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ORIGINAL ARTICLE

Parents' Math Gender Stereotypes and Their Correlates: An Examination of the Similarities and Differences Over the Past 25 Years

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Abstract

Though one might imagine that traditional gender stereotypes about math have lessened over the years, this assumption remains to be tested. We know little about the extent to which parents' gender stereotypes about math abilities and their correlates have changed over time or the extent to which they replicate across research methods and racial/ethnic groups. To address these issues, we used four longitudinal U.S. datasets collected from 1984 to 2009 (*n's* = 537–14,470, 49–53% girls, 32–95% White, 1–59% Black, 0–22% Latinx) that included similar survey items. Across the datasets, parents believed that boys were better at math than girls. This was particularly consistent among White parents, where the small effects favoring boys replicated across all four datasets covering three decades. Compared to White parents, Black and Latinx parents were significantly less likely to favor boys. After controlling for parent education, income, and their child's math grade, parents' traditional gender stereotypes were significantly and negatively associated with girls' math self-concept, a small effect that replicated across all four datasets. These findings have implications for teachers and parents, as parents (particularly White parents) were significantly more likely to hold traditional math gender stereotypes, which relates to children's math self-concept.

Keywords STEM · Sexism · Traditional gender stereotypes · Math stereotypes · Math self-efficacy · Motivational beliefs · Expectancy-value beliefs · Parents · Math self-concept

A pervasive gender stereotype throughout many Western societies is that men are better at math than women. This math ability gender stereotype would appear to stem from societal influences as gender differences are not found in K–16 math course performance and test scores (Lindberg et al., 2010; Nollenberger et al., 2016; Scafidi & Bui, 2010). Though the belief that boys are better at math than girls helps boys' math outcomes, it hinders math outcomes for girls—a group that is marginalized in math and in STEM more broadly (Breda et al., 2020; Régner et al., 2014). Though these stereotypes and their correlates are troubling, few studies have tested if individuals' math ability gender stereotypes have improved over time and whether these patterns are pervasive among non-White populations who are marginalized in STEM (McGuire et al., 2020; Starr & Simpkins, 2021).

In addition to testing the reproducibility of findings for the sake of replication (Maxwell et al., 2015), historical replication is especially valuable when considering gender and STEM motivation to understand the extent to which these troubling patterns emerge among marginalized groups and persist today. For decades, psychologists have studied gender gaps in STEM to explain why girls and women tend to be less motivated in STEM than boys and men. Though women have made gains in many STEM fields between the 1980s and the 2010s, including in math (e.g., Ceci et al., 2014), media portrayals have not substantially improved (Long et al., 2010) and gender gaps in youth's STEM motivational beliefs persist today (e.g., Breda et al., 2020). Yet, we know very little about historical shifts in the contextual factors

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contributing to these persistent gaps. According to situated expectancy-value theory, parents and their beliefs are the first primary influence on their childs' development, including their STEM beliefs, that continue to shape their development well into adulthood (e.g., Eccles & Wigfield, 2020). To address these critical gaps in the literature, we examined the prevalence of parents' math ability gender stereotypes across 25 years (1984 to 2009) and across racial/ethnic groups in four large U.S. datasets. Furthermore, we examined the relations between parents' math ability gender stereotype beliefs and children's math motivational beliefs.

Situated Expectancy-Value Theory (SEVT)

Eccles' situated expectancy-value theory of achievement-related choices (SEVT, Eccles & Wigfield, 2020) has often been used to examine social factors related to gender differences in individuals' math motivational beliefs, choices, and performance. SEVT postulates that individuals' gender stereotypes are culturally situated beliefs that affect their motivation and behaviors (Eccles & Wigfield, 2020). According to SEVT, parents are central socializers of children's math motivational beliefs, and parents' gender stereotypes about a domain like math are theorized to influence how they interact with their children and their children's subsequent motivational beliefs (Eccles & Wigfield, 2020). Students' motivational beliefs in a particular domain are composed of two primary constructs—ability self-concept beliefs (beliefs about how good someone is in a domain such as math) and value beliefs (beliefs about how interesting, useful, important, or costly a task is) (Eccles & Wigfield, 2020). Specifically, if a parent believes their child's gender group is generally good at a domain, they may provide greater support or have more confidence in their child, resulting in their child endorsing higher ability self-concept and value beliefs in that domain (e.g., Bleeker & Jacobs, 2004, Simpkins et al., 2015). Students' motivational beliefs, in turn, are central determinants of their academic and career choices and outcomes (e.g., Eccles & Wigfield, 2020). Thus, parents' gender stereotypes about a domain like math have implications for their children's motivational beliefs and subsequent outcomes in that domain (Simpkins et al., 2015).

The Prevalence of Parents' Math Gender Stereotypes Across Races/Ethnicities

Prior studies indicate that parents on average are more likely to believe boys and men are better at math than girls and women (Eccles et al., 2000; Herbert & Stipek, 2005; Jacobs & Eccles, 1992; Lindberg et al., 2008; Lummis & Stevenson, 1990; Stoet et al., 2016). However, many prior studies relied on one dataset and focused on White, middle-class families. The prevalence of gender stereotypes may differ based on race/ethnicity given that cultural beliefs about gender roles and academic ability vary across groups and the extent to which these groups face oppressive systems in STEM (Rouland et al., 2013). Thus, it is unclear if the same gender math ability stereotypes are as pronounced in groups where both men and women are marginalized in STEM due to their race/ethnicity. Examining the prevalence of gender stereotypes based on race/ethnicity warrants further examination, particularly considering the growing diversity of the U.S. population.

Although SEVT mentions the social context and race/ethnicity as informing developmental motivational processes through socialization, it provides less specific guidance on the extent to which the prevalence of these stereotypes or their correlates might vary. For that, we turn to social status theory, which posits that people are more likely to endorse stereotypes when they have something to gain from them; and thus, socially privileged groups (e.g., White people, men) are more likely to endorse traditional gender stereotypes because they have more status to gain by upholding current social systems (Rowley et al., 2007). In contrast, low-status, non-privileged groups are more likely to endorse egalitarian views (Rowley et al., 2007). Based on social status theory, parents of boys, as well as White and Asian individuals (particularly parents of White and Asian boys) have more to gain by upholding traditional gender stereotypes about math because of their strong representation in STEM whereas parents of girls and Black and Latinx individuals (particularly parents of Black girls and Latinas) have less to gain from upholding traditional stereotypes and may be more likely to endorse gender egalitarian or non-traditional stereotype beliefs. Studies examining parents' stereotypes suggest that parents of boys may be more likely to hold traditional stereotype beliefs compared to parents of girls (e.g., Lee et al., 2022; Starr & Simpkins, 2021). For example, one longitudinal study examined traditional math gender stereotypes among mothers of elementary school students; they found that over time, the endorsement of the traditional stereotype that boys are better in math increased among parents of boys, yet decreased among parents of girls (Lee et al., 2022).

Regarding race/ethnicity, Black parents may be less likely to hold traditional math gender stereotypes both due to social status theory as well as cultural beliefs that value self-reliance and confidence among Black women and girls (Black & Peacock, 2011). Findings among Black and White Americans support that there are more egalitarian or non-traditional gender role beliefs endorsed among Black Americans than among White Americans (Rowley et al., 2007; Skinner et al., 2021). For example, one study found that on average Black mothers rated girls as more competent than boys at academics (Wood et al., 2010). Relatedly, two studies on gender stereotypes among Black and White late elementary and middle school children found that girls and Black youth were less likely to endorse traditional gender stereotypes than their peers (Evans et al., 2011; Rowley et al., 2007). Black girls were the least likely to endorse the stereotype that boys are better than girls in math and science, whereas White boys were the most likely to endorse the stereotype (Rowley et al., 2007). Another study found that Black women have weaker implicit gender stereotypes than White women, and the same difference emerged among men (O'Brien et al., 2015). Thus, this evidence from Black youth and adults suggest that Black parents may endorse less traditional gender stereotypes in math than White parents, but this difference has currently not been tested among parents to our knowledge.

Moreover, there is a dearth of studies exploring the prevalence of math ability gender stereotypes among Latinx and Asian students. Research finds that Asian societies generally endorse more traditional gender stereotypes about work and family, and several Asian societies have lower gender equality scores than the U.S. and Western Europe (Nollenberger et al., 2016). Though one study found that middle schoolers in China believed boys are better at math than girls (Liu, 2018), it is unclear if this pattern generalizes to Asian parents in the U.S. Parallel to cultural beliefs among Asian families, Latinx families have been found to communicate more traditional gender-role expectations (e.g., machismo and marianismo) (Gutierrez et al., 2019). However, recent work suggests these traditional gender-roles may not translate to more traditional math gender stereotypes as one study found that, on average, Latinx mothers reported more egalitarian beliefs about math ability (Denner et al., 2018). Two additional studies found adult Latinas had significantly less traditional implicit stereotypes associating STEM with men compared to White women, although both groups stereotyped STEM as a male domain (O'Brien et al., 2015; Starr, 2018). Thus, past research suggests that Asian parents might endorse more traditional math gender stereotypes similar to White families whereas Latinx parents may endorse less traditional stereotypes similar to Black families. However, it remains an open question whether these cultural gender role beliefs manifest in parents' math ability stereotypes. In this study, we build on the literature in this area by examining the prevalence of parents' math ability gender stereotypes across White, Black, Asian, and Latinx families.

Parents' Gender Stereotypes and Their Children's Math Motivational Beliefs

Prior studies have found a connection between parents' math gender stereotypes and their children's motivational beliefs (e.g., Jacobs, 1991; Kurtz-Costes et al., 2008; Simpkins et al., 2015; Tiedemann, 2000). Girls, on average, have lower math motivational beliefs than boys (e.g., Dapp & Roebers, 2018; Else-Quest et al., 2010). According to SEVT, social contexts, including socializers, are one potential reason for this disparity (Eccles & Wigfield, 2020). For example, parents' gender stereotypes are conveyed to their children through what parents say to them, what they provide for them, and how they interact with them. For example, three longitudinal studies found that mothers' traditional math ability gender stereotypes negatively predicted girls' math self-concepts, but positively predicted boys' math self-concept (Bleeker & Jacobs, 2004; Jacobs & Eccles, 1992; Tiedemann, 2000). Finally, regarding value beliefs, one study found that parent stereotypes significantly predicted their adolescents' math attainment value (Starr & Simpkins, 2021). Much of the prior research has been conducted among White, middle-class families using one dataset. Additionally, few prior studies have included both self-concept and value beliefs when assessing the relations between parent math stereotypes and child motivational beliefs. Thus, we aim to diversify the evidence by testing for these relations in multiple datasets and by youth's race/ethnicity as well as their gender.

Current Study

Past theories argue that parents' gender stereotypes shape their parenting and ultimately youth's motivational beliefs (Eccles & Wigfield, 2020); however, prior work on parents' gender stereotypes is largely based on White, middle-class populations and research is needed on more diverse racial/ethnic groups. Moreover, there have been major efforts over the last several decades to reduce traditional gender role stereotypes of math ability. Have these efforts worked? Replication studies are one method to help examine effects across contexts, including racial/ethnic groups and historical time. Replication studies that capitalize on multiple existing datasets and compare effect sizes are critical to the field of psychology (Duncan et al., 2014; Open Science Collaboration, 2015). Scholars have argued that conceptual replication, or replication of findings across different measures, contexts, and sample demographics, provides powerful evidence concerning the extent to which effects persist across different methods and participants (Plucker & Makel, 2021). However, to our knowledge, no replication study has investigated the robustness of parents' gendered math ability stereotypes across race/ethnicity in relation to historical changes in societal beliefs and structures.

The current study tests the replication of findings across four U.S. datasets that span three decades. We included any datasets that collected information on parents' gender math ability stereotypes and children's math ability self-concept and values; four datasets met these criteria. We tested the following hypotheses in each dataset (when possible) and examined the heterogeneity in effect sizes across datasets to assess replication. Based on prior literature demonstrating that adults favor boys as better at math over girls (e.g., Denner et al., 2018), we hypothesized that, overall, parent gender stereotypes would favor boys in all datasets, with similar effect sizes across datasets (Hypothesis 1a).

Additionally, we held two hypotheses based on prior literature on gender, race/ethnicity, and social status theory (Rowley et al., 2007). First, we hypothesized that parents of boys would report significantly stronger traditional gender stereotypes favoring males than parents of girls (Hypothesis 1b). Second, we hypothesized that Asian and White parents would endorse significantly stronger traditional gender stereotypes than Black and Latinx parents (Hypothesis 1c). Next, based on the prior literature connecting parent gender stereotypes to their children's motivational beliefs, we hypothesized that parent gender stereotypes would be positively associated with boys' motivational beliefs, but negatively associated with girls' motivational beliefs, even after controlling for demographic factors and math achievement (Hypothesis 2). We also wished to explore the extent to which these relations might vary based on race/ethnicity. Finally, we hypothesized that these associations would replicate across time and groups.

Method

Datasets

The present study used four datasets. Three datasets were large, local datasets: Michigan Study of Adolescent and Adult Life Transitions (MSALT), Childhood and Beyond (CAB), and Maryland Adolescent Development in Context Study (MADICS). The fourth dataset, High School Longitudinal Study (HSLS), was a large nationally representative dataset. Use of the data was approved by the University of California, Irvine Institutional Review Board under the project name "Family Support of Math and Science: Examining an Untapped Source of Resilience for Diverse High School Students" (protocol HS# 2018-4349). In each dataset, parents' gender stereotypes and children's motivational beliefs were asked concurrently. A small number of parent-youth dyads were excluded from our sample if they were missing (a) parent stereotype data (MSALT: < 1%, CAB: < 1%, MADICS: 2%, HSLS: 14%), or (b) all child motivation data from the wave used in this study and the most recent follow-up (MSALT: 0%, CAB: 3%, MADICS: 1%, HSLS: 2%).

For more information on the local datasets, including study questionnaires, see the Gender and Achievement Program websites (https://garp.education.uci.edu/). For more information about HSLS, see the National Center for Education Statistics website (https://nces.ed.gov/surveys/hsls09/; NCES, 2019). Detailed descriptions of the participants in each study are in Table 1 and below.

Michigan Study of Adolescent and Adult Life Transitions (MSALT)

MSALT followed two cohorts of Southeastern Michigan children. The present study included 1,426 children (50% girls, $n = 713$; 93% White, $n = 1326$) and their parents. The study included data from parents and children in Wave 2 (1984) when children were in 5th and 6th grade (ages 10–12).

Childhood and Beyond (CAB)

CAB is a dataset among middle-class Midwestern children and their parents from three different cohorts. The present study included a sample of 537 children (49% girls, $n = 263$; 95% White, $n = 510$) and their parents (see Table 1 for more detail on participants). Relevant data were collected from parents and children in Wave 3 (1989) when children were in 3rd, 4th, and 6th grade (ages 8–12).

Maryland Adolescent Development in Context Study (MADICS)

MADICS is a longitudinal study following one cohort of primarily Black and White families from a range of socioeconomic statuses in the Maryland and DC areas. The present sample included data from 1,026 children (50% girls, $n = 513$; 59% Black, $n = 605$; 20% White, $n = 205$) and their families. This study included data from parents and children in Wave 3 (1993) when children were in 8th grade (ages 13–14).

High School Longitudinal Study (HSLS)

HSLS is a nationally representative longitudinal study of adolescents and their families from 944 schools across the United States. The present study used data from 14,470 adolescents and parents (50% girls, $n = 7235$; 54% White, $n = 7813$; 22% Latinx, $n = 3183$; 12% Black, $n = 1736$; 3% Asian, $n = 434$). A stratified random sample design was used to determine eligible schools and children, resulting in a nationally representative sample. The present study included data from parents and children in Wave 1 (2009) when adolescents were in 9th grade (ages 14–15). Analyses with HSLS data were adjusted to be representative of the study population by using the analytic weight W1PARENT, clusters, and strata.

Measures

The datasets included the same constructs with only slight variations at the item level. For a full list of items by dataset, see Supplementary Table 1 in the online supplement. As noted in the Introduction, our goal was to test for conceptual replication. Thus, the concepts in each study were the same, but the specific questions differed across some of the

Table 1 Participants by Dataset

Indicator	MSALT	CAB	MADICS	HSLS
Design	2 cohorts	3 cohorts	1 cohort	1 cohort
Data included				
Year when collected	1984 (W2)	1989 (W3)	1993 (W3)	2009 (W1)
Youth's grades	5^{th} and 6^{th}	3^{rd}, 4^{th}, and 6^{th}	8^{th}	9^{th}
Sample sizes				
Total N: Dataset[a]	1,437	557	1,060	16,700
Total N: Current study	1,426	537	1,026	14,470
Demographic information				
% Girls (*n*)	50% (*n* = 715)	49% (*n* = 265)	50% (*n* = 508)	50% (*n* = 7,230)
Race/ethnicity				
% White (*n*)	93% (*n* = 1,320)	95% (*n* = 465)	32% (*n* = 326)	54% (*n* = 7,820)
% Black (*n*)	3% (*n* = 44)	1% (*n* = 4)	59% (*n* = 599)	12% (*n* = 1,740)
% Latinx (*n*)		1% (*n* = 3)	2% (*n* = 18)	22% (*n* = 3,180)
% Asian (*n*)		2% (*n* = 11)	2% (*n* = 19)	3% (*n* = 430)
% Other race/ethnicity	2% (*n* = 28)	< 1% (*n* = 2)	6% (*n* = 64)	9% (*n* = 1,300)
% Parent college degree	18%	43%	43%	39%
Family income	30,000 or less: 44%	40,000 or less: 43%	40,000 or less: 27%	35,000 or less: 32%
	30–40,000: 23%	40–60,000: 23%	40–60,000: 25%	35–75,000: 33%
	Over 40,000: 33%	Over 60,000: 34%	Over 60,000: 48%	Over 75,000: 35%

Note. HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year restricted dataset; n's rounded to the nearest tens place

W wave

[a]Total number of parents who participated in the wave

datasets–affording us an opportunity to examine conceptual replication, which is considered a stronger test of replication compared to exact replication (e.g., Maxwell et al., 2015).

Parents' Math Ability Gender Stereotypes

Parents in each study were asked a similar question to assess math stereotypes (Eccles et al., 1990): "How would you compare boys and girls in math?" (1 = *girls are much better,* 2 = *girls are somewhat better,* 3 = *girls and boys are the same,* 4 = *boys are somewhat better,* and 5 = *boys are much better*). The exact wording of the item varied slightly by dataset. The most notable differences include the following: (a) in the HSLS dataset and the MSALT dataset, "females/males" was used rather than "girls/boys," and (b) in the MADICS dataset, parents were asked about "math and science" in the same question (rather than just math). Across datasets, participants' responses were recoded so that the response "girls and boys are the same" was set to 0. Options that reflected the belief that girls are better at math were set to be below 0 (-1 = *girls are somewhat better*, -2 = *girls are much better*). Responses that reflected the traditional belief that boys are better at math were set to above 0 (1 = *boys are somewhat better,* 2 = *boys are much better*). This single item is useful because it allows individuals to endorse non-traditional beliefs (that girls are better at math), equality (girls and boys are equal), or traditional stereotypes (that boys are better at math) (e.g., Starr & Simpkins, 2021). This item has been used to measure math gender stereotypes in other published studies and has strong face validity as it directly asks about math ability stereotypes rather than a combination of ability and interest stereotypes (e.g., Eccles et al., 1990; Kurtz-Costes et al., 2014; Starr & Simpkins, 2021).

Additionally, the item has demonstrated criterion validity; for example, a prior study using this item to measure math stereotypes among U.S. elementary and middle school students found that the item positively correlated with stereotyping boys as better at science and girls as better at language arts, as well as knowledge of the stereotype (Kurtz-Costes et al., 2014). Prior research has found that single items perform similarly to scales with multiple items (e.g., Fisher et al., 2016; Hays et al., 2012; Nichols & Webster, 2013). Thus, despite limitations, a single item measure is useful particularly in cases where there are time constraints—as is often the case in large-scale surveys like the present study (Fisher et al., 2016; Gardner et al., 1998).

Children's Math Self-concept and Value Beliefs

Each dataset contained indicators of children's math self-concept and value beliefs based on Eccles' situated expectancy-value model (e.g., Eccles & Wigfield, 1995). These items have been validated through prior work (e.g., Eccles & Wigfield, 1995; Lauermann et al., 2017). The math self-concept belief scale included 3–5 items with alphas that ranged from .82 to .91; an example item is "How good at math are you?" (1 = *not at all good*, 7 = *very good*; see Supplementary Table 1 in the online supplement for a list of items). The value belief scale included 3–6 items with alphas that ranged from .64 to .84; an example value belief item is "In general, how useful is what you learn in math?" (1 = *not at all useful*, 7 = *very useful*). MSALT and CAB used a 7-point response scale, whereas HSLS used a response scale of 1–4 and MADICS used a 1–5 response scale for two value questions and 1–7 for the remaining questions. Evidence of measurement invariance across gender and race/ethnicity on these self-concept and value beliefs has been reported (e.g., Hsieh et al., 2021; Jiang et al., 2020; Rubach et al., In press). For more information about scale psychometric properties including measurement invariance in these datasets, see Jiang et al. (2020) (HSLS); Diemer et al. (2016) (MADICS); Jacobs et al. (2002) (CAB); and Gniewosz et al. (2015) (MSALT); and Rubach et al. (In press) for race/ethnicity and gender invariance information in all four datasets.

Background and Control Variables

In the present study, we also examined potential within and between group differences based on participants' gender (girl or boy, reported by youth or parent) and race/ethnicity (Asian, Black, Latinx, White, or other, reported by youth or parent). Furthermore, as control variables we included a measure of youth's math performance (math grade in MSALT and MADICS, standardized math test score in HSLS, and teacher report of math ability in CAB), household income reported by parent, and highest education obtained by a parent. These were chosen as control variables given that prior studies find they are associated with youth's math self-concept and value beliefs (e.g., Schoon & Eccles, 2014).

Plan for Analysis

Among the analytic sample, the proportion of missing data across the four datasets ranged from 0%–20% for individual items in the motivational belief scales, 0%–26% for parent education and income, and 0%–17% for child's math achievement. Within each dataset, we compared dyads with some missing data to dyads with no missing data among the analytic sample. In MSALT, participants with some missing data reported significantly lower parent education and math ability self-concept (*ps* $< .04$) and were significantly less likely to be White ($p < .001$) compared to participants with complete data. In CAB, participants with some missing data had significantly lower teacher reported math ability ($p = .002$) compared to participants with complete data. In MADICS, participants with some missing data reported significantly lower family incomes and parent education levels (*ps* $< .009$) compared to participants with complete data. Additionally, the children with missing data in MADICS had significantly lower math value beliefs and math achievement and were more likely to be boys (all *ps* $< .03$). Finally, in HSLS, participants with some missing data reported significantly lower parent education and family incomes (all *ps* $< .001$). They were also significantly less likely to be White and the child was more likely to be a boy and report lower value beliefs (all *ps* $< .001$) compared to participants with complete data. Missing data in all datasets were handled with multiple imputation (Enders, 2010). Thirty datasets for *each* of the four original datasets were imputed in SPSS v26 using auxiliary variables that included data from other time points (e.g., motivation data from the most recent follow-up), demographic data, and transcript data (e.g., math grade and SES). Math self-concept and value beliefs, parent income, parent education, and math achievement were imputed. If students/parents were missing race/ethnicity, the dyad was still included but this information was not imputed. Imputed datasets were then analyzed in SPSS or STATA. STATA was used with the HSLS dataset to incorporate sampling weights, while SPSS was used for all other datasets. Both programs have a function that allows researchers to run the analysis in each imputed dataset and then pool the results. The pooled results are presented in this paper.

To examine Hypothesis 1a, that overall parent gender stereotypes would favor boys in all datasets, one-sample *t*-tests were estimated, comparing the means to "0 = both genders are equal". This was done within each dataset overall, and among girls and boys separately. To examine Hypothesis 1b, that parents of boys would have significantly more traditional gender stereotypes favoring males than parents of girls, independent samples *t*-tests were conducted within each dataset comparing the stereotypes of parents of boys to parents of girls. Two of the four datasets, MADICS and HSLS, had enough racial/ethnic diversity to test racial/ethnic differences. To examine Hypothesis 1c, that Black and Latinx parents would have significantly less traditional math gender stereotypes than White and Asian parents, ANCOVAs were run investigating main effects of race/ethnicity and gender as well as the interaction between the two.

After calculating means, standard deviations, and effect sizes (Cohen's *d*) within each dataset, we tested the extent to which the effects replicated across datasets. Specifically, we used random-effects models to estimate the combined effects or average effect sizes across datasets that were adjusted for sample size using Comprehensive Meta-Analysis version 3.3 (CMA, Borenstein et al., 2021). Effect sizes were interpreted using Cohen's *d* rule of thumb, with 0.2 constituting a small effect size and 0.5 constituting a medium effect. In addition to the combined effect size, we obtained Cochran's *Q* and I^2; these statistics describe the heterogeneity of effect sizes across datasets. A significant Cochran's *Q* statistic indicates that there is significant heterogeneity in the size of the effects across datasets. The I^2 indicates the percentage of variance that differs between datasets; an I^2 under 25 indicates there is homogeneity or similarity in the effects across the datasets, under 40 indicates some homogeneity, whereas over 75 indicates considerable heterogeneity or variability in the effects across datasets (Borenstein et al., 2021; Hedges & Schauer, 2019).

Hypothesis 2 posited that parent gender stereotypes would be positively associated with boys' motivational beliefs, but negatively associated with girls' motivational beliefs. To test this prediction, regressions were run within each dataset separately among boys and girls. Parent education, family income, and child math achievement were controlled for. Because it is not recommended to calculate combined average effects and heterogeneity statistics across datasets using betas, these were not calculated for Hypothesis 2 (Hunter & Schmidt, 2015). Instead, we plotted the unstandardized B coefficients with 95% confidence intervals to compare whether effects overlapped by dataset, gender, and race/ethnicity (using unstandardized coefficients is recommended when the predictor variable is easy to understand, such as the case with a single item predictor; Baguley, 2009). This approach has been recommended to compare effects, including those in different study samples (e.g., Hoekstra et al., 2012; Thompson, 2007).

Results

Hypothesis 1a: Prevalence of Parents' Math Gender Stereotypes

Our first hypothesis was that parents would favor boys over girls as better at math. Parents significantly favored the belief that boys are better at math than girls – a pattern that replicated (a) across all four datasets, (b) among parents of boys and girls, and (c) among White and Asian parents. Below, we describe the findings overall, and by child gender and race/ethnicity.

First, we examined the data for all parents (see left side of Table 2 and top of Fig. 1). The effect sizes for all parents were small (ranging from $d = .24$ in HSLS to $d = .32$ in CAB) except one effect size that was less than small ($d = .14$ in MADICS), with a combined small effect size of $d = .24$ (across all four datasets). The *Q* and I^2 statistics suggest that there was a significant amount of variability or heterogeneity in these effect sizes across datasets [$Q(3) = 15.399$, $p = .002$, $I^2 = 80.519$]. Thus, though parents across all four datasets were significantly more likely to endorse the belief that boys are better than girls at math, this effect ranged from less than small to small across the datasets. As shown on the left side of Fig. 2, the percentage of all parents endorsing the belief that boys are better than girls ranged from 19% (CAB and MADICS) to 28% (HSLS) whereas the percentage of parents endorsing the belief that girls are better than boys ranged from 4% (CAB) to 11% (HSLS). Importantly, most parents across datasets reported gender egalitarian beliefs, ranging

Table 2 One Sample *t*-Tests Investigating Whether the Means for Boys and Girls as well as Parents of Boys and Girls Significantly Differ from Egalitarianism (0)

Dataset	All parents[a]				Parents of boys[a]				Parents of girls[a]				Comparison of parents of boys and girls[b]	
	N	*M* (*SD*)	*t*	*d*	*N*	*M* (*SD*)	*t*	*d*	*N*	*M* (*SD*)	*t*	*d*	*t*	*d*
MSALT	1,426	.15(.53)	10.955***	.28	715	.17(.52)	8.942***	.33	711	.13(.54)	6.584***	.24	3.187	.19
CAB	537	.15(.47)	7.294***	.32	272	.20(.47)	7.095***	.43	265	.09(.47)	3.258***	.19	2.655**	.23
MADICS	1,026	.09(.65)	4.469***	.14	518	.13(.66)	4.608***	.20	508	.05(.63)	1.700*	.08	2.144*	.13
HSLS	14,470	.20(.84)	28.643***	.24	7,240	.28(.83)	28.71***	.34	7,230	.12(.84)	12.146***	.14	11.525***	.19
Combined	–	–	–	.24	–	–	–	.31	–	–	–	.16	–	–

Note. 0 = both genders equally good at math. 1 = Boys better, -1 = Girls better. Cohen's d effect size standards: .2 = small, .5 = medium, .8 = large. HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year; *n*'s rounded to the nearest tens place

[a]One sample *t*-test examining if gender stereotype mean is significantly different from 0 (both genders equally good at math)

[b]Independent samples *t*-test comparing the means for parents of boys and girls

*$p < .05$; **$p < .01$; ***$p < .001$

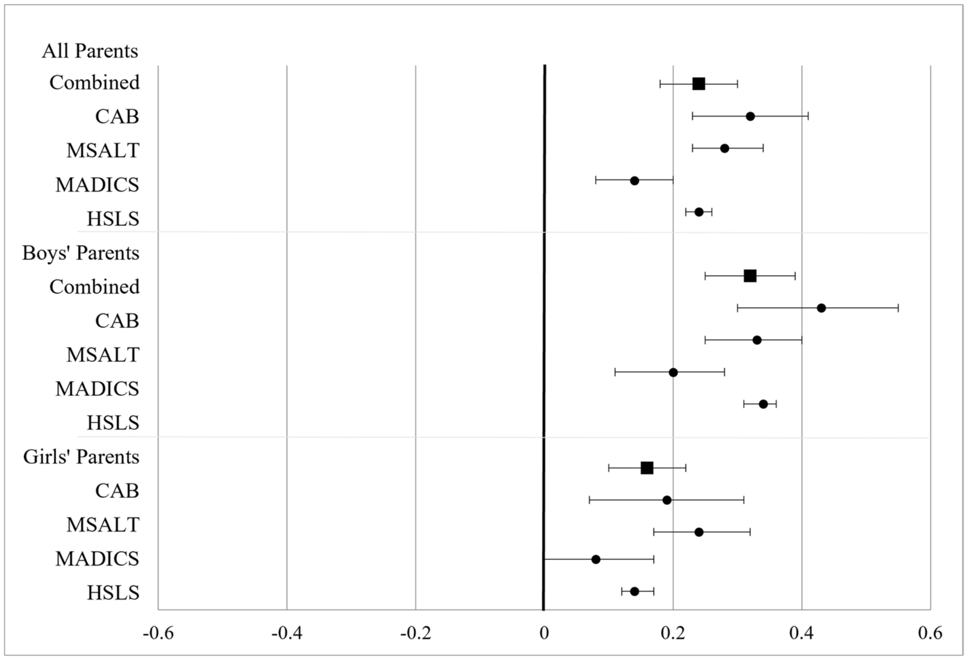


Fig. 1 Parent Math Gender Stereotypes: Effect Sizes (Cohen's *d*) by Dataset and Gender (HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year)

from 61% in HSLS (collected in 2009) to 77% in CAB (collected in 1989).

Hypothesis 1b: Math Gender Stereotypes by Child Gender

Next, we examined parents' beliefs separately for parents of boys and parents of girls. We expected that although parents overall would favor boys in math compared to girls, parents of boys would be especially likely to favor boys when compared to parents of girls. The findings shown in the middle of Table 2 suggest that parents of boys and parents of girls both favored boys; however, the combined effect across the datasets was small for parents of boys (combined $d = .31$; Table 2 and Fig. 1) but was less than small for parents of girls (combined $d = .16$). Among parents of boys, the effects ranged from small to medium for parents of boys ($d = .20$ - .43), which were significantly different across datasets [$Q(3) = 13.472$, $p = .004$, $I^2 = 77.732$]. The percentage of parents of boys endorsing the belief that boys are better than girls ranged from 21% (MADICS) to 32% (HSLS) (see the middle of Fig. 2). Among parents of girls, the effect sizes were less than small to small ($d = .08$ - .24; Table 2 and Fig. 1), and were significantly different across datasets [$Q(3) = 8.226$, $p = .042$, $I^2 = 63.529$]. The percentage of parents of girls endorsing the belief that boys are better than girls ranged from 16% (CAB and MADICS) to 26% (HSLS) (see the right side of Fig. 2).

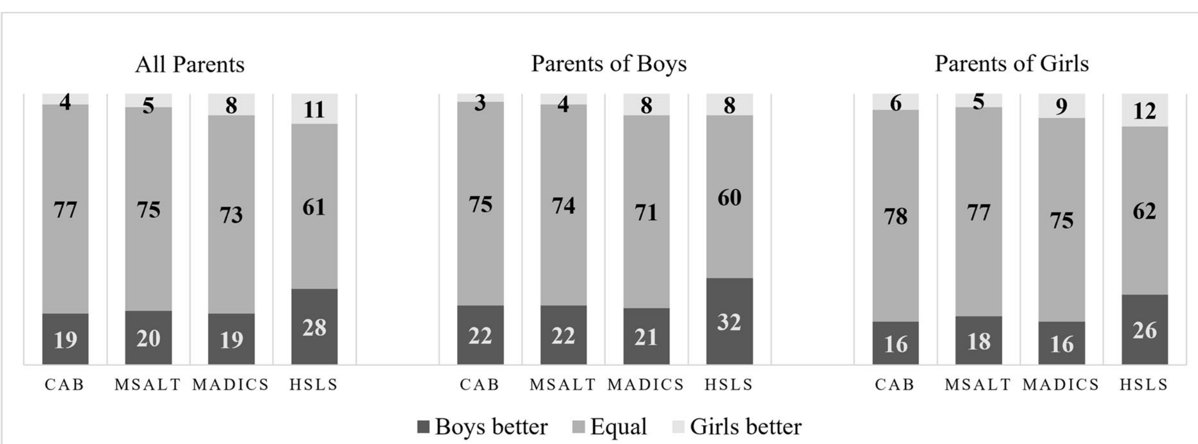


Fig. 2 Frequencies of Answer to "Who is Better at Math, Girls or Boys?" by Dataset and Gender of Child (HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year)

In addition to exploring whether group means differed from gender egalitarianism, we tested whether parents of boys had more traditional gender stereotypes than parents of girls (Fig. 1). As shown on the right side of Table 2, parents of boys held more traditional stereotype beliefs that boys are better than girls than parents of girls in each dataset ($d = .19$ - $.23$) except MSALT ($d = .13$). In sum, we found that parents were significantly more likely to hold the traditional stereotype that boys are better than girls particularly among parents of boys; this was similar across datasets however the effect sizes varied.

Math Gender Stereotypes Within Each Racial/Ethnic Group

We also examined the prevalence of parents' gender stereotypes within each racial/ethnic group (Table 3 and Fig. 3). We expected that White and Asian parents would be significantly more likely to hold traditional math gender stereotypes when compared to Black and Latinx parents. CAB and MSALT datasets were over 90% White. MADICS included Black and White parents, and HSLS included Asian, Black, Latinx, and White parents. Thus, racial/ethnic differences in the gender effects could be tested across Black and White parents in MADICS and across Asian, Black, Latinx, and White parents in HSLS. In addition, replication of the effects for Black parents could be tested across MADICS and HSLS, and the effects for White parents could be tested across all four datasets as they all included White parents.

All four datasets included White parents. White parents were significantly more likely to believe boys are better in math than girls in all datasets ($d = .27$ - $.39$) (see top of Table 3 and top of Fig. 3). The combined effect size was .33, which suggests White parents endorsed traditional math ability stereotype beliefs favoring boys and these effects for White parents replicated across all four datasets [$Q(3) = 2.930$, $p = .402$, $I^2 = 0$].

MADICS and HSLS included Black parents. In the HSLS dataset, Black parents favored boys as better at math than girls ($d = .20$); however, Black parents in the MADICS dataset held gender egalitarian beliefs ($d = .03$). Their combined effect was .12, but the size of the effect varied significantly across the two datasets [$Q(1) = 12.515$, $p < .001$, $I^2 = 92.010$]. The HSLS dataset also included Asian and Latinx parents. As expected, Asian parents significantly favored boys as better at math than girls ($d = .29$). Latinx parents' beliefs were gender egalitarian ($d = –.04$).

To test if math stereotype beliefs varied across racial/ethnic groups, we estimated ANOVAs in MADICS and HSLS. Each ANOVA included a main effect for gender, a main effect for race/ethnicity, and an interaction between gender and race/ethnicity (i.e., a 2×2 ANOVA in MADICS and a

Table 3 Math Gender Stereotype Comparisons by Racial/Ethnic Group in MADICS and HSLS

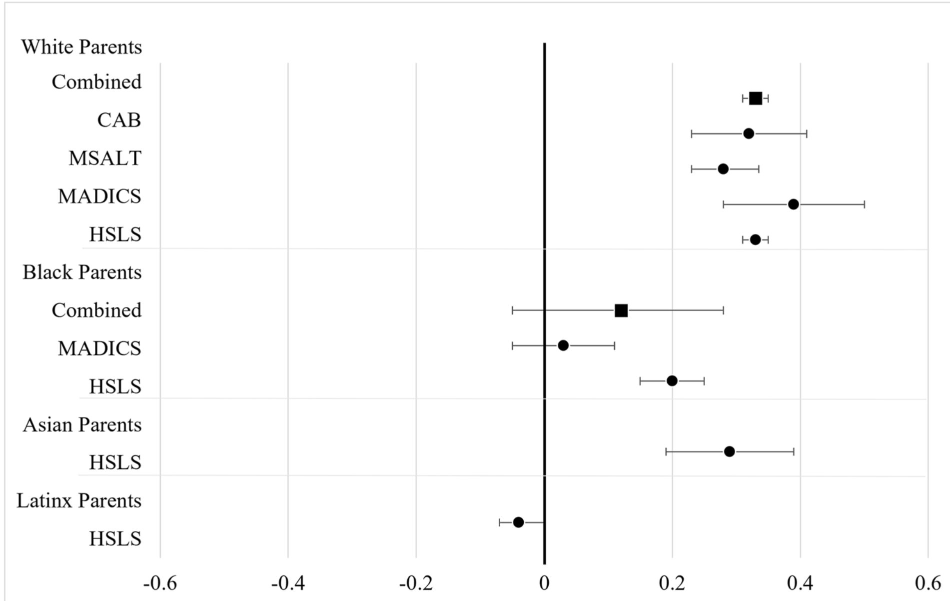
	All Parents				Parents of boys				Parents of girls			
Dataset	*N*	*M (SD)*[a]	*t*	*d*	*N*	*M (SD)*[a]	*t*	*d*	*N*	*M (SD)*[a]	*t*	*d*
White parents												
MSALT	1,320	.15 (.52)	10.480***	.29	670	.17 (.52)	8.462***	.33	650	.13 (.53)	6.254***	.25
CAB	465	.15 (.48)	6.739***	.31	233	.21 (.49)	6.542***	.43	232	.09 (.47)	2.917**	.19
MADICS	326	.20 (.51)	6.996***	.39	154	.21 (.51)	5.085***	.41	172	.19 (.51)	4.808***	.37
HSLS	7,820	.21 (.77)	24.118***	.27	3,910	.29 (.75)	24.169***	.39	3,910	.13 (.78)	10.418***	.17
Combined	9,931	–	–	.33		–	–	.40		–	–	.24
Black parents												
MADICS	599	.02 (.70)	.873	.03	322	.08 (.71)	1.893*	.11	277	-.03 (.71)	–.780	–.04
HSLS	1,740	.18 (.88)	8.525***	.20	870	.28 (.89)	9.269***	.31	870	.10 (.85)	3.468***	.12
Combined	2,336	–	–	.12		–	–	.22		–	–	.05
Asian parents												
HSLS	430	.35 (1.21)	3.598***	.29	215	.51 (1.29)	5.823***	.40	215	.19 (1.29)	2.170*	.15
Latinx parents												
HSLS	3,180	–.03 (.77)	–2.198	–.04	1,590	.03 (.75)	1.600	.04	1,590	–.09 (.80)	–4.489***	–.11

Note. There were significant race main effects in the MADICS and HSLS datasets, with small effect sizes. In the MADICS dataset, White parents had significantly more traditional math gender stereotypes than Black parents (White > Black). In the HSLS dataset, all four racial/ethnic groups of parents (Asian, Black, Latinx, and White) had significantly different math gender stereotypes. Asian parents held the most traditional math gender stereotypes, followed by White parents, followed by Black parents. Latinx parents had the least traditional stereotypes, endorsing gender egalitarian beliefs on average (Asian > White > Black > Latinx). HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year. Numbers rounded to nearest tens place

*$p < .05$; **$p < .01$; ***$p < .001$

[a] 0 = both genders equally good at math. 1 = Boys better, –1 = Girls better

Fig. 3 Parent Math Gender Stereotypes: Effect Sizes (Cohen's *d*) by Dataset and Race/Ethnicity (Effect sizes are Cohen's HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year)



2×4 ANOVA in HSLS). Gender of child was included given stereotypes were found to significantly differ by child gender (as discussed above) and to explore whether child gender effects differed by race/ethnicity.

As expected, there were some gender and race/ethnicity main effects. The gender main effect indicated that in MADICS, parents of boys and girls had similar stereotypes [$F(1) = 2.13$, $p = .144$, $\eta p^2 = .00$]. However in HSLS, parents of boys had more traditional math gender stereotypes than parents of girls across all racial/ethnic groups [$F(1) = 23.73$, $p < .001$, $\eta p^2 = .01$].

The race/ethnicity main effect suggested that Black parents had significantly less traditional stereotypes than White parents in MADICS [$F(1) = 15.92$, $p < .001$, $\eta p^2 = .017$]. This difference between Black and White parents replicated in the HSLS dataset, with additional findings involving Asian and Latinx parents [$F(3) = 36.19$, $p < .001$, $\eta p^2 = .015$]. Asian parents endorsed significantly more traditional math gender stereotypes than all other ethnic groups (ps < .001) and Latinx parents endorsed significantly less traditional math gender stereotypes than all other groups (ps < .001). White parents had significantly more traditional gender stereotypes than Black and Latinx parents (ps < .001). There was no significant gender by race/ethnicity interaction in either data set suggesting that the differences between parents of girls and parents of boys did not vary across racial/ethnic group in either dataset: HSLS [$F(3) = 1.18$, $p = .319$, $\eta p^2 = .00$], MADICS [$F(1) = .936$, $p = .334$].

In conclusion, White parents had more traditional stereotypes than Black parents in both datasets. Additionally, in HSLS, Asian parents had significantly more traditional gender stereotypes than other ethnic groups, whereas Latinx parents had significantly less traditional math gender stereotypes than all other groups. Black parents had less traditional stereotyped beliefs in the 1990s dataset when compared to the 2009 dataset. White parents held traditional stereotypes in all four datasets, with similar effect sizes that replicated across datasets.

Hypothesis 2: Parent Math Gender Stereotypes and Motivational Beliefs

Regressions were used to test the extent to which parent stereotypes were associated with their children's motivational beliefs while controlling for children's math performance, parents' income, and parents' education. Each regression was estimated separately in each dataset. In addition, separate regressions were estimated for boys and girls given the divergent expectations with expected positive relations for boys and negative relations for girls. Finally, these regressions were estimated across all racial/ethnic groups in each dataset and then separately for each racial/ethnic group in MADICS and HSLS to test if the significant relations emerged for each group. Given the number of findings, Table 4 simply provides the regression coefficients of math stereotypes predicting motivational beliefs. See Supplementary Table 2 in the online supplement for all regression coefficients for the full model, including control variables.

Several significant associations emerged for girls. Parents' traditional math gender stereotypes had a significant negative relation to girls' concurrent math ability self-concept in three out of four datasets when examining all parents (βs = –.26 [CAB], -.17 [MADICS], and –.03 [HSLS], ps < .05). Similarly, parents' traditional math stereotypes were significantly and negatively related to girls' value beliefs in the same three datasets (βs = –.42 [CAB], –.18 [MADICS], and –.03 [HSLS],

ps < .05). Next, we examined if these relations emerged for each racial/ethnic group. The findings suggest the relations between parents' math ability gender stereotypes and girls' math self-concept and value were only statistically significant for White families but not for Black, Asian, or Latinx families (see Table 4) even though several of the effects were similar in size or even larger among Asian, Black, and Latinx families compared to White families in the HSLS dataset. We plotted the regression coefficients with 95% confidence intervals to examine whether the coefficients varied across groups (see Supplementary Fig. 1a, b in the online supplement). The confidence intervals for the regression coefficients overlapped with one exception: White families in CAB did not overlap with Latinx or White families in HSLS. This pattern indicates that effects largely did not differ by race/ethnicity. Overall, our hypothesis that parents' math gender stereotypes would negatively relate to girls' ability self-concept and value beliefs was supported among White parents, which replicated in three out of four datasets.

Fewer significant relations were found among boys compared to girls; parent math gender stereotypes had significant and positive relations to boys' math ability self-concept in two datasets when examining all parents ($\beta = .19$ [MSALT] $\beta = .03$ [HSLS]) and math value beliefs in another dataset ($\beta = .16$ [MSALT]). The analyses on each racial/ethnic group suggest that the positive relations only emerged for White families in three of the four datasets for boys' ability self-concept (MSALT, HSLS, and MADICS) and two of the four datasets for boys' value beliefs (MSALT and HSLS). These constructs were not significantly related for Black, Asian, or Latinx families. However, the magnitude of some of these relations in the HSLS dataset were similar, and effect sizes with 95% confidence intervals overlapped, with the exception of Black and White families in HSLS (see Supplementary Fig. 2a, b in the online supplement). This finding indicates that effects did not differ significantly by race/ethnicity.

Discussion

Believing that boys are better in math than girls may be a common stereotype among parents and may have consequences for their children's math self-concept and value beliefs, particularly for girls (Breda et al., 2020; Régner et al., 2014). However, findings regarding the prevalence of math ability gender stereotypes are inconsistent and few studies have examined these issues among non-White

Table 4 Regression Analysis Coefficients: Gender Stereotypes and Motivational Beliefs, by Grade and Gender

	Parent Stereotypes Predicting Students' Math Motivation			
	Self-concept		Task-value	
	Boys	Girls	Boys	Girls
	B (SE)	*B* (SE)	*B* (SE)	*B* (SE)
All parents				
MSALT	.186 (.080)*	–.077 (.076)	.164 (.084)*	–.009 (.075)
CAB	.240 (.131)****	–.264 (.134)*	.011 (.164)	–.419 (.155)**
MADICS	.130 (.081)	–.174 (.081)*	–.033 (.064)	–.184 (.074)*
HSLS	.033 (.015)*	–.029 (.014)*	.019 (.001)	–.027 (.012)*
White parents				
MSALT	.173 (.084)*	–.071 (.081)	.142 (.087)****	–.003 (.080)
CAB	.156 (.130)	–.278 (.133)*	.044 (.157)	–.400 (.152)**
MADICS	.250 (.122)*	–.399 (.177)*	–.046 (.159)	–.150 (.149)
HSLS	.075 (.015)***	–.031 (.016)*	.027 (.014)*	–.016 (.012)
Black parents				
MADICS	.099 (.095)	–.040 (.096)	–.028 (.074)	–.097 (.089)
HSLS	–.047 (.030)	–.031 (.028)	–.050 (.026)	–.036 (.032)
Asian parents				
HSLS	–.045 (.057)	–.040 (.038)	.039 (.053)	–.028 (.040)
Latinx parents				
HSLS	.065 (.035)	–.025 (.035)	.000 (.023)	–.030 (.024)

Note. Numbers reported are pooled unstandardized beta coefficients (and standard errors) from separate regressions, controlling for parent education and income and student math grade. HSLS SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Longitudinal Study of 2009 (HSLS:09), Base Year

* $p < .05$; ** $p < .01$; *** $p < .001$; **** $p < .10$

participants or across historical time (McGuire et al., 2020; Starr & Simpkins, 2021). The present study sought to explore whether parent bias favoring boys in math and its associations with boys' and girls' math ability self-concept replicated across racial/ethnic groups and datasets that varied in historical time.

As expected, parents on average favored boys over girls in all datasets, although the most common response from parents was that boys and girls are equally good at math (61%–77% of parents across datasets). Additionally, there was variation based on race/ethnicity. We found that White parents were more likely to believe that boys are better at math than girls compared to Black and Latinx parents, with small effect sizes that did not significantly change over three decades. Asian parents endorsed significantly more traditional stereotypes compared to Black and Latinx parents. Furthermore, parents' stereotypes were negatively associated with girls' math self-concept and positively associated with boys' self-concept among White families. Unexpectedly, the associations between parents' stereotypes and their children's self-conceps were not statistically significant in non-White families though the size of the effects were similar. Below, we discuss these main findings in greater depth.

Historical Comparisons

One issue confronting the field is a lack of replication across studies particularly when considering replications across multiple datasets in one study, which is critical yet uncommon in this field (Duncan et al., 2014). Historical replication is especially valuable when considering gender and STEM motivation. Psychologists have studied gender and math motivation for decades; and yet despite societal changes in many gender norms, the motivational gender gaps in STEM have persisted. Because of this, it is important to examine historical changes in societal beliefs, such as math gender stereotypes, to help identify why these differences may have persisted.

In the present study, parent math ability gender stereotypes were measured at four different time points, ranging from 1984 to 2009. Despite the 25-year range, we found that White parents, on average, believed boys are better at math than girls, with small effect sizes replicating across all datasets. White parents' traditional stereotypes were also significantly associated with their children's math self-concept in three out of four datasets, positively for boys and negatively for girls. Given these patterns and other findings on the relations between parent math gender stereotypes and their children's math motivational beliefs (e.g., Bleeker & Jacobs, 2004), persistent parental math gender stereotypes may be one of the small but potential reasons why gender gaps have persisted in children's math motivational beliefs, particularly among White youth (Parker et al., 2020; Rubach et al., In press; Seo et al., 2019). These findings support situated expectancy-value theory (Eccles & Wigfield, 2020), which posits that the stereotypes of socializers such as parents influence their children's motivational beliefs.

Testing for replication was also possible among Black participants across two datasets. The prevalence of parents' math ability gender stereotypes did not replicate across datasets. Although Black parents in both datasets had significantly less traditional stereotypes than White parents, Black parents in 2009 (HSLS dataset) were still biased towards boys with a small effect size compared to Black parents in 1993 who were more gender egalitarian (MADICS dataset). This pattern was unexpected, given we expected Black parents in both datasets would not be significantly biased towards boys (e.g., Evans et al., 2011; Rowley et al., 2007). There could be a few reasons for these differences. First, there could be historical shifts in parents' beliefs over this 16-year period between the two studies. Second, much of past research on Black families has been conducted in smaller, local datasets, similar to MADICS. A nationally representative dataset like HSLS may have included Black families who are often understudied, such as those from rural areas, who may have more traditional math gender stereotypes. Furthermore, MADICS included Black families who had a higher average SES than national levels for Black families. Prior research among Black adults has found that income and education are positively related to more gender egalitarian attitudes and lower race-based stereotypes, respectively (Stickney & Konrad, 2007; Wodtke, 2012). Future studies might investigate the contribution of SES and other potential reasons further, which we discuss in greater detail in the next section.

The negative relations between parent math gender stereotypes and their child's motivational beliefs additionally replicated among girls in three out of four datasets among all parents, though these findings were driven by White families. Across historical time, parents' traditional stereotypes were negatively related to girls' ability self-concept and value beliefs, even after controlling for factors such as math grade and family income. Among boys, the relations were inconsistent; in two out of four datasets (the earliest and latest datasets collected), parents' traditional gender stereotypes were positively related to boys' math ability self-concept beliefs. The nonsignificant relations between parent stereotypes and motivational beliefs among Black families replicated across MADICS and HSLS. Thus, parents' traditional math gender stereotypes may be primarily helping White boys' math ability self-concepts, but also harming White girls' math ability self-concepts. Below, we discuss the findings based on race/ethnicity in greater depth.

Racial/Ethnic Comparisons

A second contribution of this study is that we examined the prevalence and correlates of parents' stereotypes across and within multiple racial/ethnic groups. Black and Latinx parents had significantly more egalitarian math ability gender stereotypes than Asian and White parents. These are some of the first findings on math gender stereotypes among Asian and Latinx parents regarding prevalence, correlates, and differences with other racial/ethnic groups.

The finding that Black and Latinx parents were less likely to endorse traditional gender stereotypes than Asian and White parents supports social status theory (Rowley et al., 2007). Social status theory posits that disenfranchised groups are often less likely to support traditional stereotypes because they have less to gain by upholding the status quo and may be more aware of social justice issues (Rowley et al., 2007). As a result, Black and Latinx parents, particularly those who are parents of girls, are expected to notice injustices (Rowley et al., 2007). In contrast, White and Asian parents, particularly when they are parents of boys, may have more incentive to uphold stereotypes about math that privilege their child or boys/men of their racial/ethnic group. In the current study, Asian and White parents of boys and girls were likely to hold traditional gender math ability stereotypes though the sizes were larger for Asian and White parents of boys ($d = .40$ and .40 respectively) than Asian and White parents of girls ($d = .15$ and .24 respectively).

But why might there be even a small effect for Asian and White parents of girls to uphold traditional math gender stereotypes that do not favor their daughters? Based on social status theory, this might occur because some members of their racial/ethnic group, including men/boys in their family and community, may benefit from endorsing and propagating these stereotypes. It is also possible that racial/ethnic groups who are overrepresented or privileged in STEM may have more traditional gender stereotypes because they have greater exposure to STEM careers and thus more exposure to math-related gender stereotypes. Both explanations also help clarify the contrasting finding between Asian and Latinx parents in the current study. Asian and Latinx cultures may espouse traditional gender role beliefs (e.g., Gutierrez et al., 2019; Tang et al., 2010), but Asians are privileged in math (and STEM more broadly) whereas Latinxs are often marginalized. In our findings, Asian parents endorsed stronger traditional math gender stereotypes than Latinx parents, which align with racial/ethnic groups that typically experience privilege versus marginalization in STEM. Though social status theory has typically been used to predict the stereotypes of the corresponding group (e.g., how much girls compared to boys endorse gender stereotypes) (Kurtz-Costes et al., 2008; Rowley et al., 2007), these findings suggest that social status theory might have broader implications based on where people are situated within an intersectional lens.

We also found that relations between parents' stereotypes and youth's math motivational beliefs were generally statistically significant among White families, but not among other races/ethnicities, though the effect sizes were sometimes similar. Two possible reasons why effects of similar size can vary in their statistical significance across groups is varying sample size (e.g., small size of the Asian families in HSLS) and differing within group variability. In the HSLS dataset, for example, the magnitude of the effects were sometimes similar across race/ethnicity, but the standard error was larger among Asian and Latinx families than White families. White families were the largest group within HSLS, accounting for 54% of the sample. The within group variability among White families in HSLS was smaller compared to the other groups. It is possible that White parents' more traditional stereotypes may collude with mainstream cultural beliefs present in media and schools, resulting in larger and more homogeneous impacts on their children's math motivational beliefs. In contrast, Black and Latinx parents in HSLS were less likely to endorse traditional math gender stereotypes, which may contradict messages that their children receive from other socializers, resulting in a lower, more heterogenous overall impact. These divergent patterns across race/ethnicity help explain why prior research may have found larger gender gaps in math self-concept among White youth compared to youth from marginalized racial/ethnic backgrounds (Parker et al., 2020; Rubach et al., In press; Seo et al., 2019). More research is needed to conclusively determine the relations between parent math gender stereotypes and adolescent motivational beliefs, particularly among Asian, Black, and Latinx families.

Limitations and Future Research Directions

This study was unique in that it implemented multiple large datasets to investigate parents' gender stereotypes in math. This approach made testing the replication of stereotype prevalence possible, but it also has limitations. First, the earliest dataset we found examining this question was from 1983, well into the second wave feminist movement. If we had been able to include datasets from an earlier time (such as the 1950s), it is possible we would have found historical changes in math gender stereotypes. Furthermore, our two earliest datasets were over 90% White, which limited our ability to test for replication among other racial/ethnic groups, particularly Asian and Latinx families given they were only represented in one dataset. Additionally, sample sizes were relatively limited in some groups when split by race and gender, particularly among Asian families in the HSLS dataset. This smaller sample among Asian families may have led to non-significant results, particularly regarding relations between parent stereotypes to youth motivational beliefs. In this case, the regression coefficients among Asian families were larger than White families, but results were not statistically significant and should be interpreted with caution. As mentioned above, large standard errors among the Asian and Latinx families could have impacted the significance of these effects and indicate rich variability within these race/ethnic groups. Asian and Latinx are broad ethnic categories that incorporate a variety of nationalities and cultures (e.g., Kang et al., 2021). Among Asian nationalities and cultures, for example, some are well-represented in STEM whereas others are not, which may result in greater variability in the processes we tested. Due to dataset demographics and the way race/ethnicity was measured, we were not able to attend to these different backgrounds; however future research should investigate differences and similarities within Asian and Latinx cultures.

We investigated differences by race/ethnicity and gender, finding that underrepresented groups in STEM (parents of girls, Black, and Latinx parents) had significantly less traditional stereotypes. Future studies might also explore differences related to family income and parent education. Given that low income and first-generation students are also underrepresented in STEM, they may also be less likely to endorse math gender stereotypes. This might also differ at the intersections of race/ethnicity and gender (e.g., low-income White males may still feel they have something to gain by upholding traditional stereotypes), so future studies could take this into account by focusing on the role of socio-economic status for race/ethnicity by gender.

Furthermore, we examined the ability stereotype that boys are better than girls in math, however there are many other gender stereotypes about math, such as who finds it more useful. Compared to ability stereotypes, these value-related gender stereotypes among parents may be more highly related to children's math value beliefs. Relatedly, future studies might ask about STEM subjects beyond math. Relative to fields like computer science and engineering, math has greater gender parity (National Science Foundation (NSF), 2021). Thus, people may hold stronger male bias regarding fields like computer science when compared to math (Master et al., 2021). However, we believe assessing math gender stereotypes is still important, given that math is a gateway to these fields.

Practice Implications

Our findings have several practical implications for teachers and parents. First, we found that the traditional stereotype that boys are better in math that existed in the 1980s largely persisted among parents in 2009, particularly among White families. Our findings imply that traditional gender stereotypes about math ability continue to pervade social attitudes. White parents may communicate their traditional gender stereotypes favoring boys to their children. Furthermore, given most teachers are White (U.S. Department of Education, 2016), teachers may also communicate these stereotypes to their students. These beliefs may be one factor lowering girls' math self-concept and may partly explain why the gender gap in youth's math motivational beliefs persists. Thus, interventions that focus on lowering parents', teachers', and children's math gender stereotypes could be implemented by schools and other institutions such as science museums (e.g., Law et al., 2021; Lee et al., 2022).

However, it is also important to note that many parents endorsed the belief that boys and girls are equally good in math (61%–71% of parents across datasets). Black and Latinx parents were especially likely to indicate that they believed girls are better at math, and parents of girls had less bias than parents of boys. Prior research has demonstrated that one strength of many Black families is their encouragement of strength and self-reliance among their daughters (Black & Peacock, 2011). Our findings suggest Black individuals may carry this strength with them into STEM, where Black families and youth were more likely to endorse counter-traditional gender stereotypes about math ability and be especially supportive of their daughters in STEM.

Another potential reason for greater counter-stereotypical beliefs among Black and Latinx families may be that Black and Latinx boys are often unsupported in schools, tracked into more remedial math courses, and may experience negative stereotypes and discrimination (Berry, 2008; Umarji et al., 2021). These experiences for boys of color may lower people's traditional stereotype that boys are better in math if they are often placed in remedial courses and have accumulating negative experiences (Musto, 2019; Skinner et al., 2021). However, it is also important to note that Black girls and Latinas also face these barriers (Musto, 2019). Future studies might investigate how both contribute to more counter-traditional math gender stereotypes among Black and Latinx youth and families. Furthermore, studies about traditional gender bias should aim to investigate between and within group differences and be careful not to generalize to different racial/ethnic groups.

Conclusion

This study makes important contributions in several areas. First, this study is the first to investigate math ability gender stereotypes among parents across multiple datasets, allowing for tests of replication and potential historical differences. Second, this study allowed us to examine the relation between parents' stereotypes and their children's motivational beliefs. Many parents endorsed egalitarian beliefs or counter-stereotypical beliefs, especially among Black and Latinx parents. However, math ability gender stereotypes among White parents have not lessened over three decades, and White parents' stereotypes were negatively associated with girls' self-concept and value beliefs in math in three out of four datasets. This small but persistent bias towards believing boys are better in math than girls among parents may be one reason why, despite many societal changes in regards to gender and similar math grades and test scores, math motivational beliefs have still not reached gender parity. Understanding why can help us develop and direct math supports better to increase motivational beliefs, and in turn math and STEM outcomes for girls and women.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11199-022-01337-7.

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Availability of Data and Material Data and material is available at the following websites. HSLS: https://nces.ed.gov/surveys/hsls09/ MSALT, CAB, and MADICS: https://garp.education.uci.edu/msalt.html

Code Availability SPSS and STATA were used for this paper's analyses.

Compliance with Ethical Standards

Ethics Approval The present study used deidentified, secondary human participant data from four datasets: MSALT, CAB, MADICS, and HSLS. Use of the data was approved by the University of California, Irvine Institutional Review Board under the project name "Family Support of Math and Science: Examining an Untapped Source of Resilience for Diverse High School Students" (protocol HS#2018-4349).

Informed Consent The present study used deidentified, secondary data from four datasets. More information on the datasets, including informed consent, can be found at the following websites. MSALT, CAB, and MADICS: Gender & Achievement Research Program, https://garp.education.uci.edu/msalt.html. HSLS: National Center for Education Statistics, https://nces.ed.gov/surveys/hsls09/

Conflicts of Interest The authors have no conflicts of interest to disclose.

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