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REVIEW ARTICLE

Black and Latinx Adolescents' STEM Motivational Beliefs: a Systematic Review of the Literature on Parent STEM Support

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Abstract

STEM careers are among the fastest growing and highest paid occupations throughout the world. However, persistent social inequities in STEM domains emerge early for Black and Latinx adolescents, creating numerous barriers to their pursuit of STEM. Developmental and motivational theories highlight parents as a source of strength and support for students' STEM motivational beliefs. We conducted a systematic review of the existing work on parents' STEM socialization processes that shape Black and Latinx adolescents' STEM motivational beliefs. As part of this goal, we examined the variability within Black adolescents and within Latinx adolescents based on (a) other demographic factors (e.g., gender) and (b) racial/ethnic promotive and inhibitive factors (e.g., racism). The systematic literature search and eligibility screening yielded 36 relevant peer-reviewed, empirical journal articles published between January 2000 and January 2020. Overall, a majority of studies found support for positive relations between parents' STEM-specific support and adolescents' motivational beliefs among Black and Latinx families. Additionally, most studies included analyses within each racial/ethnic group, and about half of all articles included racial/ethnic promotive or inhibitive factors, such as familism or racism. In our discussion, we highlight an agenda for future research and discuss bridging theoretical perspectives to better position research to more accurately describe STEM motivation among youth from historically underrepresented groups.

Keywords African American · Latino · Hispanic · Caregiver · Family · Motivation · Race · Ethnicity

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Introduction

Black and Latinx people continue to be underrepresented in science, technology, engineering, and math (STEM) college majors and occupations (NSF, 2019). For example, even though Black and Latinx Americans comprise 11% and 17% of the US workforce, they only account for 9% and 8% of the STEM workforce, respectively (Pew Research Center, 2021). This racial/ethnic gap is an equity issue on multiple levels. STEM professions need the perspectives and talents of Black and Latinx individuals when designing services and innovations that benefit a diverse society (NSF, 2019). For example, some current commercial health devices are poorly calibrated to accurately measure health metrics (e.g., heart rates on smartwatches) of darker-skinned individuals, highlighting the need for a more diverse medical and technology workforce that attends to the needs of diverse populations and designs devices that are equally effective for all (Shcherbina et al., 2017). Furthermore, STEM jobs are some of the most widely available and highest paid careers in the USA, which provide key pathways for social mobility (Zakaria, 2011). All youth who are passionate about STEM deserve to be supported and provided with these opportunities for upward mobility (NSF, 2019; Puente et al., 2021). Though much of the existing literature identifies current racial/ethnic disparities and barriers through group comparisons, these comparisons often depict Black and Latinx adolescents as being deficient or lower in STEM motivation and outcomes compared to their White or Asian counterparts. To support the success of Black and Latinx adolescents, we need research focused solely on Black and Latinx adolescents (not group comparisons) to identify what specifically supports their positive STEM development.

Adolescence is an important developmental period to examine positive STEM development both because this period is marked by consistent racial/ethnic gaps in STEM and because the decisions adolescents make during this period (e.g., course decisions) have profound educational and occupational consequences (e.g., Andersen & Ward, 2014). Though culturally grounded models highlight the many barriers Black and Latinx youth often face (García Coll et al., 1996; Rafaelli et al., 2005), adolescence can also be a positive turning point where some youth develop new STEM aspirations if provided support (e.g., Starr et al., 2022). One of the strongest predictors of individuals' STEM performance and choices throughout life are their motivational beliefs (such as expectancy-value beliefs), making these beliefs and the factors that support them important to investigate (Else-Quest et al., 2013; Maltese & Tai, 2011; Watt et al., 2012).

Parents typically are children's first socializers and continue to be an important source of support well into adulthood (e.g., Simpkins et al., 2015a). However, much of the existing work on parent support of youth's STEM motivational beliefs is based on processes among middle-class, White families (Ramani & Siegler, 2008; Sonnenschein et al., 2016). Though some parenting processes may generalize to Black and Latinx families, this is an assumption at best, as parenting is determined in part by the culturally grounded practices of individuals' racial/ethnic group and

the marginalizing forces Black and Latinx families continually face (García Coll et al., 1996; Huguley et al., 2021; McLoyd, 1990; Raffaelli et al., 2005).

More research needs to describe how parents serve as a source of strength for Black and Latinx adolescents' STEM motivational beliefs, including the culturally grounded ways parents provide support and how they help Black and Latinx adolescents deal with barriers often not encountered by their White, middle-class counterparts. For example, Black and Latinx youth often encounter numerous barriers in STEM, including under-resourced schools, biased teachers, and societal messages that they do not belong in STEM (e.g., Gale, 2020). Although schools and our larger society are not always positive contexts for Black and Latinx youth, parents (and other family caregivers) are an important, positive source of support for students' academic outcomes (e.g., Koch et al., 2019; Hill & Tyson, 2009).

To be clear, families are not the source of the structural barriers Black and Latinx adolescents face nor should they carry the burden to rectify these barriers. However, describing parents' STEM supports can help researchers make more comprehensive school and policy recommendations that can build on the strengths Black and Latinx families possess. Thus, our goal was to conduct a systematic review of peer-reviewed articles examining the relations between STEM parents' support and adolescents' motivational beliefs among Black and Latinx families.

Theoretical Perspectives About Motivational Beliefs and Parenting

The existing relevant theories either focus on motivational processes with limited attention to cultural or racial/ethnic processes or they focus on how culture and race/ethnicity inform parenting practices and development more generally—neither of which describes the relevant culturally and racially/ethnically informed motivational processes on their own. We utilized theory bridging (e.g., Leaper, 2011) to integrate aspects of culturally grounded models with motivation theories to enrich our understanding of STEM support among Black and Latinx families, as depicted in Fig. 1. The white boxes in the figure include constructs from motivation theories (Brown & Lent, 2019; Eccles & Wigfield, 2020; Kaplan & Maehr, 2007; Oyserman & Lewis, 2017); and the gray boxes and highlighted text include constructs from culturally grounded models (García Coll et al., 1996; McLoyd, 1990; Rafaelli et al., 2005).

The bottom of Fig. 1 includes the individual and family motivational processes. Some of the most prominent motivational theories used to investigate parental influences on motivation include the situated expectancy-value theory (Eccles & Wigfield, 2020), goal orientation theory (Kaplan & Maehr, 2007; Vandewalle et al., 2019), and cognitive career theory (Brown & Lent, 2019). Although each perspective emphasizes unique aspects, there is notable overlap in the core constructs (Lee et al., 2020). All of these theories include individuals' motivational beliefs—beliefs about one's competence, values, aspirations, and identity in STEM—shown at the bottom right of Fig. 1. For example, situated expectancy-value theory examines STEM competence beliefs in the form of ability self-concept and expectations for success in addition to value and identity beliefs. Similarly, identity is included in many of these theories, which posit that students tend to pursue a domain like STEM

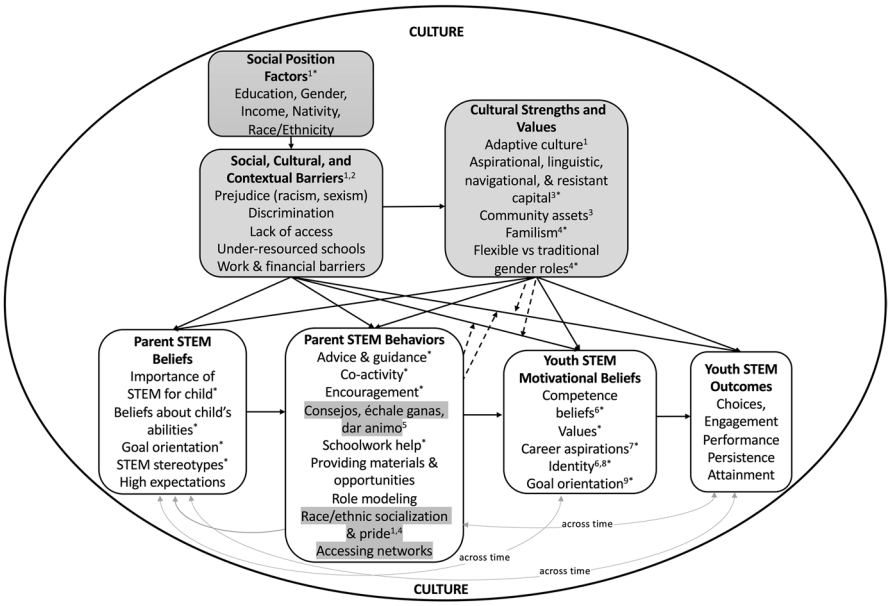

Fig. 1 A graphical overview of systematic review findings. [1]García Coll et al. (1996), [2]Raffaelli et al. (2005), [3]Yosso (2005), [4]Eccles and Wigfield (2020), [5]Brown and Lent (2019), [6]Oyserman and Lewis (2017), [7]Kaplan and Maehr (2007); Vandewalle et al. (2019)

if they believe it fits with their identity (e.g., Elmore & Oyserman, 2012; Oyserman & Lewis, 2017). Taken together, individuals' STEM motivational beliefs listed in the figure are covered in this review because they cover a range of the most central theoretical constructs. Extensive research suggests that these STEM motivational beliefs predict later STEM outcomes as shown at the bottom right of Fig. 1 (e.g., Eccles & Wang, 2016; Schoon & Eccles, 2014).

Next, utilizing motivational theories (e.g., Eccles & Wigfield, 2020) as well as culturally grounded frameworks (e.g., Soto-Lara & Simpkins, 2020), we highlight the parental beliefs and behaviors that influence their children's motivational beliefs. The family socialization sub-model of situated expectancy-value theory posits that youth's motivational beliefs are shaped by the combined contributions of multi-ple parent behaviors as shown in Fig. 1, including co-activity and encouragement (Eccles et al., 1993; Eccles & Wigfield, 2020). Several culturally grounded frameworks suggest additional parent behaviors that are likely to shape youth's motivation, including race/ethnic socialization and consejos, or advice that is rooted in cultural meaning and emphasizes the importance of having an education (García Coll et al., 1996; Raffaelli et al., 2005; Yosso, 2005). For example, Black parents may engage in racial socialization to help their children manage racist messaging they might experience in upper-level mathematics courses, where teachers express lower expectations (Berry & McClain, 2009). These STEM parenting practices are determined by parents' STEM-related beliefs, such as their gender stereotypes about

STEM (Starr & Simpkins, 2021) and beliefs about whether their child is competent in STEM (e.g., Jacobs & Eccles, 1992).

Although motivational theories acknowledge that these individual and contextual motivational processes are shaped by culture and individuals' social position in society, culturally grounded ecological models more thoroughly describe the cultural and racial/ethnic processes that impact the development of youth of color (Boykin, 1986; García Coll et al., 1996; McLoyd, 1990; Rafaelli et al., 2005). According to these theories, socio-historical-cultural processes shape racial/ethnic minority family functioning and youth adjustment overall, including family and motivational processes in STEM. As shown on the top left of Fig. 1, the integrative model of minor-ity child development posits that social position factors, including gender and race/ethnicity, shape individuals' experiences with racism and oppression, which in turn impact the contexts children have access to and the barriers they face (García Coll et al., 1996). These barriers impact the family and individual motivation processes, such as shaping parents' and youth's beliefs about who belongs in STEM and access to enriching STEM opportunities.

These culturally grounded ecological models also emphasize cultural strengths Black and Latinx families possess, as shown on the top right of Fig. 1 (García Coll et al., 1996; Rafaelli et al., 2005; Vélez-Agosto et al., 2017). These assets include an adaptive culture that empowers families and youth to overcome daily barriers through responsive strategies (e.g., leveraging kinship; García Coll et al., 1996). Other theories on Black and Latinx families highlight the ways in which cultural values, including familism (or the high importance of family over individuals), faith and spirituality, and kinship strengthen parents' socialization practices (Hernández & Bámaca-Colbert, 2016; Jarrett et al., 2011; Raffaelli et al., 2005; McLoyd et al., 2019). For instance, familism positively relates to parents' STEM support among those who value STEM (Simpkins et al., 2018). Overall, these cultural processes need to be considered to accurately understand STEM motivational and socialization processes within Black and Latinx families.

Family Socialization, Social Identities, and Motivation

Though several studies have examined these family socialization processes among White families (Harackiewicz et al., 2012; Simpkins et al., 2015b), the parallel literature on Black and Latinx adolescents is comparatively limited (Huguley et al., 2021; Simpkins et al., 2020). As a result, the current theoretical and empirical knowledge about adolescents' STEM motivational development is biased toward White families. These potential biases are problematic as they obscure constructs and processes applicable for more diverse populations and perpetuate deficit notions about Black and Latinx families. It is essential to examine these processes among Black and Latinx adolescents to gain insight into positive family motivational processes for these underrepresented populations.

Individual and family processes are shaped by the broader cultural context (Eccles & Wigfield, 2020; Soto-Lara & Simpkins, 2020). For example, stereotypes and expectations around gender and race/ethnicity are determined by society's

norms and beliefs (Eccles, 1993; Eccles & Wigfield, 2020). Historically, Black and Latinx minority populations in the USA are differentially racialized and occupy distinct racial locations that set them apart from each other and the White majority population (Flores-Gonzalez, 2017; Soto-Lara & Simpkins, 2020). Furthermore, Black and Latinx families have unique, intersecting sociocultural processes that inform the ways in which parents socialize their children (Soto-Lara & Simpkins, 2020; Varner & Mandara, 2014). Therefore, it is important to examine parent STEM support within Black families and within Latinx families.

Variations Within Racial/Ethnic Groups

A second aim of our study was to examine within-group variation. Examining within-group variation is vital to understanding how parent STEM support uniquely influences Black and Latinx youth. Much of the existing STEM literature that examines race and ethnicity focuses on differences between racial/ethnic groups with the narrative that Black and Latinx youth are underperforming compared to White and Asian youth. This heavy focus on between-group differences ignores the rich variability within each racial/ethnic group and does not address the specific factors that support youth's STEM success within each group (e.g., Causadias et al., 2018; Quintana et al., 2006; Simpkins et al., 2015b). Emerging work suggests that there is rich variability among individuals within the same racial/ethnic group in terms of parental support (e.g., Simpkins et al., 2015b) and youth's STEM outcomes (Hsieh et al., 2021; Parker et al., 2020). These within-group variations may be due to processes discussed in culturally grounded ecological models, including other social position factors (e.g., gender, SES) or variability in racialized experiences and cultural values. Such variation can emerge at the mean level (e.g., parents provide less STEM support for girls than boys) or at the process level (e.g., parent support positively relates to STEM motivational beliefs for boys but not for girls). For this reason, we investigated students' STEM beliefs as a function of both (a) potential within-group variations at the mean and process levels based on social position factors and (b) racial/ethnic and cultural processes.

Finally, given prior research and theory (e.g., stage environment fit; Eccles et al., 1993), we explored potential within-group variations based on whether youth were in middle school versus high school. For example, certain types of support might be more developmentally appropriate for younger adolescents (e.g., schoolwork support), whereas other supports might be more important for older adolescents (e.g., advice about STEM course choices). In sum, we were interested in examining within-group variations based on social position factors, racial/ethnic and cultural processes, and developmental period.

Summary

The purpose of this study was to review recent empirical studies (published on 2000–2020) considering parent or family STEM-specific support and adolescent STEM motivational beliefs as outlined in Fig. 1 among Black and Latinx families. Specifically, we were interested in the following questions: First, how does the current body of literature conceptualize parent support among Black and Latinx families, and do these studies find parent support positively relates to student STEM beliefs? Second, are there any within-group variations in these indicators among Black adolescents and among Latinx adolescents based on social position factors, racial/ethnic and cultural processes, and developmental period?

Method

Positionality Statement

It is important to acknowledge our backgrounds as researchers and how they may relate to the research process (Hill et al., 2005). The first author is a postdoctoral scholar in education and is a queer White woman raised in rural Illinois, in a low-income, non-college educated family. Her experience in rural schools and growing up in a low-income multigenerational household has informed her perspective on academic motivation, culture, and families. The second author is a 1.5-generation immigrant, Filipino-American, male, postdoctoral scholar raised in a lower-SES area in Southern California and is the first in his family to go to college in the USA. His research focuses on family and cultural influences and is informed in part by his upbringing in a Filipino, single-parent household that emphasized familism values. The third author is a White woman raised in California whose family has been in the USA for more than three generations. The context in which she was raised and her research expertise made her aware of the importance of cultural processes in family systems.

Literature Search

Using guidelines from the Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA, Moher et al., 2009), we conducted our literature search in three phases: the database search, the backwards search, and the forwards search. All three searches were conducted in the 3-week period between February 10, 2021 and March 2, 2021; see Fig. 2 for an outline of the number of articles identified, excluded, and included for each step. First, we conducted the initial search for peer-reviewed, empirical journal articles published between January 2000 and January 2021 via five major journal article databases: PsycInfo, PsycArticles, SocAbstracts, ERIC, and Web of Science (due to the wide breadth of articles indexed by Web

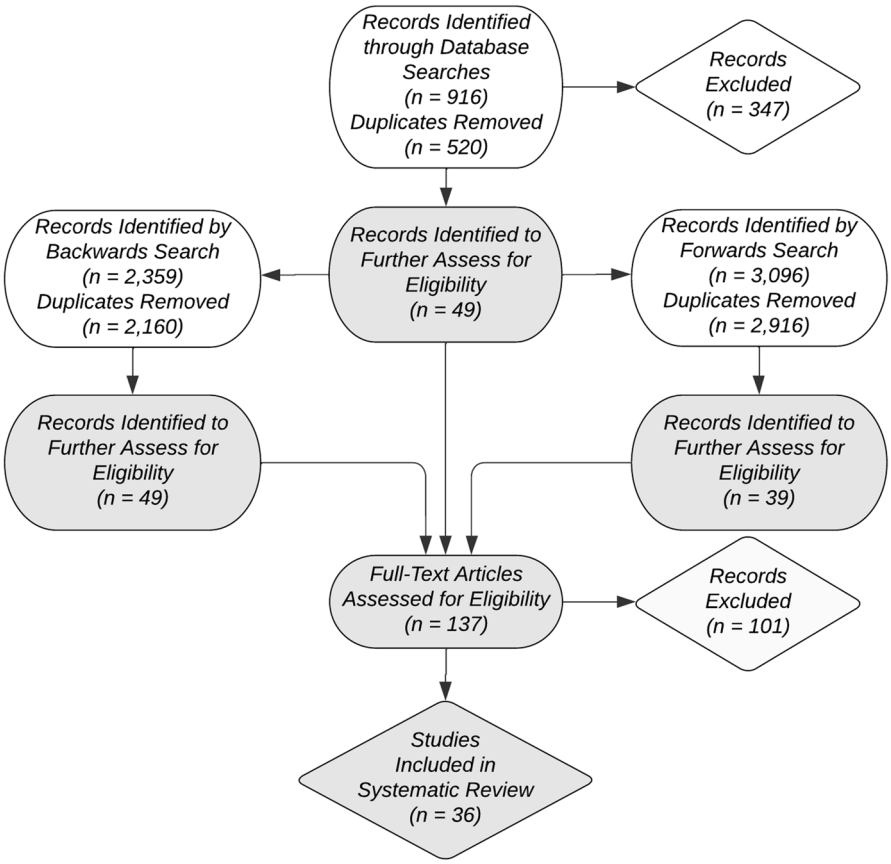

Fig. 2 PRISMA flow chart of literature search and screening. *Note.* From the entire process, a total of 6371 were identified; 5596 were unique articles, while 775 were duplicates. For exclusion, we used a hierarchical exclusion labeling method, whereby the first exclusionary reason that applied was coded; the order was (1) not an empirical journal article, (2) not among adolescents (or retrospectively focused on adolescence); (3) no parent or family STEM-specific support, (4) no adolescent STEM-related beliefs or behavior, and (5) the sample was not at least 10% Black or Latinx and/or did not include between or within ethnic analyses.

of Science, we specified the inclusion of articles only from psychology, education, and family studies). We chose to focus on published, peer-reviewed journal articles to ensure quality of publications included; however, we acknowledge that one limitation of these search criteria is missing non-significant findings that were not published.

For search terms, we first listed a series of family- and parent-related words (e.g., mother, paren*, famil*, caregiver, home). We chose these words because we wished to center the present review on adult caregivers, such as parents, without exclud-ing other potential caregivers. This review did not include peer family members that provide STEM support, such as siblings and cousins, although these family members may provide unique support (e.g., Ramos Carranza & Simpkins, 2021). These

family-related words were followed by socialization-related words about beliefs and behaviors, chosen to reflect terms that might be used for STEM support (e.g., belief*, behavior, support, engag*, activit*). These were followed by terms related to motivational beliefs, such as beliefs about competence in STEM, that were chosen to cover words a variety of motivational theories use to describe their target constructs (e.g., motivation*, aspirations, utility, interest, self-eficacy). Next, we included words related to STEM, chosen to cover a wide breadth of the physical and biological sciences in addition to math, computer science, and engineering (e.g., math*, science, engineering, technology, Biolog*). Finally, we included Black- and Latinx-related search terms, developed to cover a range of identity labels for people who are Black or Latinx (e.g., Black*, Latin*, underrepresented minority, Hispanic, African American). For a full list of the search terms, please see the Supplementary Materials. Using the articles that passed the initial abstract screening, we then conducted a backward search and a forward search. For each article that passed our initial search, we obtained articles in their reference list (the backward search) and more recently published articles that cited that study on Google Scholar (the forward search) (Moher et al., 2009).

Screening of Eligible Studies

From the literature search, we identified 6371 articles over our total search. Of these, 775 were duplicates and removed, leaving 5596 articles to screen. Using the PRISMA method, we first screened these articles based on the title and abstract. Articles were excluded if they (1) were not peer-reviewed empirical journal articles written in English and published between January 2000 and 2020, (2) did not focus on adolescents' STEM-specific motivational beliefs, (3) did not measure parent or adult caregiver STEM-specific support, (4) or did not include a sample of at least 10% Black and/or Latinx participants or did not include analyses within- or between-racial/ethnic groups. The first and second author conducted the screening based on inclusionary/exclusionary criteria. Of the 520 non-duplicated articles gathered from the initial database search, 30% (n = 156 studies) were randomly selected for both coders to screen (while the remaining 70% were randomly divided between the two authors). Both coders read and recorded which articles met the criteria for further review; they had high agreement (95% agreement; k = .73). The authors then met to discuss discrepancies; articles were included in the second stage as long as one coder had selected it as meeting the inclusion criteria. At the second stage, backward and forward searches were conducted (as described above) and screened by the first two authors.

Based on our criteria, 137 articles were selected for further review (49 from the initial search, 49 from the backward search, and 39 from the forward search). The first author reviewed each of the 137 articles in their entirety to determine which articles fit our criteria and consulted with the second and third author when necessary. Based on this review process, 36 final articles were selected to include in this systematic review. One hundred one articles were excluded, most commonly because the study did not include parent or adult caregiver STEM support (n = 67,

66%), included fewer than 10% Black/Latinx participants or did not include race or ethnicity as a within or between subjects factor (n = 14, 14%), did not include adolescents (nor were they retrospective studies about adolescent experiences) (n = 9), were not empirical (n = 6), or included an outcome variable that was not a STEM-related motivational belief (n = 5). See Fig. 2 for a full breakdown of the screening process, based on the PRISMA method.

Results

Characteristics of the Studies

Articles were coded for their method, participant demographics, and findings (see Table 1). Regarding study design, 50% of the studies were quantitative (n = 18), 42% were qualitative (for example, longitudinal interview studies that employed grounded coding) (n = 15), and 8% were mixed methods (n = 3). A majority of studies (75%, n = 27) were cross-sectional, and none was experimental. Science was the most common STEM domain examined (28%, n = 10), followed by STEM broadly defined (n = 8).

The 18 quantitative studies had sample sizes ranging from 104 to 22,190, whereas the 15 qualitative studies had samples that ranged from 3 to 44. All but one UK study (Archer et al., 2015) took place in the USA. Regarding race/ethnicity, the percentage of Black and Latinx youth ranged from 26 to 100% of the sample. Over half of studies (64%, n = 23) included only Black and/or only Latinx participants, including 10 that focused solely on Black families and nine on Latinx families. The majority of studies included analyses within each racial/ethnic group (n = 30, 83%); among the six studies that did not include within-group analyses, only three had a majority White and Asian sample (Friedel et al., 2007; Friedel et al., 2010; Lee & Simpkins, 2021). Of these six studies, three found no racial/ethnic differences in parent STEM support across studies (Friedel et al., 2007, 2010; Garriott et al., 2014) though two studies found that parent STEM support was higher for Asian or White girls than Black or Latina girls (Kang et al., 2018; Leaper et al., 2012). Additionally, 19 studies (53%) included analyses that examined potential within-racial/ethnic-group variation based on characteristics such as gender. Furthermore, nearly half (42%, n = 16) of the studies included a measure specific to racial/ethnic or cultural processes (see Table 1). Half of the studies (50%, n = 18) focused on high school students (9–12th grades) with 25% (n = 9) focused on middle school (6–8th grade). Eight studies were qualitative retrospective studies among undergraduates, asking them to recall their adolescent years.

The studies varied in the measures of STEM parent support as well as youth motivational beliefs. In a majority of studies, parent (or family) support was reported by adolescents (83%; n = 30) with six studies including reports from parents or fam-ily members. Most studies examined overall parent support (47%, n = 17), whereas

Table 1 Studies identified by systematic review ($N = 36$)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Alliman-Brissett and Turner (2010)	Correlational, cross-sectional	$N = 108$ 8th graders from a majority Black/Latinx public school in Southwest; 100% URM (100% B); 49% F	Math	Career aspirations	Overall support ($r = .38$) Y; M & F	Yes, inhibitive processes	Yes
Archer et al. (2015)	Qualitative, correlational	$N = 10$ 6–8th grade from 11 UK schools; 100% URM(100% B); 100% F	Science	Career aspirations, identity	Advice, encouragement, importance beliefs, stereotypes Y & P; P	Yes, inhibitive processes	Yes
Aschbacher et al. (2010)	Qualitative, longitudinal	$N = 33$ 10–12th graders from 6 diverse California HSs; 48% URM (24% B, 24% L), 51% non-URM (21% A, 30% W); 61% F	Science, engineer, math	Career aspirations	Overall support Y; Fam	Yes, inhibitive processes	Yes
Berry et al. (2011)	Qualitative, cross-sectional	$N = 32$ 7–8th graders from rural southern schools; 100% URM (100% B); 0% F	Math	Identity	Overall support Y; P	Yes, inhibitive processes	Yes
Berry (2008)	Qualitative, cross-sectional	$N = 8$ middle schoolers from majority Black urban Southeastern schools; 100% URM (100% B); 0% F	Math	Competence	Advice, encouragement, schoolwork support Y & P; M & F	Yes, inhibitive processes	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Blustein et al. (2013)	Qualitative, cross-sectional	*N* = 9 high schoolers from diverse urban HSs; 100% URM (22% B, 44% L, 33% B&L); 56% F	STEM	Career aspirations	Advice [Y; Fam]	Yes, promotive processes	Yes
Bouchey and Harter (2005)	Correlational, cross-sectional	*N* = 378 6–8th graders from 2 urban schools in Colorado; 65% URM (65% L); 21% non-URM (21% W); 53% F	Math, science	Competence, importance	Schoolwork support (*r*'s = .27–.38), success beliefs (*r*'s = .29–.62), importance beliefs (*r*'s = .20–.35) [Y; M & F]	No	Yes
Bruning et al. (2015)	Qualitative, cross-sectional	*N* = 3 high schoolers from Colorado, Iowa, and Ohio; 66% URM (33% B, 33% L); 33% non-URM (33% W); 100% F	Engineer	Career aspirations, importance	Advice, encouragement [Y; Fam]	Yes, inhibitive processes	Yes
Denner et al. (2018)	Correlational, longitudinal	*N* = 247 5–6th graders from rural Northern California; 100% URM (100% L); 54% F	Math	Competence	Co-activity (β = .11), stereotypes (girls β = −.29; boys β = .02) [P; M]	No	Yes
Dika and D'Amico (2016)	Correlational, cross-sectional	*N* = 226 7–12th graders from majority of Latinx HSs in Puerto Rico; 100% URM (100% L); 39% F	Engineer	Competence, importance	Importance beliefs (*r*'s = .37–.43) [Y; P]	No	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Friedel et al. (2007)	Correlational, cross-sectional	*N* = 1021 middle schoolers from 4 diverse MSs in Midwest; 30% URM (26% B, 4% L); 65% non-URM (65% W); 52% F	Math	Competence	Mastery v. performance goal orientation (*r* = .37) Y; P	No	No
Friedel et al. (2010)	Correlational, longitudinal	*N* = 929 6–7th graders from 4 diverse MSs in Midwest; 31% URM (27% B, 4% L); 65% non-URM (65% W); 53% F	Science	Competence	Mastery v. performance goal orientation (*β*'s = .05–.15) Y; P	No	No
Garriott et al. (2014)	Correlational, cross-sectional	*N* = 210 high schoolers from 10 HSs in Midwest; 62% URM (31% B, 31% L); 25% non-URM (25% A); 60% F	Math, science	Competence, importance	Overall support (*r*'s = .33–.35) Y; M & F	No	No
Garriott et al. (2017)	Correlational, cross-sectional	*N* = 258 high schoolers from diverse HSs; 100% URM (100% L); 45% F	Math, science	Career aspirations, competence, importance	Importance beliefs (*r*'s = .40–.43) Y; Fam	Yes, promotive processes	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Hanson (2007)	Mixed methods, cross-sectional	*N* = 1062 13–28-year-olds from a nationally representative web survey; 26% URM (26% B); 74% non-URM (74% W); 100% F	Science	Career aspirations, competence, importance	Encouragement (*B*'s = .53–.65) $^{Y; M \& F}$	No	Yes
Hsieh et al. (2019)	Correlational, longitudinal	*N* = 104 10th graders from 3 diverse HSs in Arizona; 100% URM (100% L); 40% F	Science	Competence, importance	Overall support (*B*'s = .02–.07) $^{Y; P}$	No	Yes
Jackson and Suizzo (2015)	Qualitative retrospective, cross-sectional	*N* = 44 undergraduates from a large public university in Southcentral USA; 100% URM (100% L); 100% F	Science	Identity	Co-activity, importance beliefs $^{Y; P}$	Yes, promotive processes	Yes
Kang et al. (2018)	Correlational, cross-sectional	*N* = 1821 6–8th graders from 5 diverse urban MSs; 38% URM (17% B, 21% L); 36% non-URM (17% A, 19% W); 50% F	STEM	Career aspirations, importance	Co-activity (*B*'s = .29–.41) $^{Y; Fam}$	No	No
Koch et al. (2019)	Qualitative, cross-sectional	*N* = 6 high schoolers from urban HSs in California; 100% URM (NR); 100% F	STEM	Career aspirations, importance	Overall support $^{Y; Fam}$	Yes, promotive processes	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Leaper et al. (2012)	Correlational, cross-sectional	*N* = 579 13–18-year-old high schoolers from California and Georgia; 59% URM (9% B, 50% L); 30% non-URM (8% A, 22% W); 100% F	Math, science	Competence	Encouragement (*r*'s = .22–.26) Y; M & F	No	No
Lee and Simpkins (2021)	Correlational, longitudinal	*N* = 14,580 9–11th graders from a nationally representative US sample; 31% URM (11% B, 20% L); 59% non-URM (4% A, 55% W); 51% F	Math	Competence	Co-activity (*r* = .07) P; P	No	No
Martin et al. (2013)	Qualitative retrospective, cross-sectional	*N* = 4 UG engineering students from University of Houston in majority White male courses; 100% URM (100% L); 100% F	Engineer	Career aspirations	Advice Y; Fam	No	Yes
Onuma et al. (2020)	Qualitative retrospective, cross-sectional	*N* = 8 undergraduates from both HBCUs and PWIs; 100% URM (100% B); 38% F	STEM	Career aspirations	Advice, co-activity, encouragement Y; Fam	No	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Richardson et al. (2020)	Qualitative retrospective, cross-sectional	*N* = 9 undergraduates; 100% URM (100% B); 100% F	Engineer	Career aspirations	Overall support Y; P	No	Yes
Rodriguez et al. (2019)	Qualitative retrospective, cross-sectional	*N* = 5 undergraduates from a large PWI in Southwest; 100% URM (100% L); 100% F	Engineer	Identity	Overall support Y; Fam	Yes, promotive processes	Yes
Russell and Atwater (2005)	Qualitative retrospective, cross-sectional	*N* = 11 undergraduates from large PWI in Southeast; 100% URM (100% B); 73% F	Science	Career aspirations	Encouragement, importance beliefs Y; Fam	Yes, inhibitive processes	Yes
Sha et al. (2016)	Correlational, longitudinal	*N* = 986 high schoolers from 15 diverse public HSs in Pittsburgh and Bay Area; 41% URM (28% B, 13% L); 36% non-URM (2% A, 34% W); 45% F	Science	Competence, importance	Co-activity (β's = .33–.48) Y; F	No	Yes
Simpkins et al. (2015b)	Correlational, cross-sectional	*N* = 988 9th graders from 3 diverse HSs in Arizona; 51% URM (51% L); 49% non-URM (49% W) 49% F	Science	Competence	Co-activity (*B*'s = .13–.26), encouragement (*B*'s = .16–.20), schoolwork support (*B*'s = .07–.13) Y; P	No	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Simpkins et al. (2018)	Correlational, longitudinal	*N* = 104 9–10th graders from 3 diverse HSs in Arizona; 100% URM (100% L); 40% F	Science	Competence, importance	Overall support (*B*'s = .20–.29)$^{Y; P}$	Yes, promotive processes	Yes
Simpkins et al. (2019)	Correlational, longitudinal	*N* = 104 9–10th graders from 3 diverse HSs in Arizona; 100% URM (100% L); 40% F	Science	Competence, importance	Encouragement (*B*'s = .09–.20)$^{Y; P}$	No	Yes
Starr and Simpkins (2021)	Correlational, longitudinal	*N* = 22,190 9–11th graders from a nationally representative US sample; 35% URM (13% B, 22% L); 56% non-URM (3% A, 53% W); 50% F	Math, science	Identity	Stereotypes (girls *B* = −.06, boys *B* = .06) $^{P; P}$	No	Yes
Stipanovic and Woo (2017)	Qualitative, cross-sectional	*N* = 18 12th graders from the Southeastern USA; 100% URM (100% B); 61% F	STEM	Career aspirations	Advice $^{Y; P}$	No	Yes
Strayhorn (2017)	Mixed methods retrospective, cross-sectional	*N* = 140 undergraduates from a large public HBCU and a PWI; 100% URM (100% B); 0% F	STEM	Competence, career aspirations, identity	Overall support $^{Y; P}$	Yes, inhibitive processes	Yes

Table 1 (continued)

Citation	Study design	Sample[a]	STEM domain	STEM motivation	Parent support[b]	Race/eth. processes	Within-group
Talley and Ortiz (2017)	Mixed methods retrospective, cross-sectional	*N* = 48 undergraduates from a large diverse public university in Texas; 43% URM (8% B, 35% L); 58% non-URM (4% A, 54% W); 100% F	STEM	Competence, career aspirations	Overall support $^{Y; Fam}$	Yes, promotive processes	Yes
Tao et al. (2020)	Correlational, cross-sectional	*N* = 1041 high schoolers from predominately Southern urban and suburban schools; 100% URM (100% B); 50% F	Engineer	Competence, importance	Encouragement (*r*'s = .14–.17) $^{P; P}$	No	Yes
Walker (2006)	Qualitative, cross-sectional	*N* = 21 high schoolers from a majority of Black/Latinx HS in New York City; 100% URM (38% B, 52% L; 10% B&L); 67% F	Math	Competence	Advice, encouragement, importance beliefs, schoolwork support $^{Y; P}$	Yes, promotive processes	Yes

Eth. ethnic, *Engineer.* engineering or technology. Career aspirations include STEM major aspirations and persistence beliefs/goals. Effect sizes are included for quantitative studies

[a]*%URM* percent underrepresented minority, *B* Black, *L* Latinx, *B&L* Black and Latinx (multiethnic), *%nURM* percent non-underrepresented minority, *A* Asian, *W* White, *%F* percent female, *MS* middle school, *HS* high school, *UG* undergraduate. NR indicates that the article did not include specific information for this race/ethnic category. When race/ethnicity % does not add up to 100%, the remaining ethnic breakdown is either multiethnic or other/not reported (specific ethnicities not described)

[b]First letter indicates reporter (^{Y} = youth, ^{P} = parent); second letter indicates the target or person asked about (^{P} = parent(s), ^{Fam} = family, ^{M} = mother, ^{F} = father)

seven studies separated support from mothers and fathers and seven studies examined general family support. Adolescent indicators of STEM motivational beliefs were always reported by adolescents and fell into five categories: beliefs about competence (n = 20), importance of STEM (n = 11), career/major aspirations (n = 16), identity beliefs (n = 5), and goal orientation (n = 2).

Findings

Overall, most studies (83%, n = 30) found evidence that parental support positively relates to adolescent STEM motivational beliefs. Five studies found mixed or partial evidence, and one did not find evidence that parent support was predictive of adolescent motivational beliefs (Martin et al., 2013). Table 1 includes a list of all articles including the design, participant information, type of specific indicators, and effect sizes for quantitative research. Table 2 lists all the articles that found full, mixed, or no evidence for positive relations between parent support and adolescent motivational beliefs separately for Black and Latinx adolescents and by type of parent support (i.e., beliefs and behaviors). Finally, we placed an asterisks (*) by constructs in our theoretical framework depicted in Fig. 1 that were addressed in our review. Below, we discuss study findings separated by parent beliefs about STEM, parent behaviors related to STEM, and within racial/ethnic group variations. STEM motivational beliefs were categorized broadly into competence beliefs, importance beliefs, career aspirations, goal orientation, and identity.

Parent Beliefs

A third of all studies (31%, n = 11) measured parent beliefs as predictors of adolescent motivational beliefs. These were either parent beliefs about their child (e.g., importance of STEM for their child) or stereotypes parents held about STEM domains (see Table 1).

Child-Specific Beliefs Parents hold a variety of beliefs that are specific to their child. The existing literature includes studies focused on all of the parent beliefs for their child listed in Fig. 1: beliefs about the importance of STEM, beliefs about their child's abilities in STEM, and the extent to which parents believed in a mastery or performance goal orientation. First, parent beliefs about how important or valuable they believed STEM was for their child was examined in seven studies (19%). Importance beliefs significantly and positively predicted adolescent STEM beliefs, namely importance beliefs, competence beliefs, career aspirations, and/or identity, with small to medium effect sizes (r's = .20 to .43) (Archer et al., 2013; Bouchey & Harter, 2005; Dika & D'Amico, 2016; Garriott et al., 2017; Jackson & Suizzo, 2015; Russell & Atwater, 2005; Walker, 2006). For example, two cross-sectional studies among Latinx families found medium, positive relations between parent importance beliefs and adolescent importance and competence beliefs in engineering among

Table 2 Summary of study findings by race/ethnicity ($N = 36$)

	Black			Latinx		
Factor	Supported	Mixed findings	Outcomes	Supported	Mixed findings	Outcomes
Overall support	Alliman-Brissett and Turner (2010); Aschbacher et al. (2010); Berry et al. (2011); Garriott et al. (2014); Koch et al. (2019); Richardson et al. (2020); Strayhorn (2017); Talley and Ortiz (2017)		Belonging, career aspirations, competence, identity, importance	Aschbacher et al. (2010); Garriott et al. (2014); Koch et al. (2019); Rodriguez et al. (2019); Talley and Ortiz (2017); Simpkins et al. (2018)	Hsieh et al. (2019)	Career aspirations, competence, identity, importance
Parent beliefs						
Success				Bouchey and Harter (2005)		Competence, importance
Importance	Archer et al. (2015); Russell and Atwater (2005); Walker (2006)		Competence	Bouchey and Harter (2005); Dika and D'Amico (2016); Garriott et al. (2017); Jackson and Suizzo (2015); Walker (2006)		Career aspirations; competence, importance; identity
Mastery goal	Friedel et al. (2007); Friedel et al. (2010)		Competence, goal orientation	Friedel et al. (2007); Friedel et al. (2010)		Competence, goal orientation
Stereotypes	Archer et al. (2015); Starr and Simpkins (2021)		Career aspirations, identity	Denner et al. (2018); Starr and Simpkins (2021)		Competence, identity
Parent behaviors						

Table 2 (continued)

Factor	Black			Latinx		
	Supported	Mixed findings	Outcomes	Supported	Mixed findings	Outcomes
Advice	Archer et al. (2015); Berry (2008); Blustein et al. (2013); Onuma et al. (2020); Stipanovic and Woo (2017); Walker (2006)	Bruning et al. (2015)	Career aspirations, competence, identity, importance	Blustein et al. (2013); Walker (2006)	Bruning et al. (2015); Martin et al. (2013)	Career aspirations, competence, importance
Co-activity	Kang et al. (2018); Lee and Simpkins (2021); Onuma et al. (2020); Sha et al. (2016)		Career aspirations, competence, importance	Denner et al. (2018); Jackson and Suizzo (2015); Kang et al. (2018); Lee and Simpkins (2021); Sha et al. (2016); Simpkins et al. (2015b)		Career aspirations, competence, identity, importance
Encouragement	Archer et al. (2015); Berry (2008); Bruning et al. (2015); Leaper et al. (2012); Onuma et al. (2020); Tao et al. (2020); Walker (2006)	Hanson (2007); Russell and Atwater (2005)	Career aspirations, competence, identity, importance	Leaper et al. (2012); Simpkins et al. (2015b); Simpkins et al. (2019)		Competence, importance
Schoolwork support	Berry, 2008	Walker (2006)	Competence	Bouchey and Harter, (2005); Simpkins et al. (2015b)	Walker (2006)	Competence, importance

middle and high schoolers (Dika & D'Amico, 2016) and in math and science among high schoolers (Garriott et al., 2017). Second, parent beliefs about their child's ability or potential to succeed in STEM were measured in one study, which found that Black and Latinx parent beliefs about their child's STEM abilities had a small to large positive relation to middle schooler's competence and importance (r's .29 to .62) (Bouchey & Harter, 2005). Third, two studies among Black and White mid-dle schoolers and their families found that parents' mastery goal orientation versus performance goal orientation (characterized by an emphasis on learning verses an emphasis on comparison to others, respectively) had small to medium positive relations with early adolescents' competence beliefs (β's = .05 to .15; r = .37) (Friedel et al., 2007, 2010). In sum, parent beliefs about their child in STEM had significant positive relations to their child's motivational beliefs, with small to medium effect sizes.

Stereotype Beliefs About STEM Finally, parents' stereotype beliefs about STEM were measured in three studies (Archer et al., 2013; Denner et al., 2018; Starr & Simpkins, 2021). All three studies found that believing STEM is more appropriate for males or White people negatively impacted the beliefs of Black and Latinx girls and Black youth (Archer et al., 2013; Denner et al., 2018; Starr & Simpkins, 2021). For example, two longitudinal studies examining parent STEM gender stereotypes found small, negative effects for girls (βs = −.06 and B = −.29, respectively) (Denner et al., 2018; Starr & Simpkins, 2021); in one study among Latinx families, parent gender stereotypes were negatively related to parent math support and in turn adolescent girls' competence beliefs in middle school (Denner et al., 2018). In sum, parent stereotypes were found to negatively relate to Black and Latinx girls' STEM identity, career aspirations, and competence beliefs.

Parent STEM Behaviors

Over half of the studies (56%, n = 20) included measures of specific types of parent behaviors. These behaviors represented four categories shown in Fig. 1: encouragement, co-activity, advice, and schoolwork support (see Table 1 for study details and Table 2 for a breakdown of findings).

STEM Encouragement Parent or family encouragement in STEM was examined in a third of all studies (31%, n = 11). Encouragement included recognizing and talking to adolescents about their strong STEM abilities and provision of emotional support when adolescents were discouraged. All eleven studies found that parent encouragement positively predicted adolescent STEM beliefs, namely competence beliefs, importance beliefs, career aspirations, and identity, with small to large effect sizes (B's = .09 to .65; r's = .14 to .22) (Archer et al., 2013; Berry, 2008; Bruning et al., 2015; Hanson, 2007; Leaper et al., 2012; Onuma et al., 2020; Russell & Atwater, 2005; Simpkins et al., 2015b; Simpkins et al., 2019; Tao et al., 2020; Walker, 2006). For example, two studies among majority Latinx middle and high school samples found that parental encouragement had small, positive relations to adolescents'

importance and competence beliefs (Leaper et al., 2012; Simpkins et al., 2019). Similar results were found in two studies with majority Black high school samples investigating career aspirations and/or competence and importance beliefs (Hanson, 2007; Tao et al., 2020). However, one retrospective mixed methods study among Black women found that parent encouragement did not emerge as a primary factor in the qualitative findings, even though they found medium, positive relations between parent science encouragement and adolescent career aspirations, competence, and importance beliefs in the quantitative data; instead, the women identified their personal dedication as important (Hanson, 2007). Similarly, a qualitative retrospective study among Black college students found that although parent encouragement fostered their STEM career aspirations, encouragement from teachers was identified as most critical (Russell & Atwater, 2005). In sum, this research suggests that encouragement matters though the effects can be small.

STEM Co-activity Co-activity was examined in seven studies (19%) and included STEM-related activities adolescents engaged in with a parent (e.g., going to a science museum or fixing things at home). All seven studies found support for significant relations between STEM co-activity and adolescent identity, career aspirations, competence, and/or importance beliefs, with small to medium effect sizes among quantitative studies (B's = .13 to .41; β's = .33–.48; r = .07) (Denner et al., 2018; Jackson & Suizzo, 2015; Kang et al., 2018; Lee & Simpkins, 2021; Onuma et al., 2020; Sha et al., 2016; Simpkins et al., 2015b). This included studies focused on Black adolescents' career aspirations (Onuma et al., 2020) and Latinx adolescents' STEM identity, importance, and/or competence beliefs (Denner et al., 2018; Jackson & Suizzo, 2015; Simpkins et al., 2015b). Two longitudinal studies found that parent STEM co-activity in early adolescence predicted changes in adolescent competence and importance beliefs with small to medium effect sizes later that school year (Sha et al., 2016) or helped buffer the negative effects of poor-quality math teaching 2 years later (Lee & Simpkins, 2021). Furthermore, two qualitative retrospective studies found that undergraduates mentioned parent-adolescent STEM co-activity as helping to foster their STEM identity and career aspirations (Jackson & Suizzo, 2015; Onuma et al., 2020).

STEM Advice STEM advice was examined in eight articles (22%), which included assistance in picking STEM courses and providing insight about STEM careers and opportunities. All of these studies were qualitative, and all but two studies (Bruning et al., 2015; Martin et al., 2013) found that parental STEM advice was an important factor in Black and Latinx adolescents' development of their STEM identity, career aspirations, competence, and importance beliefs (Archer et al., 2015; Berry, 2008; Blustein et al., 2013; Bruning et al., 2015; Onuma et al., 2020; Stipanovic & Woo, 2017). For example, three qualitative studies found that Black and Latinx middle and high schoolers felt their parents' STEM advice played a positive role in them developing STEM career aspirations (Archer et al., 2015; Blustein et al., 2013; Stipanovic & Woo, 2017). However, two qualitative studies found that Black and Latina high school girls and college women rarely mentioned STEM advice as an important factor for developing their STEM career aspirations and importance

beliefs (Martin et al., 2013) or found that parents did not have the STEM content knowledge or understanding of the academic system needed to successfully support them via STEM advice (Bruning et al., 2015). Instead, students mentioned the STEM advice they received from institutional and peer groups as helpful (Bruning et al., 2015; Martin et al., 2013). Furthermore, Bruning et al. (2015) found that Black and Latinx adolescent girls reported that their families were able to support them in other ways, such as through encouragement. Although theories suggest parental advice and guidance is a core aspect of support (Eccles & Wigfield, 2020; Hill & Tyson, 2009), the extant literature provides mixed support for this conclusion in regard to STEM.

STEM Schoolwork Support Finally, parents' help with adolescents' STEM schoolwork was included in four articles, such as checking homework answers and asking about STEM coursework (Berry, 2008; Bouchey & Harter, 2005; Simpkins et al., 2015b; Walker, 2006). Three of the four studies found that schoolwork support was positively related to adolescent STEM competence and importance beliefs, with effects ranging from small to medium (*B*'s = .02 to .13; *r*'s = .27 to .38). For example, two cross-sectional studies among majority Latinx samples found that school-focused activities were positively related to middle or high school science or math importance and competence beliefs, with small to medium effect sizes (Bouchey & Harter, 2005; Simpkins et al., 2015b). One qualitative study among Black and Latinx high school students found that parents were often unable to help with homework; however, they still supported adolescents in other ways (such as through encouragement) (Walker, 2006). Overall, the majority of studies examining schoolwork support found it to be helpful for adolescents, with one exception.

Overall Support Eleven studies used overall measures of parent support that encompassed multiple types of specific support including those discussed in the prior sections (Alliman-Brissett and Turner, 2010; Arschbacher et al., 2010; Berry et al., 2011; Garriott et al., 2014; Hsieh et al., 2019; Koch et al., 2019; Rodriguez et al., 2019; Richardson et al., 2020; Simpkins et al., 2018; Strayhorn, 2017; Talley & Ortiz, 2017). All eleven studies found evidence that parent or family overall support positively predicted adolescent STEM motivational beliefs, with effects ranging from small to medium (*B*'s = .02 to .29; *r*'s = .33 to .38). These included studies focused solely on Black families (e.g., Berry et al., 2011; Strayhorn, 2017) or Latinx families (e.g., Hsieh et al., 2019; Rodriguez et al., 2019). For example, six studies found that overall parent support predicted adolescent competence beliefs in STEM, math, and science, in addition to other motivational outcomes such as career aspirations and importance beliefs, with small to medium effect sizes (Alliman-Brissett and Turner, 2010; Arschbacher et al., 2010; Garriott et al., 2014; Hsieh et al., 2019; Simpkins et al., 2018; Strayhorn, 2017; Talley & Ortiz, 2017). Three of the stud-ies were longitudinal (Arschbacher et al., 2010; Hsieh et al., 2019; Simpkins et al., 2018). For example, one longitudinal quantitative study by Hsieh et al. (2019) found that parent support in 9th grade had small positive relations with changes in Latinx students' science importance and competence beliefs in 11th grade in science overall

and in biology, but not in chemistry or physics. Collectively, this work suggests that parents' overall support positively relates to adolescent STEM motivational beliefs both concurrently and longitudinally, though it is not clear if these relations will emerge in each of the specific STEM disciplines.

Within Racial/Ethnic Group Variation

As depicted in Fig. 1, within-group variations can emerge based on other social position factors or due to racial or ethnic processes (García Coll et al., 1996; Raffaelli et al., 2005). Finally, developmental differences can create variability in individual and family processes as well (Eccles et al., 1993). Below, we discuss each potential within-group difference factor in greater depth.

Social Position Factors Half of the articles examined within racial/ethnic group variation based on social position factors (García Coll et al., 1996), most commonly gender (50%; $n = 18$); three papers also included SES, nativity, or college generation (Archer et al., 2015; Bruning et al., 2015; Martin et al., 2013). These studies found mean level differences but not process differences; for example, levels of parent support might differ by gender, but parent support predicted motivational beliefs across groups (e.g., Simpkins et al., 2015b). Given the prevalence of mean-level gender differences, we provide a more in-depth discussion below.

Adolescents' gender often predicted differences in parent support and STEM motivational beliefs. The five studies examining parent beliefs indicated that parent gender stereotypes and traditional cultural values may impact parent supportive behaviors in addition to adolescent motivational beliefs (Aschbacher et al., 2010; Blustein et al., 2013; Denner et al., 2018; Simpkins et al., 2018; Starr & Simpkins, 2021). Four papers compared parent support behaviors provided to boys compared to girls (within and across ethnic groups), and all found that girls, on average, were provided less STEM support from parents than boys (Aschbacher et al., 2010; Leaper et al., 2012; Simpkins et al., 2015b; Tao et al., 2020). In sum, quantitative studies indicated that girls overall received less STEM support from parents than boys.

Finally, four qualitative studies focused on the barriers of staying motivated in STEM and getting STEM support as Black or Latinx girls, finding that many girls described being overlooked or otherwise devalued due to their race/ethnicity and gender (Archer et al., 2015; Bruning et al., 2015) as well as experiencing barriers due to limited resources (Martin et al., 2013). For example, two studies found that Black and Latinx girls and women frequently brought up disadvantages based on their race/ethnicity and gender, such as low expectations and stereotyping (Archer et al., 2015; Bruning et al., 2015). However, one retrospective qualitative study among Latina women in engineering found that many viewed their ethnicity and gender as providing advantages, such as cultural capital (e.g., the ability to speak Spanish; Jackson & Suizzo, 2015). Finally, three studies focused on how parents helped Black boys navigate barriers experienced in schools due to stereotyping and low expectations (Berry, 2008; Berry et al., 2011; Strayhorn, 2017). In conclusion,

most studies that examined gender and race tended to find that girls on average received less support than boys and that being a Black or Latina girl or woman or Black boy or man led to lower expectations and greater stereotypes.

Racial/Ethnic and Cultural Processes As shown in Fig. 1, promotive and inhibitive cultural or societal related processes impact Black and Latinx parents' STEM support and youths' motivational beliefs. About half of the studies (42%, $n = 16$) included these processes with the majority of those studies ($n = 13$) utilizing qualitative or mixed methods (see Table 1). Seven of these studies examined potential promotive factors, such as cultural values (e.g., familism) and honoring parent sacrifices. Nine studies examined negative or inhibitive constructs, such as racism or lack of belonging due to race. A majority of the studies examining promotive factors were primarily among Latinx participants, whereas a majority of studies investigating inhibitive factors were among Black participants.

Studies that examined promotive cultural factors generally found that they positively predicted greater parent support (Garriott et al., 2017; Jackson & Suizzo, 2015; Koch et al., 2019; Rodriguez et al., 2019; Simpkins et al., 2018; Talley & Ortiz, 2017; Walker, 2006). For example, two studies among Latinx high school students found that parent familism and support were positively related (Garriott et al., 2017; Simpkins et al., 2018). Additionally, two qualitative studies examining the cultural practice of honoring parent sacrifices found that Latinx (and sometimes Black) students used their parents' stories of working hard for their children and having to give up their educational dreams as motivation to stay on their path toward STEM goals (Rodriguez et al., 2019; Walker, 2006). However, two studies found that the processes were more complicated for girls (Jackson & Suizzo, 2015; Talley & Ortiz, 2017). For example, a qualitative retrospective study among Latina undergraduate women found that familism was connected to STEM support but also to more restrictive gender norms (Jackson & Suizzo, 2015). Although women reported feeling supported in their STEM goals from their families, they also felt pressure to take care of their families, which sometimes conflicted with their STEM goals. Overall, most studies found that promotive cultural factors were helpful for adolescents, although a few studies found that familism could have a mixed effect for girls.

The nine studies examining negative factors generally found that barriers, such as racism, were negatively related to adolescent STEM motivation but that parents could help mitigate the negative effects, as shown with the dashed arrows in Fig. 1 (Alliman-Brissett and Turner, 2010; Archer et al., 2015; Aschbacher et al., 2010; Berry, 2008; Berry et al., 2011; Blustein et al., 2013; Bruning et al., 2015; Russell & Atwater, 2005; Strayhorn, 2017). For example, three studies discussed students' awareness of others' low expectations of them in STEM and stereotypes about them due to their race, gender, or class, highlighting the importance parents and other adult figures play in helping them persist in STEM despite barriers (Archer et al., 2015; Aschbacher et al., 2010; Bruning et al., 2015). Overall, these studies found that students experienced barriers due to their race but that parent support could help them stay motivated in STEM.

High School and Middle School Processes We were interested in any potential differences between samples that included middle schoolers (n = 9) compared to those that included high schoolers (n = 18). Studies that took place in middle school were more likely to focus on math and/or science (89% vs. 65%) and less likely to investigate engineering, technology, or STEM more broadly when compared to stud-ies about high school (11% vs. 35%). Additionally, a larger percentage of middle school-focused studies included schoolwork support as an indicator of parent support (33% vs. 12% of high school studies). Furthermore, both studies about mastery versus performance goal orientation took place among middle school students. Finally, compared to studies among high schoolers, middle school studies were more likely to focus on career aspirations (44% vs. 33%) and STEM identity (e.g., how much a student identified with science) (11% vs. 6%). Overall, although there were some differences in the measures used, we found no process level differences across periods. In other words, studies with high school students and those with middle school students were equally likely to find that parent support predicted adolescent motivational beliefs.

Discussion

Using our framework that bridges motivation and culturally grounded theories, this systematic review of parent STEM support and adolescent STEM motivational beliefs among Black and Latinx families was conducted with two goals in mind: (a) to describe how parent STEM support has been conceptualized and its relations with adolescent STEM motivational beliefs and (b) to describe within-group variations. This review makes several significant contributions, as noted at the top of Table 3.

The Field's Current Findings on Parent STEM Support Among Black and Latinx Families

One of the central contributions of this review is showing that parent support typically has small, positive associations with Black and Latinx adolescents' STEM motivational beliefs, including their identity, career aspirations, importance beliefs, and competence beliefs. These positive associations emerged regardless of whether parent STEM support was measured with a specific belief or behavior or with a broad overall indicator that combined multiple beliefs or behaviors. In cases where parent STEM support was not predictive, it was often because parents were unable to provide that specific type of support (e.g., schoolwork support or STEM advice) even though they still provided other types of meaningful support (e.g., encouragement) (e.g., Bruning et al., 2015; Walker, 2006). These positive relations align with motivation theories focused on parent influences (e.g., Eccles & Wigfield, 2020) and suggest that parenting helps support the success of Black and Latinx adolescents.

Although evidence suggests that all types of parent STEM support matter, parent importance beliefs, competence beliefs, and co-activity had stronger, more consistent relations with adolescent motivation compared to other indicators (Table 3).

Table 3 Sample of current findings and directions for future research

Current findings

Parent beliefs

- Beliefs about STEM importance and youth competence were consistently positively related to adolescents' motivational beliefs[1,2]
- Traditional STEM gender stereotypes negatively predicted Black and Latina girls' motivational beliefs[3,4]

Parent behaviors

- STEM co-activity was positively related to adolescents' motivational beliefs most consistently[5,6]
- STEM encouragement and advice were positively related to adolescents' motivational beliefs though sometimes inconsistently[7,8]

Adolescent motivational beliefs

- Most research focuses on adolescent competence beliefs, importance beliefs, and career aspirations[9,10]

Within group variability

- Girls received less support than boys; Black girls, Latina girls, and Black boys faced lower expectations and greater stereotypes; but parent support predicted motivational beliefs for all[11,12]
- Promotive cultural factors were usually examined for Latinx students and predicted greater parent support[13,14]
- Race-related barriers were usually examined for Black students, but parent support could help them stay motivated[15,16]

Potential future directions

Culturally grounded theories to draw on

- African American child development model[17]
- Bridging multiple worlds theory[18]
- Critical race theory[19]
- Cultural microsystem model[20]
- Latino model of youth development[21]
- Intersectionality framework[22]
- Mathematics learning as a racialized experience framework[23]
- The integrative model[24]
- Triple quandary framework[25]

Methodological considerations

- Centering youth and family voices (e.g., participatory research)
- Checking conceptual meaning and measurement invariance
- Qualitative, phenomenological, ethnographic methodologies[26]
- Strength-based perspectives
- Within-group analyses[27]

Parent support constructs

- Consejos, échale ganas, dar animo[28]
- Consideration of key community and family members beyond parents[27,29]
- Families serving as guardians of opportunities[30]
- How parents help youth cope with barriers[30]
- Kinship networks including fictive kin
- School involvement focused on navigational support and school reform[30,31]

Table 3 (continued)

• Helping adolescents access networks and capital[29]	• Supplementary and compensatory home involvement[31]
• High expectations linked to overcoming societal and structural barriers[27,26,30]	• Racial/ethnic socialization and pride (e.g., cultural and racial bias academic socialization)[31]
Cultural strengths to consider	
• Cultural values (e.g., kinship, respect for elders)[32]	• Institutional responsiveness to families' cultural strengths
• Family capital (e.g., aspirations, navigational, resistant capital)[33]	• The potential strengths and challenges of cultural values (e.g., familism)[9,26]

[1]Aschbacher et al. (2010); [2]Bouchey and Harter (2005); [3]Archer et al. (2015); [4]Denner et al. (2018); [5]Kang et al. (2018); [6]Sha et al. (2016); [7]Blustein et al. (2013); [8]Simpkins et al. (2019); [9]Talley and Ortiz (2017); [10]Tao et al. (2020); [11]Leaper et al. (2012); [12]Simpkins et al. (2015b); [13]Koch et al. (2019); [14]Rodriguez et al. (2019); [15]Alliman-Brissett and Turner (2010); [16]Strayhorn (2017); [17]McLoyd (1990); [18]Cooper et al. (2002); [19]Delgado (1995); [20]Vélez-Agosto et al. (2017); [21]Raffaelli et al. (2005); [22]Crenshaw (1989); [23]Martin (2009); [24]García Coll et al. (1996); [25]Boykin (1986); [26]Walker (2006); [27]Jackson and Suizzo (2015); [28]Soto-Lara and Simpkins (2020); [29]Martin et al. (2013); [30]Berry (2008); Berry et al. (2011); [31]Huguley et al. (2021); [32]Halgunseth (2019); [33]Yosso (2005)

In wparticular, parent importance and competence beliefs were positively related to students' STEM importance and competence beliefs, with several medium effect sizes (e.g., Bouchey & Harter, 2005; Garriott et al., 2017). This finding aligns with motivational theories suggesting that these parental beliefs are central to helping youth develop their STEM motivational beliefs (e.g., Eccles & Wigfield, 2020) as well as racial/ethnic theories suggesting that parents' hopes or aspirational capital for their child are valuable among Black and Latinx families (e.g., Yosso, 2005). Moreover, parents' confidence in their child's STEM competence may be especially valuable, given other adults' low expectations and stereotypes in the media may undermine Black and Latinx youth's ability beliefs (e.g., Archer et al., 2015; Huguley et al., 2021). Similarly, STEM co-activity was consistently related to adolescent motivation with some studies indicating medium effect sizes (e.g., Sha et al., 2016). This finding aligns with prior work suggesting that parents engaging in STEM activities with their children can be particularly motivating (e.g., Zucker et al., 2021). The remaining parent behaviors—advice, encouragement, and schoolwork support—had some inconsistent findings and small effect sizes. In sum, although all types of parent STEM support reviewed related to students' STEM motivational beliefs, parent co-activity, importance beliefs, and competence beliefs had particularly strong, consistent relations.

Advancing Motivation Research Through Theory Bridging

The findings from this review underscore the importance of theory bridging to develop more culturally grounded conceptualizations of parenting. Theory bridging refers to synthesizing two or more complementary theories to create a more tailored framework (e.g., Leaper, 2011). Although all of the studies in this systematic review focused at least partially on race and ethnicity, only four studies incorporated theories that explicitly focused on race/ethnicity and culture. Prior research's heavy reliance on mainstream US (i.e., White, upper-middle class, college educated) definitions of parent STEM support limits the field's knowledge concerning Black and Latinx parents' support. Indeed, the most consistent findings and the most well-researched constructs in this review were core constructs from motivational theories, such as parents' importance beliefs, beliefs about children's abilities, encouragement, and co-activity. Relatedly, adolescents' importance beliefs, competence beliefs, and career aspirations were youth constructs that received the greatest research attention. We argue that bridging motivation theories and theories about race/ethnicity and culture is a strategy to develop more culturally grounded constructs and help researchers situate their results in a richer lens.

To help guide our research question and results, we employed a new framework depicted in Fig. 1, which bridged motivational and culturally grounded theory to better explain parent support and youths' motivational beliefs among Black and Latinx families. We view this figure as a living model that will benefit from further refinement as the work in this area flourishes and as these processes are considered by diverse perspectives. This review highlights several current

gaps in the literature concerning the constructs and processes detailed in Fig. 1. We summarize what we see as some of the core next steps in Table 3.

One area that needs further development is the constructs emphasized in culturally grounded theories of development (see the middle of Table 3 for examples). Several of the constructs in Fig. 1 have not been systematically studied among Black and Latinx family STEM motivational processes though there are a few notable exceptions. For example, Soto-Lara and Simpkins (2020) bridged Eccles' parent socialization model (Eccles, 1993) with the cultural microsystem model (Vélez-Agosto et al., 2017) to highlight that culture is intrinsically embedded within parents' beliefs and practices. This approach paired with qualitative data afforded a richer understanding of parent science support that encompassed both traditional mainstream parenting practices that have been systematically studied, like advice giving, and newer, understudied parenting practices grounded in Latinx culture, such as *consejos*, or advice that is rooted in cultural meaning. As a second example, Jackson and Suizzo (2015) used the integrative model (García Coll et al., 1996) and social cognitive career theory (Brown & Lent, 2019) to explore Latina science identity development. The authors found that various sources of support were built upon each other to collectively promote youths' science identity. For example, Latinas reported that although familism was a strength they drew upon, there were also trade-offs including higher expectations of contributing to the family (Jackson & Suizzo, 2015). Bridging theories in this way and incorporating parents' and adolescents' insider perspectives from qualitative research can help us to overcome biases present in our current theories and identify more comprehensive, ecologically valid indicators of parent support and youth motivation to more fully capture Black and Latinx family strengths (e.g., Halgunseth, 2019; McLoyd et al., 2019; Spencer, 2006).

Table 3 provides additional examples of culturally grounded theories, and methodological approaches scholars have used in STEM research. For example, theories such as critical race theory (Delgado, 1995) and mathematics learning as a racialized experience framework (Martin, 2009) may help researchers understand why and how domains such as STEM are structurally racialized and can be alienating and unwelcoming to minoritized youth. Other theories such as the African American child development model (McLoyd, 1990), the Latino model of youth development (Raffaelli et al., 2005), and bridging multiple worlds theory (Cooper et al., 2002) may facilitate researchers to investigate and measure culturally grounded ways in which parents help their children navigate an academic domain such as STEM. Based on these theories and prior research, Table 3 also outlines additional parent support constructs future studies might consider, such as examining the role of racial/ethnic socialization and pride (e.g., Huguley et al., 2021) and the role of kinship networks and the wider community (e.g., Martin et al., 2013). Finally, we suggest cultural strengths that future studies might consider (discussed more below). Incorporating such theories and constructs may help motivational researchers conduct research that is culturally grounded and attends to the strengths of Black and Latinx youth and families.

A second area ripe for research is understanding the barriers and family strengths mentioned in theories focused on the development of youth of color, such as

familism, ethnic pride, and racial socialization (García Coll et al., 1996; Raffaelli et al., 2005). We found that studies including promotive factors tended to be among Latinx families, whereas studies examining inhibitive factors such as barriers tended to be among Black families. Both are important to understanding the lived experiences of Black and Latinx families. For example, researchers could investigate how parent academic support and racial socialization serve as sources of strength against racism in STEM as shown with the dashed arrows in Fig. 1. Prior research has found that parent racial/ethnic socialization is related to greater resilience (e.g., Varner et al., 2018) and academic success (Wang et al., 2020); such benefits might emerge in STEM as well.

Additionally, these cultural strengths and parents' STEM behaviors might help families mitigate the negative influences of the barriers they face. For example, Yosso's (2005) community cultural wealth model highlights the capital or strengths that Black and Latinx families possess. Yosso's (2005) concept of aspirational capital, or parents' aspirations for their children, has been identified as a strength among immigrant Latinx parents (Halgunseth, 2019), although it has not been studied extensively regarding STEM. Resistant capital, or the knowledge and skills parents teach their children to challenge inequality, might be another useful construct in light of the racism Black and Latinx adolescents face (Yosso, 2005). Black mothers, for example, raise their daughters to assert their intelligence and resist societal stereotypes, making resistant capital an important addition to research examining STEM motivational beliefs among Black girls (Yosso, 2005).

Finally, adolescents' sense of belonging did not emerge as a primary factor in the studies investigated. However, given the exclusionary practices Black and Latinx adolescents face, it may be crucial to understand this belief, including how it relates to adolescents' STEM identity (e.g., Gray et al., 2022; Skinner et al., 2017). For example, future studies might examine how adolescents' sense of belonging in STEM might contribute to their STEM identity or help to authentically integrate their STEM identity with their racial/ethnic identity. These examples provide strategies toward new perspectives, serve as a nudge to reconsider extensively studied processes that seem established, and help guard against assuming theories largely based on one group to apply to all groups. We encourage motivation researchers to consider the theories and constructs listed in Table 3 as well as others to help widen their gaze and strength-based methods that center youth and family voices to further develop a list of relevant constructs and processes.

The Importance of Within-Group Variability

Another important implication of this review is the importance of within-group variability. Exploring what factors relate to parent STEM support and adolescent STEM motivational beliefs within each racial and ethnic group is the only way to determine potential causal influences among these groups and can help us avoid deficit narratives and develop strength-based recommendations for each group (e.g., Syed et al., 2018).

Though perhaps not surprising given the centrality of gender differences in STEM, about half of the studies that investigated within-group variations focused on gender. These studies generally suggest that girls received less STEM support from parents than boys (e.g., Leaper et al., 2012; Tao et al., 2020), which points to the importance of intersectional identities when examining parent support among Black and Latinx families. For example, Black and Latinx girls/women felt marginalized due to both their race and gender, which led them to feel they did not belonging in STEM (e.g., Archer et al., 2015; Bruning et al., 2015). However, three qualitative studies found that girls or women felt their STEM motivational beliefs were positively impacted by teacher and institutional support (Bruning et al., 2015; Martin et al., 2013) or their personal drive (Hanson, 2007), suggesting potential avenues for intervention. These studies point to the ways specific race/ethnic identities, gender, and socializers or institutions intermingle to inform these processes (Crenshaw, 1989; Hsieh et al., 2021).

Despite some differences in the means, the relations between parent STEM support and adolescents' motivational beliefs were similar across boys and girls (Simpkins et al., 2015b), studies that included majority Black and majority Latinx samples (e.g., Archer et al., 2015; Jackson & Suizzo, 2015), and middle and high school students (e.g., Friedel et al., 2010; Simpkins et al., 2018). In other words, STEM parent support positively relates to motivation similarly across gender, race/ethnicity, and age. Additionally, the review suggests that although one group may have a higher mean than another group, the relations are similar—providing further evidence that increasing parents' STEM support may theoretically increase Black and Latinx students' STEM outcomes.

In addition to examining parent STEM support, it is important to examine factors related to culture and race/ethnicity that impact families. In line with prior theory (e.g., García Coll et al., 1996), almost half of all studies investigated racially and ethnically based promotive and inhibitive factors. Multiple studies found that familism was positively associated with parent STEM support (Garriott et al., 2017; Jackson & Suizzo, 2015; Simpkins et al., 2018; Talley & Ortiz, 2017). However, qualitative studies suggest that familism could have challenges as well as strengths for girls, as noted earlier (Jackson & Suizzo, 2015; Talley & Ortiz, 2017). This is an important contribution, as it implies that the impact of some cultural strengths may vary. Future research might explore how girls negotiate these tradeoffs while pursuing STEM in addition to how institutions including schools can be responsive to students' cultural values and practices rather than using a color-blind approach or advising that they simply need to reprioritize things.

Implications of Findings for Parents, Educators, and Practitioners

Our findings have several implications for parents, educators, and practitioners. Parents are vital sources of support for adolescents' STEM motivation. Educators and practitioners should connect with, leverage, and support parents. However, several qualitative studies discussed Black and Latinx parents feeling that teachers and schools underestimate or discriminate against them and their children (Archer et al.,

2015; Aschbacher et al., 2010; Berry, 2008). Thus, teachers should work to reduce structural barriers Black and Latinx families face, including those within schools (e.g., Alliman-Brissett and Turner, 2010). Furthermore, it is essential that teachers connect with parents and families in the ways that families prefer and that celebrate cultural strengths (see Gray et al., 2022; Robinson, 2022). Teachers should learn about the ways parents already support their children, such as through their passions or funds of knowledge, and find strategic ways to build on what families already do (e.g., Lachney et al., 2021). For example, one 15-month intervention among high school students and their parents used strategies such as providing parents with guidance about how to talk to adolescents about relevant connections to math and science (e.g., video games, driving) (Harackiewicz et al., 2012). A key to this intervention was that it was flexible in content and structure, so that families could pick out topics that were most relevant to them on their own schedule. Because this intervention was provided to the majority of White families, school-based interventions that provide Black and Latinx adolescents with culturally relevant STEM resources are especially needed (e.g., Eglash et al., 2011; Lachney et al., 2021).

Our findings also indicate that family support still matters during adolescence. Increasing autonomy and exploring identities are central developmental tasks during adolescence, and parents can support their adolescents while also affording greater autonomy. For example, certain forms of support, such as discussions about career pathways, may be more helpful in late adolescence compared to other types of support (Simpkins et al., 2015b). Additionally, in several studies, students felt that their parents did not have the skill set to support them in advanced STEM coursework. Nevertheless, parents' STEM encouragement made a difference (e.g., Walker, 2006), and teachers and extracurricular programs provide complementary support (e.g., Martin et al., 2013; Russell & Atwater, 2005).

Black and Latinx adolescents face numerous barriers in pursuing STEM, such as stereotypes, discrimination, and marginalization. Parents are critical in supporting their youth, but they cannot turn the tide alone. Black and Latinx adolescents and families deserve to be supported by the broader social systems—including educational, corporate, and societal systems. Schools, corporations, and policy makers have the power to reduce barriers and create more supportive environments for Black and Latinx adolescents (see Graham et al., 2022).

Limitations and Future Directions

Although our systematic review made several contributions, there are limitations worth noting. First, because we did not include unpublished studies, there likely is a publication bias in our results due to the dificulties of publishing non-significant work. This may be partly why most studies found significant relations. Additionally, excluding book chapters may have excluded some qualitative work given that this work is often published in books. Four additional limitations concern our chosen population. Our paper focused on Black and Latinx families given their underrepresentation in STEM, but these populations are heterogeneous, differing by heritage, socioeconomic status, language status, generation status, and many other factors.

Our review attended to several of these factors, but others were not included in the papers we reviewed. Future research might examine additional demographic factors, such as generation status. Furthermore, other underrepresented ethnic groups, such as Native Americans and Pacific Islanders, were not included in our review nor in most STEM equity studies. Additionally, underrepresentation in STEM is defined by other demographics, such as gender, college generation, and family income, which our review did not systematically include. Finally, our review focused on parents and other adult family caregivers; future research needs to explore peer family members, including siblings and cousins. Prior studies among Latinx families have found that older siblings and cousins offer complementary, unique support; for example, siblings are often more familiar with younger siblings' coursework and can provide more coursework assistance and guidance than parents (Puente & Simpkins, 2020; Ramos Carranza & Simpkins, 2021). Furthermore, Black and Latinx families may be supported by their larger race and ethnic community, which may employ a range of culturally adaptive practices to protect and nurture youth (Halgunseth, 2019; McLoyd et al., 2019; Soto-Lara & Simpkins, 2020). Such support may extend to STEM, which future research might explore.

Conclusion

This systematic review found evidence that parent STEM-specific support positively relates to Black and Latinx adolescents STEM motivational beliefs. This was found across various types of parent support (e.g., co-activity, encouragement, importance beliefs) as well as various study designs. Although sometimes mean level variations were found based on gender, the relations between parenting and adolescent motivation were similar. Some recommendations for future directions include bridging developmental and racial/ethnic specific theories and continuing to examine within-group variability. This review speaks to the strong positive role Black and Latinx families play in their adolescent's STEM motivational development.

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*Indicates a citation from our systematic review.

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