the implicit and explicit measures, and as would be expected, implicit math-gender stereotypes were related to lower math self-concept for girls and higher math self-concept for boys. In addition, they found that more positive implicit math self-concepts were related to better math achievement. These results further suggest that girls who have internalized math-gender stereotypes throughout elementary school may also have worse outcomes in math.

To our knowledge, only two studies have examined these relations among samples that included adolescent participants and the results were mixed. Passolunghi et al. (2014) found that the more girls (ages seven to thirteen years) explicitly gender-stereotyped math, the less math ability they reported having. However, in their study, implicit academic-gender stereotypes did not predict self-reported math ability, and neither explicit nor implicit stereotypes predicted the value (i.e., attitudes, utility, and importance) that they expressed toward math. By contrast, Steffens et al. (2010) found that among a sample of girls in Germany (ages nine and fifteen years), implicit gender stereotypes significantly predicted academic self-concept, academic achievement, and enrolment intentions, above and beyond their explicit stereotypes, which were also a significant predictor (see also Steffens & Jelenec, 2011), providing further evidence that girls' math-gender stereotypes can predict math orientation by late childhood and into adolescence.

In addition, a number of studies have found that by early adulthood, academic-gender stereotypes can predict important math-related outcomes. For example, studies have shown that university women's implicit academic-gender stereotypes are associated with more negative math attitudes, decreased math identification, greater math anxiety, and lower math performance (Kiefer & Sekaquaptewa, 2007; Nosek et al., 2002; Nosek & Smyth, 2011; see also; Dunlap & Barth, 2019; Farrell & McHugh, 2017). In addition, studies have found that female undergraduates' implicit (but not explicit) academic-gender stereotypes are associated with worse performance on math exams and less interest in pursuing a math-related career (Kiefer & Sekaquaptewa, 2007; Lane et al., 2012; Ramsey & Sekaquaptewa, 2011). Notably, these stereotypes are not limited to women outside of STEM fields. Women within STEM majors also implicitly gender stereotype math (Farrell & McHugh, 2017; Smyth & Nosek, 2015) and science (Dunlap & Barth, 2019), and have been found to report lower math self-concepts than their male peers (Rinn et al., 2013).

3. The present research

In the current research, we aimed to extend previous findings by examining the academic-gender stereotypes of adolescent daughters, who were in the process of considering university programs, as well as their parents, with a focus on implicit stereotypes. Specifically, the first goal was to examine whether parents' implicit and/or explicit academic-gender stereotypes and academic self-concept would predict their daughters' implicit and/or explicit academic-gender stereotypes. Given the lack of literature examining parents' and adolescent daughters' implicit academic-gender stereotypes, and the mixed findings in early childhood, it was unclear whether any relation would emerge. However, given that theory and research suggest that parents can influence girls' academic beliefs and values (Cohen & Rubinsten, 2017; del Río et al., 2019; Eccles & Wigfield, 2020; Else-Quest et al., 2008; Froiland & Davison, 2016; Gottfried et al., 2017; Wigfield & Eccles, 2020), and that past findings suggest implicit stereotypes may account for additional variance in academic outcomes above and beyond explicit stereotypes (Cvencek et al., 2015, 2021; Steffens et al., 2010), we were specifically interested in whether parents' academic-gender stereotypes and self-concept would predict their daughters' academic-gender stereotypes and whether implicit stereotypes might emerge as a significant predictor. In addition, as past research suggests that mothers' attitudes and behaviors might be more predictive of daughters' math-related outcomes than fathers' attitudes and behaviors (Casad et al., 2015; Tomasetto et al., 2015, see also, 2011; Hoferichter & Raufelder, 2019), we were interested in examining whether a similar pattern of results would emerge for both mothers and fathers.

The second goal was to determine whether adolescent girls' own implicit and/or explicit academic-gender stereotypes would predict a latent variable, math orientation, that included their academic attitudes, self-reported academic ability, and intentions to pursue a degree in STEM. Research suggests that academic-gender stereotypes predict aspects of women's math orientation in early adulthood (e.g., Kiefer & Sekaquaptewa, 2007; Nosek et al., 2002; Nosek & Smyth, 2011); however, it seems possible that these relations are most likely to emerge once students have made the often-challenging transition to university. As such, we aimed to assess whether these would emerge in late adolescence, prior to this transition. In addition, given that both theory and research suggest that a relationship exists between academic attitudes, ability, and achievement-related decisions (e.g., Eccles & Wigfield, 2020), we tested a model in which daughters' academic (math over liberal arts) attitudes, self-reported (math over liberal arts) ability, and intentions to pursue a degree in STEM all contributed to a latent variable that we termed academic orientation. Based on the results from studies in early adulthood, as well as some results from childhood and early adolescence, we predicted that both implicit and explicit academic-gender stereotypes would negatively predict adolescent daughters' academic orientation.

To address these questions, we used structural equation modeling to examine whether mothers' and fathers' academic-gender stereotypes and academic self-concepts would predict daughters' implicit and explicit academic stereotypes and whether daughters' stereotypes would predict their academic orientation, a latent variable which includes daughters' academic attitudes, their self-reported ability, and their intentions to pursue a STEM degree. In addition, we examined the latent variable of academic orientation both as a relative measure of daughters' orientation toward math versus liberal arts, and as a measure of math orientation and liberal arts orientation separately. We took this approach for several reasons. Students are often faced with the decision as to whether to pursue a degree in arts or in science. However, previous research suggests that adolescents' math self-concept is not always negatively related to their self-concepts in other academic domains (e.g., liberal arts; Parker et al., 2015). Some research also suggests that adolescents who strongly identify with both math and English may be less likely to choose an occupation within a STEM field (Wang et al., 2013). As such, students might pursue a degree in liberal arts because they have a strong preference for liberal arts over math, or they might make this decision in the face of an equally positive orientation toward both domains. Given that our implicit measure of academic stereotyping confounds gendered associations with math and liberal arts, we were interested in determining whether daughters' academic-gender stereotypes would predict their relative orientation toward these domains as well as their orientation toward only one of the domains, specifically math but not liberal arts. Such a finding would lend additional support for the possibility that these gender stereotypes are specifically predictive of girls' orientation toward math in late adolescence.

4. Method

4.1. Participants

A total of 658 people participated during Fall and Spring Open House Days at a large post-secondary institution. Given the location of the research, any interested visitor could participate, including those who did not meet our inclusion criteria. Among the total sample of adolescents who participated ($N = 329$, $M_{age} = 17.23$, $SD = 2.2$), 80% were female ($N = 262$) and 77% ($N = 272$) had at least one parent participate with them. This study received ethics approval from the York University Office of Research Ethics, protocol number e2014-226.

For the present study, only daughters aged 15–19 years of age who participated along with at least one parent met our inclusion criteria. In order to avoid duplicate family data, six additional adolescents who met this criterion were excluded as they were the second daughter to participate within the same family. The final sample consisted of 415 participants including 185 daughters ($M_{age} = 17$ years, $SD = 0.64$), 147 mothers ($M_{age} = 48$ years, $SD = 5.05$, range = 36–62 years), and 83 fathers ($M_{age} = 50$ years, $SD = 5.08$, range = 37–63 years). Of the daughters, 102 (55%) participated with only their mother, 38 (21%) participated with only their father, and 45 (24%) participated with both their mother and father. The majority of parents identified as White ($N = 135$; mothers = 90, fathers = 45), additional demographic information can be found in Table 1.

Table 1
Summary of parental demographic information.

Demographics	*Mothers*		*Fathers*	
	%	N	%	N
Race				
White	61	90	54	45
East/South-East Asian	10	14	7	6
Black/African-American	8	11	11	9
Middle Eastern	5	7	2	2
South Asian	5	7	11	9
Hispanic	4	6	4	3
First Nation	3	5	2	2
Other	4	6	9	7
Highest Educational Level				
High School	11	16	19	16
Some College/University	17	25	15	12
College	24	34	15	12
Undergraduate Degree	31	45	27	22
Graduate Degree	16	23	22	18
Doctoral Degree	1	2	2	2
Average self-reported annual household income	$50,000 - $74,999		$75,000 - $99,999	

Note. One mother did not indicate her race. Two mothers and one father did not provide their level of education. Twenty-five mothers and seven fathers did not provide their annual household income.

4.2. Materials

Implicit academic-gender stereotypes. Implicit academic-gender stereotypes were measured using an Implicit Association Test (IAT; Greenwald et al., 2003). The IAT is a computer-based reaction-time measure designed to assess cognitive associations. Throughout the task, the categories "math" (calculate, compute, math, multiply, sum), "liberal arts" (arts, history, English, humanities, literature), "male" (male, him, he, man, men), and "female" (female, her, she, woman, women), were depicted with words that participants were asked to categorize (see Nosek et al., 2002 for details). Words appeared in random order and both the order and the side of the two critical blocks was counter-balanced between participants. The reaction time data from each critical block were scored using the recommended guidelines by Greenwald et al. (2003). Each participant's data were converted into a relative IAT *D*-Score ($\alpha = 0.83$; Williams & Steele, 2016), such that higher values represented greater facilitated responding to "math + male" and "liberal arts + female" (i.e., stereotype-consistent) relative to "math + female" and "liberal arts + male" (i.e., stereotype-inconsistent). As is standard practice (Smyth & Nosek, 2015), participants' data were excluded if they responded in 300 ms or less for over 10% of responses ($N = 4$; 3 daughters, 1 mother), were a three standard deviation outlier on this measure ($N = 2$; 1 daughter and 1 mother), or had more than a 30% error rate ($N = 3$; 3 daughters). Data from two fathers were removed as they were assigned the same participant number. An additional 18 daughters, 11 mothers, and 12 fathers did not complete the IAT. The final sample with implicit data included 158 daughters, 134 mothers, and 69 fathers ($N = 361$).

Explicit academic-gender stereotypes. To assess explicit academic-gender stereotypes, two one-item measures that mirrored the implicit measure were used.[1] Participants were asked to indicate on a 7-point semantic differential scale (Nosek et al., 2002; Smyth & Nosek, 2015) the extent to which they believed math was more "female" (1) or "male" (7). The same question was used to assess participants' explicit liberal arts stereotypes, and a difference score (math-arts) was created with higher scores indicating greater relative academic-gender stereotypes. Data from two mothers were removed as each was a numerical outlier.

Explicit academic attitudes. Self-reported academic attitudes were measured using two semantic differential scales, each consisting of four items (e.g., Bad (1) to Good (7); Disgusting (1) to Delightful (7); Avoid (1) to Approach (7); Afraid (1) to Unafraid (7)). Using the adjectives provided, participants were asked to rate their personal attitudes toward math, and to separately rate their personal attitudes toward liberal arts (Nosek et al., 2002). The math items were averaged to create an explicit math attitudes composite score, with higher scores indicating more positive personal attitudes toward math ($\alpha = 0.89$ for daughters, $\alpha = 0.84$ for mothers, $\alpha = 0.78$ for fathers). A comparable composite score was created for personal attitudes toward liberal arts ($\alpha = 0.92$ for daughters, $\alpha = 0.84$ for mothers, $\alpha = 0.81$ for fathers). A difference score was also created, with higher scores indicating more positive personal attitudes toward math (versus liberal arts). This difference score is used in all analyses unless otherwise noted. The data from one father and one daughter were removed from the difference score as each was a numerical outlier.

Self-reported academic ability. The academic ability scale consisted of six questions (three math-related; three liberal arts-related). Participants used a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree) to rate their own ability in math and in liberal arts (i.e., "I am good at math compared to other people", "Math has always come pretty easy to me", "Doing math has never been easy for me" (reverse-scored)). For each participant, the items were first averaged to create two separate composite scores for math ability ($\alpha = 0.88$ for daughters, $\alpha = 0.93$ for mothers, $\alpha = 0.89$ for fathers) and liberal arts ability ($\alpha = 0.86$ for daughters, $\alpha = 0.87$ for mothers, $\alpha = 0.92$ for fathers). A difference score was also created, with higher scores indicating greater self-reported personal ability in math (versus liberal arts). This difference score is used in all analyses unless otherwise noted. One daughter's data were removed from the difference score as it was a numerical outlier.

Interest in pursuing a STEM degree. To assess interest in pursuing a STEM field, daughters were asked to indicate how likely they were to pursue a degree in science, technology, engineering, or mathematics using a 7-point Likert scale (1 = very unlikely to 7 = very likely).

Identification with parents. The identification with parents scale, which was included primarily for exploratory purposes, allowed us to ensure that students who participated with one parent did not differ in their parental identification from students who participated with both parents. This scale consisted of three questions for each parent. Daughters used a 7-point Likert scale (1 = Not at all to 7 = Very (much)) to rate their identification with their mother ("How well does your mother know what you are really like"; "How close do you feel to your mother"; "How interested is your mother in the things you do"; $\alpha = 0.84$) and completed comparable questions about their father ($\alpha = 0.87$).

Demographics. Daughters provided additional information about their current and past high school courses, age, and gender. Parents provided additional information including their race, education, occupation, and annual household income. All participants also confirmed their relationship to anyone completing the study with them.

Each questionnaire, as well as additional details about the IAT, are available on the Open Science Framework (https://osf.io/2473f/).

4.3. Procedure

Participants were recruited by research assistants during university-wide Open House events at a large Canadian university. Recruitment of participants took place in close proximity to the psychology information sessions and in some cases the study was pro-

[1] We used a one-item measure of self-reported attitudes towards math and towards liberal arts. Despite the limitations of using one-item measures (Sauro, 2018), past research with other one-item measures (e.g., job satisfaction, stress) suggest that these have been found to be reliable and valid (Christophersen & Konradt, 2011; Dolbier et al., 2005; Elo et al., 2003; Sauro, 2018), particularly for unidimensional constructs (Sauro, 2018).

moted as an opportunity for families to learn more about psychological research. Each participant provided informed consent prior to participating, and for any adolescents under the age of 18, their parent or guardian also provided consent for their child's participation. Once all participating family members had completed the implicit measure and questionnaire, they were debriefed and entered into a draw to win a gift card.

5. Results

Preliminary analyses provided evidence that both daughters and their parents stereotyped academics on both implicit and explicit measures (see Table 2 and see Table S1, Figure S1, and Figure S2 in the Supplemental Materials for more information). In addition, daughters who participated with one parent did not differ in their parental identification relative to daughters who participated with both parents (see Supplemental Materials). Hence, for all subsequent analyses, we combined the data for mother-daughter and father-daughter dyads, regardless of whether daughters participated with one or two parents.

All structural equation models were run using the Lavaan package in R, and all models were estimated using maximum likelihood estimation. Missing data were handled using the “ML” function. Model fit was estimated using several fit indices. The root mean square error of approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) were used to examine how well the model fit to the data. Given that the majority of participants had arrived with only one parent, we examined mothers' and fathers' data in separate models, however, in order to maximize statistical power, all daughters' data were included for the paths examining daughters’ own implicit and explicit stereotypes and their academic orientation.

Mother-daughter dyads. The first model examined data from mothers and daughters (see Fig. 1). The model had good fit according to all of the examined fit indices ($\chi 2$ = 25.48, df = 19, p = .15; RMSEA = 0.04, 90% CI [0.00, 0.08], SRMR = 0.06, CFI = 0.98, TLI = 0.97), with factor loadings per factor of 0.81–0.99 (Mothers' Math Self-Concept) and 0.55–0.94 (Daughters' Academic Orientation, see Table S2). As can be seen in Fig. 1, mothers' academic stereotypes and self-concept did *not* predict daughters' implicit or explicit stereotypes. However, daughters' own implicit stereotypes (β = -0.26, z = -3.33, p = .001) and their explicit stereotypes (β = -0.17, z = -2.15, p = .03) significantly predicted their academic orientation. Specifically, as daughters’ implicit and explicit academic-gender stereotypes increased, their academic orientation (i.e., their attitudes toward math versus liberal arts, self-reported ability in math versus liberal arts, and intention to pursue a STEM field) decreased.

We re-ran this model using the latent variable of math orientation that included math attitudes, self-reported math ability, and intentions to pursue a STEM field, with the former two being non-relative measures. This model also had good fit ($\chi 2$ = 22.06, df = 19, p = .28; RMSEA = 0.03, 90% CI [0.00, 0.07], SRMR = 0.05, CFI = 0.99, TLI = 0.99), with factor loadings per factor of 0.82–0.99 (Mothers' Math Self-Concept) and 0.54–1.01 (Daughters' Academic Orientation, see Table S2). Again, mothers' stereotypes and self-concept did not predict daughters' implicit or explicit stereotypes. Daughters' own implicit stereotypes (β = -0.27, z = -3.68, p < .001) and explicit stereotypes (β = -0.20, z = -2.69, p = .007) both significantly predicted their math orientation, providing additional evidence that these relative stereotypes predict math orientation, a foundational area in any STEM field (See Fig. 2). We also examined a comparable model that included Liberal Arts Orientation, a latent variable that was comprised of attitudes and abilities in liberal arts as well as intentions to pursue a STEM field. This model had good fit ($\chi 2$ = 26.20, df = 19, p = .13; RMSEA = 0.05, 90% CI [0.00, 0.08], SRMR = 0.06, CFI = 0.98, TLI = 0.96), with factor loadings per factor of 0.81–0.99 (Mothers' Math Self-Concept) and -0.26–1.19 (Daughters’ Academic Orientation, see Table S2), however, none of the paths were significant (see Fig. 3).

Table 2
Average stereotypes, attitudes, and self-reported ability for all daughters, mothers, and fathers.

	N	*M(SD)*	*t*	*df*	*p*-value	95% CI
Implicit Stereotypes (D-scores)						
Daughters	158	.40(.33)	14.96	157	<.001	[.34, .45]
Mothers	134	.39(.36)	12.38	133	<.001	[.33, .45]
Fathers	69	.37(.39)	7.85	68	<.001	[.27, .46]
Explicit Stereotypes						
Daughters	182	.98(1.79)	7.39	181	<.001	[.72, 1.24]
Mothers	137	.55(1.36)	4.79	136	<.001	[.33, .78]
Fathers	80	.89(1.75)	4.56	79	<.001	[.50, 1.28]
Academic Attitudes						
Daughters	178	-1.91(1.93)	-13.20	177	<.001	[-2.20, -1.62]
Mothers	141	-.46(1.96)	-2.79	140	.006	[-.79, -.13]
Fathers	78	.38(1.60)	2.11	77	.038	[.02, .74]
Academic Ability						
Daughters	182	-1.51(2.31)	-8.83	181	<.001	[-1.85, -1.17]
Mothers	141	.01(2.33)	.07	140	.94	[-.37, .40]
Fathers	82	1.19(1.91)	5.64	81	<.001	[.77, 1.61]

Note. All measures are relative scores, such that higher values represent greater associations between math and male relative to liberal arts and female, more positive math versus liberal arts attitudes, or more positive self-reported math versus liberal arts ability. Standard deviations are in parentheses. One-sample *t*-test compares each value to 0.

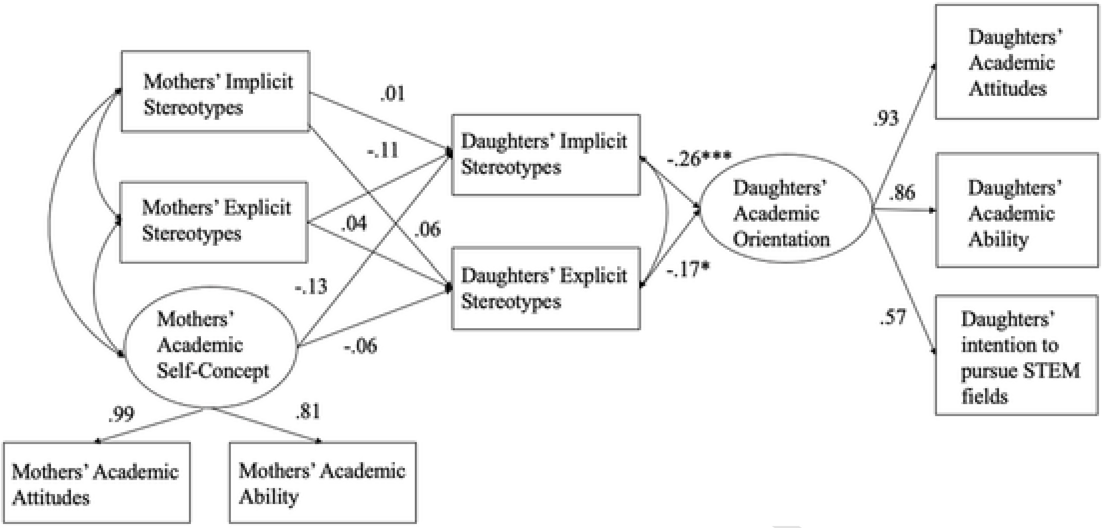

Fig. 1. Conceptual Model Specifying the Relationships Between Mothers' Academic Self-Concept, Mothers' and Daughters' Academic-Gender Stereotypes and Daughters' Academic Orientation

Note. Academic attitudes and self-reported academic ability reflect relative scores, with higher scores reflecting greater positivity toward math versus liberal arts. Stereotype measures are also relative, with higher scores indicating a greater association of math with male and liberal arts with female. **p* ≤ .05 ***p* ≤ .01 ****p* ≤ .001.

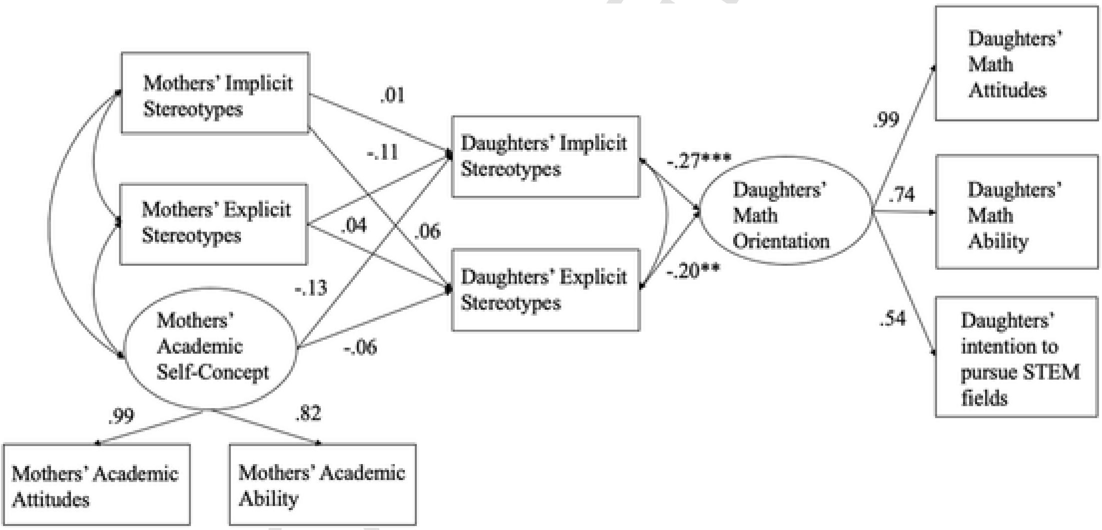

Fig. 2. Conceptual Model Specifying the Relationships Between Mothers' Academic Self-Concept, Mothers' and Daughters' Academic-Gender Stereotypes and Daughters' Math Orientation

Note. Mothers' academic attitudes and self-reported ability reflect a relative score (math minus liberal arts). Daughters' math attitudes and self-reported math ability reflect math measures only (i.e., not relative). **p* ≤ .05 ***p* ≤ .01 ****p* ≤ .001.

Father-daughter dyads. The second main model included data from fathers and daughters (see Fig. 4), and also had good fit ($\chi 2$ = 20.55, *df* = 19, *p* = .36; RMSEA = 0.02, 90% CI [0.00, 0.07], SRMR = 0.07, CFI = 1.00, TLI = 0.99), with factor loadings per factor of 0.65–1.11 (Fathers' Math Self-Concept) and 0.54–0.93 (Daughters' Academic Orientation, see Table S3). In this model, fathers' explicit academic stereotypes predicted daughters' explicit stereotypes (β = 0.25, z = 2.15, p = .03); the more fathers explicitly gender-stereotyped academics, the more their daughters did as well. In addition, daughters' own implicit (-0.26, z = -3.20, p = .001) and explicit academic-gender stereotypes (β = -0.17, z = -2.14, p = .03) significantly predicted their academic orientation.

As with mothers' data, we re-ran this model using the latent variable of math orientation that included math attitudes, self-reported math ability, and intentions to pursue a STEM field; the model had good fit, ($\chi 2$ = 30.28, *df* = 19, p = .05; RMSEA = 0.06, 90% CI [0.07, 0.09], SRMR = 0.08, CFI = 0.96, TLI = 0.93), with factor loadings per factor of 0.66–1.09 (Fathers' Math Self-Concept) and 0.51–0.99 (Daughters' Academic Orientation, see Table S3). Fathers' explicit stereotypes again predicted daughters' explicit stereotypes (β = 0.25, z = 2.16, p = .03). Similarly, daughters' own implicit stereotypes (β = -0.27, z = -3.60, p < .001) and

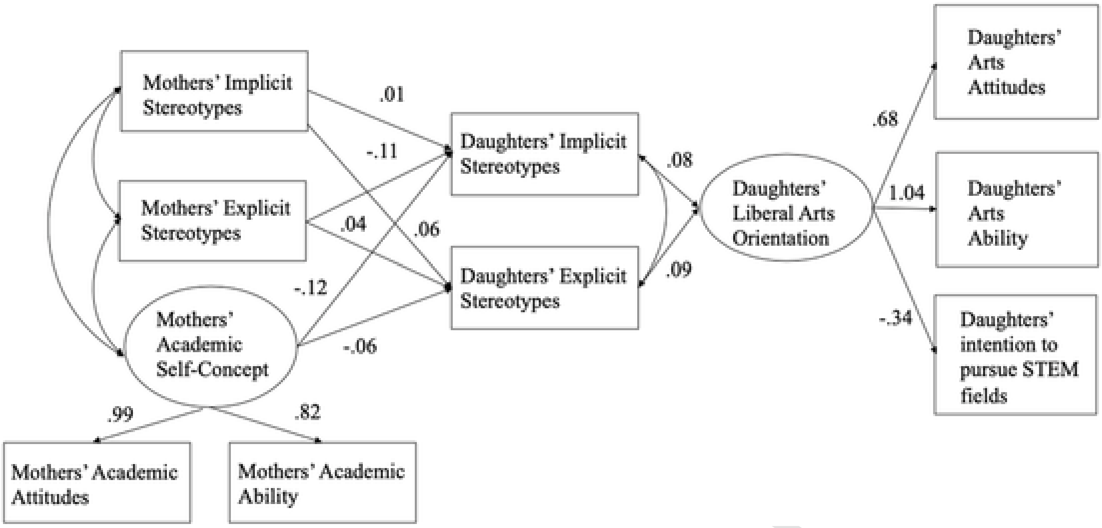

Fig. 3. Conceptual Model Specifying the Relationships Between Mothers' Academic Self-Concept, Mothers' and Daughters' Academic Gender Stereotypes and Daughters' Arts Orientation

Note. Mothers' academic attitudes and self-reported ability reflect a relative score (math minus liberal arts). Daughters' arts attitudes and self-reported arts ability reflect liberal arts measures only (i.e., not relative). $^{*}p \leq .05$ $^{**}p \leq .01$ $^{***}p \leq .001$.

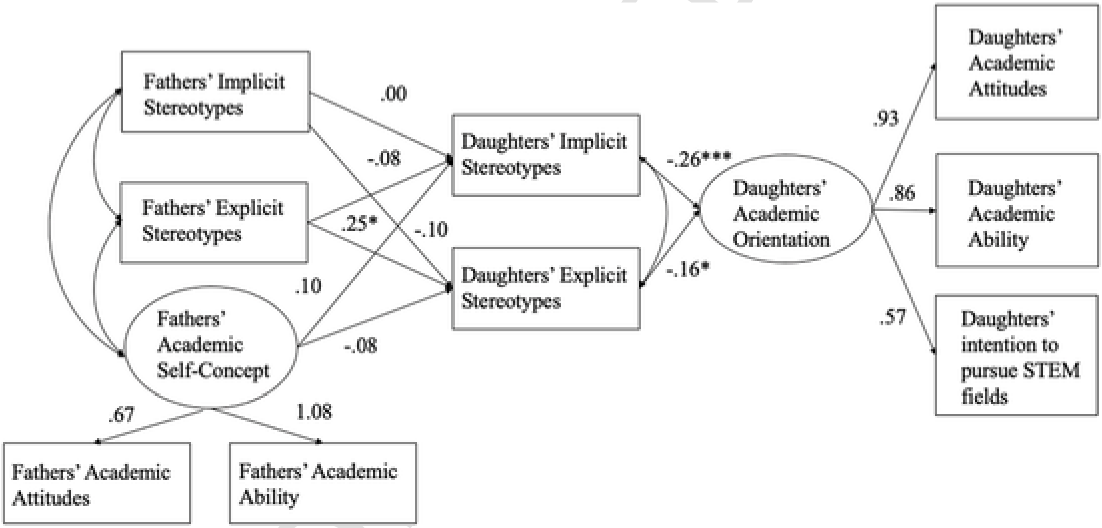

Fig. 4. Conceptual Model Specifying the Relationships Between Fathers' Academic Self-Concept, Fathers' and Daughters' Academic-Gender Stereotypes and Daughters' Academic Orientation

Note. Academic attitudes and self-reported academic ability reflect relative scores, with higher scores reflecting greater positivity toward math versus liberal arts. Stereotype measures are also relative, with higher scores indicating a greater association of math with male and liberal arts with female. $^{*}p \leq .05$ $^{**}p \leq .01$ $^{***}p \leq .001$.

explicit stereotypes (β = -0.20, z = -2.70, p = .007) both significantly predicted daughters' math orientation (see Fig. 5). Our comparison model, which instead included a comparable Liberal Arts latent variable, also had a good fit, ($\chi 2$ = 19.72, df = 19, p = .41; RMSEA = 0.01, 90% CI [0.00, 0.07], SRMR = 0.05, CFI = 1.00, TLI = 0.99), with factor loadings per factor of 0.68–1.05 (Fathers' Math Self-Concept) and -0.32–1.18 (Daughters' Academic Orientation, see Table S3). However, only fathers' explicit academic-gender stereotypes again predicted daughters' explicit stereotypes (β = 0.24, z = 2.10, p = .04; see Fig. 6).[2]

[2] All models were also run without the academic orientation latent variables, instead as regression analyses, predicting attitudes, self-reported ability, and STEM intentions separately. We felt that the analyses provided in this paper provide the most parsimonious account of our results but have included these additional analyses in the Supplemental Materials in support of open science practices and for readers who might be interested in these for theoretical and/or conceptual reasons.

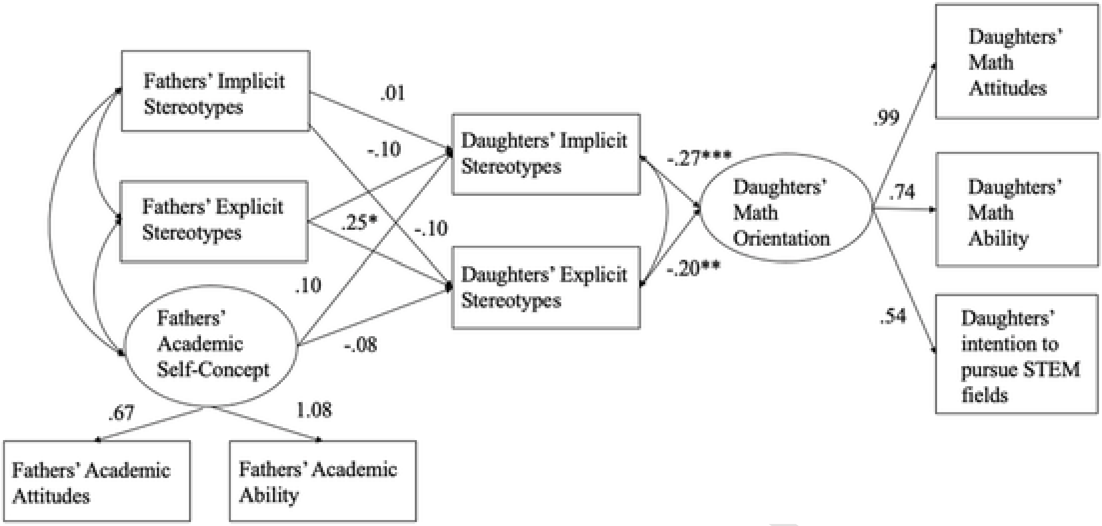

Fig. 5. Conceptual Model Specifying the Relationships Between Fathers' Academic Self-Concept, Fathers' and Daughters' Academic-Gender Stereotypes and Daughters' Math Orientation

Note. Fathers' academic attitudes and self-reported ability reflect a relative score (math minus liberal arts). Daughters' math attitudes and self-reported math ability reflect math measures only (i.e., not relative). *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$.

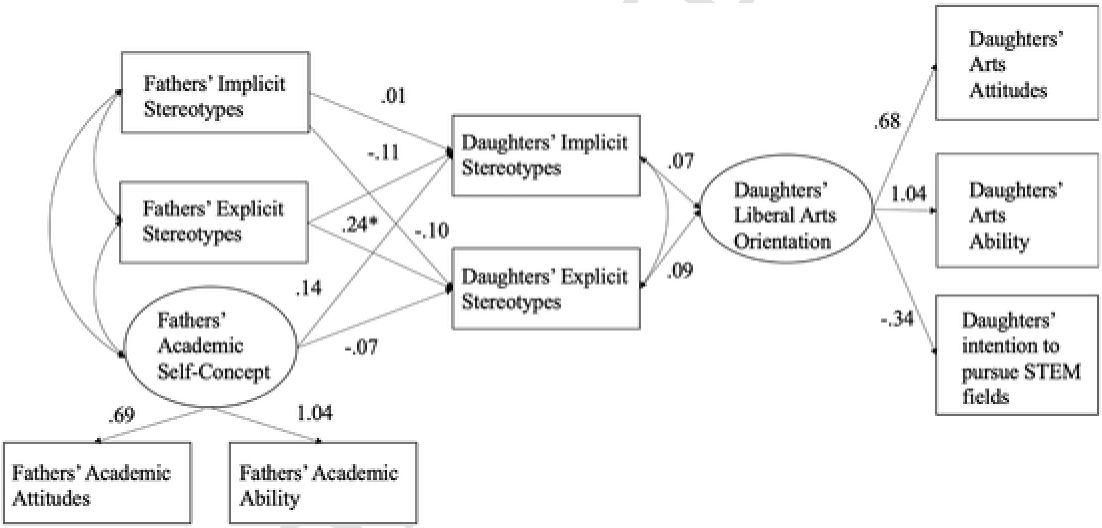

Fig. 6. Conceptual Model Specifying the Relationships Between Fathers' Academic Self-Concept, Fathers' and Daughters' Academic Gender Stereotypes and Daughters' Arts Orientation

Note. Fathers' academic attitudes and self-reported ability reflect a relative score (math minus liberal arts). Daughters' arts attitudes and self-reported arts ability reflect liberal arts measures only (i.e., not relative). *$p \leq .05$ **$p \leq .01$ ***$p \leq .001$.

6. Discussion

The aim of the present research was to increase our understanding of implicit and explicit academic-gender stereotypes among parents and their daughters in late adolescence, at a time when daughters are making important career-related decisions. Previous theory (e.g., Eccles & Wigfield, 2020; Wigfield & Eccles, 2020) suggests that achievement-related decisions are shaped by a variety of factors, including parent socialization. Research has provided some, albeit mixed, evidence that parents' self-concept and math-gender stereotypes can predict their young children's stereotypes; however, no research to date has made use of implicit measures of stereotyping to examine these relationships among adolescent daughters and their parents.

Despite previous theory and research suggesting that mothers can influence their children's stereotypes both directly and indirectly (e.g., Cohen & Rubinsten, 2017; Simpkins et al., 2005; Tomasetto et al., 2015), in the current research mothers' academic-gender stereotypes, assessed with both implicit and explicit measures, and their self-reported academic self-concept, did *not* predict their adolescent daughters' academic-gender stereotypes on either implicit or self-report measures. One novel aspect of this study was the age range, and the specific developmental period (i.e., late adolescence, prior to university) that we recruited. Our results suggest that, despite mothers' influence on stereotype development throughout childhood, in adolescence mothers' academic-gender stereotypes, including their stereotypes on implicit measures that assess spontaneously activated associations and can be less susceptible to socially desirable responding, did not predict daughters' self-reported stereotypes or daughter's own spontaneous gendered associations with math and liberal arts. Including implicit measures helps us to rule out the possibility that this lack of relation between mothers' and their daughters' stereotypes was due to socially desirable responding on the explicit measures. In addition, our implicit measures provide further theoretical insight into implicit social cognition within families by suggesting that by adolescence, parents' academic stereotypes are not significantly related to adolescent girls' gendered associations with academic domains.

In addition, building on past research with fathers (del Río et al., 2019; Galdi et al., 2017; Tomasetto et al., 2011), we found that fathers' explicit stereotypes predicted daughters' explicit academic-gender stereotypes. By contrast, fathers' academic-gender stereotypes and self-concept did not predict daughters' implicit stereotypes. It is unclear why a relationship emerged for fathers and daughters only, and only on the explicit stereotyping measure. It seems possible that as young women move toward adulthood, their fathers' explicitly shared gendered beliefs become particularly influential, as they might be more likely to be shared as daughters consider future educational pursuits and career options. However, it is also possible that fathers' stereotypes can be shaped by daughters' beliefs, interests, behaviors, and ultimately their academic performance in these domains. As Simpkins, Fredricks, and Eccles (2015) note, when children are younger, parents have more opportunities to see their children in a variety of contexts and to interpret their behaviors. However, during adolescence, the direction of this relationship may shift, as parents begin to rely more on their adolescent children's interpretations of events, rather than seeing their behaviors for themselves. Although this was not the hypothesized direction in the current study, future longitudinal research could investigate the potential bidirectional and dynamic influence that parents and daughters have on each other. Given the novelty of this finding, combined with a relatively low sample size and an inability to draw causal conclusions based on our study design, future research is needed to better understand the role that fathers can have in informing their adolescent daughters' academic stereotypes.

The lack of a consistent relationship between parents' and their daughters' math-gender stereotypes across studies can be partially explained by the Situated Expectancy-Value Theory (Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). This theory suggests that there are multiple external sources of information, including cultural influences, parental attitudes and expectations, and one's own past experiences, which combine to influence a child's math orientation. Furthermore, according to this theory, a link exists between parental attitudes and behaviors toward math, and their children's subsequent beliefs and academic values. In the current study we focused very specifically on the potential for parents' implicit and explicit stereotypes and their own self-concept to predict their daughters' implicit and explicit stereotypes. Although we found limited evidence for the predictive ability of parents' implicit academic-gender stereotypes in the present study, when considering the other sources of potentially biasing information (e.g., cultural norms and/or past experiences with math), parents may play less of a role in shaping daughters' academic-gender stereotypes during this stage in development. Instead, it seems likely that by adolescence, daughters' stereotypes are better informed by years of experiences in the math classroom, and that the stereotypes of peers and teachers, as opposed to parents, may be better predictors of academic-gender stereotypes at this developmental stage (Gottfried et al., 2017; Riegle-Crumb et al., 2017). Consistent with this possibility, Simpkins, Fredricks, and Eccles (2015; Huston, 2015) found that parents had a greater influence on their adolescent children's achievement motivation and behaviors in non-academic domains, including music and sports, where classroom feedback is less likely.

The second aim of this research was to determine whether adolescent girls' academic orientation and outcomes were predicted by their own implicit and explicit academic-gender stereotypes at this stage in development. One main finding to emerge from our analyses was that both implicit and explicit academic-gender stereotypes predicted these important math-related cognitions. Specifically, greater stereotyping on both implicit and explicit measures was associated with decreased math orientation, a latent variable that included math attitudes, self-reported math ability, and intentions to pursue a degree within a STEM field. Although not directly a test of this theory, these results are consistent with Balanced Identity Theory (Cvencek et al., 2011, 2021), as young women in our study who associated math with men and liberal arts with women to a greater extent also expressed a decreased orientation toward this domain. Similarly, consistent with the SAFE model (Schmader & Sedikides, 2018), as well as previous findings with university students (e.g., Nosek et al., 2011), we found evidence that young women with more gender stereotype-consistent associations and beliefs in these academic domains were less likely to express a positive orientation toward math and science fields.

Importantly, we found that these relationships emerged when relative (math versus liberal arts) academic orientation was considered and also when adolescent girls' math orientation was examined in isolation. As our implicit measure of academic-gender stereotypes conflates gender stereotypes associating math with men and liberal arts with women, we aimed to determine whether these stereotypes would predict not only the relative academic orientation of adolescent girls toward math versus liberal arts, but whether a similar relationship would emerge for math (but not liberal arts) orientation. These findings have the potential to offer new insights into whether relative measures of both implicit and explicit stereotyping may better reflect gender stereotypes about math as opposed to liberal arts, as is often suggested in papers that make use of this implicit measure. Consistent with our expectation, in the current study, the relationships with implicit and explicit academic-gender stereotypes emerged when relative academic orientation (math versus liberal arts) was examined, as well as when math orientation (but not liberal arts orientation) was examined. Despite the relative nature of our implicit measure, these findings are consistent with the possibility that our effects are more likely to be due to gendered associations with math as opposed to liberal arts. Future research with different types of implicit measures, including a single-category IAT (Karpinski & Steinman, 2006) or Affect Misattribution Procedure (AMP; Payne et al., 2005) could provide additional insight into these associations.

Moreover, this project has applied benefits as it can help to raise awareness about academic-gender stereotypes that persists within our society. By highlighting the importance of addressing adolescents' implicit and explicit academic-gender stereotypes, these findings have the potential to help reduce barriers to girls' and women's success in math-related fields. In addition, by ensuring that both parents and teachers are aware of academic-gender stereotypes that people acquire from a young age, programs and interventions can be tailored to challenging these stereotypes, particularly among young women in high school, prior to their selection of gatekeeping courses (e.g., grade 11 Physics) and ultimately before deciding on their post-secondary pursuits. Previous research suggests that certain targeted interventions can be effective in reducing young women's (especially first-year undergraduate women's) levels of math-gender stereotyping (Dasgupta et al., 2015; Dennehy & Dasgupta, 2017; Kawakami et al., 2008; Ramsey et al., 2013; Walton et al., 2015). In addition, targeted interventions directed at the parents of high school students can have positive effects on their children's STEM preparation in high school and ultimately have positive downstream consequences for their children's representation in STEM fields (Rozek et al., 2017). The young women in our sample are on the cusp of entering university and their academic-gender stereotypes on implicit and explicit measures are predicting their academic orientation. With these and other findings in mind, additional research examining interventions targeting both girls and boys, as well as their teachers, guidance counsellors, and parents during early high school and/or throughout childhood will be important to help reduce academic-gender stereotypes and increase young women's representation in STEM fields.

6.1. Limitations and future directions

A first limitation to the current research is that families who were attending university recruitment events (across two university campuses) chose to participate in the current study. Although this allowed us to specifically recruit adolescents and their parents while they were actively reflecting on important career-related decisions, given our proximity to psychology information sessions, it is likely that our participants do not represent the diversity of post-secondary interests in a typical adolescent population. It is also possible that our participants had generally more positive relationships within their family, leading not only to their joint attendance at the university event, but also to their self-selected participation in our study. In addition, the majority of adolescents participated with their mothers, providing a smaller sample of fathers. The lack of access to fathers reduced the power of our models using fathers' data, and this may have reduced the generalizability of these models. In addition, as daughters often arrived with one parent, there was insufficient power to examine the influence of mothers and fathers within the same family. Future longitudinal research involving both parents, at different stages of their children's development, would help determine whether and when parents' academic-gender stereotypes indirectly predict their daughters' attitudes and performance, as well as whether these relations are bidirectional (e.g., Simpkins et al., 2006; Simpkins, Fredricks, & Eccles, 20152015a).

Longitudinal research would also help to address questions of causality. Although stereotypes likely affect young women's orientation toward math, women who developed less positive math attitudes and perceived abilities during childhood and/or adolescence may associate math less with women; this relationship is likely dynamic and mutually reinforcing for both daughters and their parents (Galdi et al., 2017). Finally, parents' academic-gender stereotypes might be better predictors of daughters' stereotypes among daughters who intend to pursue a Bachelor of Science degree. Our sample size was not large enough to examine this directly, and therefore future research could address this question by recruiting adolescents interested in pursuing a wider range of academic fields.

7. Conclusion

The current findings contribute to the existing body of research examining the relation between parents' and daughters' stereotypes, attitudes, and self-reported ability by investigating implicit stereotypes, including a sample of fathers, and most notably, by examining these relations during an important transitional period of development that has been understudied in the literature. In late adolescence, young women are at a critical point when they must decide what academic program (e.g., B.A. versus B.Sc.) to pursue; the decisions that they make can have a significant impact on their career opportunities. Our research findings suggest that daughters who gender stereotype math to a greater extent have a less positive orientation toward math. Although the direction of this relationship remains unclear, our findings are consistent with the possibility that these gendered associations can contribute to decisions that prevent young women from obtaining lucrative and prestigious STEM careers (Jacobs, 2014). Breaking down barriers and decreasing the "leaky pipeline" (Steffens et al., 2010) can only happen if stereotypes are challenged, discriminatory practices are reduced, and STEM careers are increasingly welcoming for women (Cheryan et al., 2017; Schmader & Sedikides, 2018). Through continued research in this area, it is hoped that we can decrease barriers to women's participation in STEM fields and create more equitable opportunities for everyone in the future.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.adolescence.2021.09.010.

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