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Title: The role of parents in students' motivational beliefs and values

Year: 2015

Version:

THE ROLE OF PARENTS IN STUDENTS' MOTIVATIONAL BELIEFS AND VALUES

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INTRODUCTION

Motivational beliefs and values are salient determinants of performance, persistence, and behavioral choices (e.g., Eccles 2005; Eccles 2009; Eccles and Wigfield 2002). According to Eccles and colleagues' *expectancy-value theory* (Eccles et al. 1983), *competence beliefs* are motivational beliefs that refer to individuals' evaluations of their competence in different areas (Eccles and Wigfield 2002: 118). Positive estimates of one's own ability and competence are crucial for producing successful learning processes (e.g., Marsh, Trautwein, Lüdtke, Köller and Baumert 2005; Schunk and Pajares 2005). Other crucial predictors of individuals' achievement and choice behavior are *subjective task values*, which are defined as "…the quality of the task that contributes to the increasing or decreasing probability that an individual will select it…" (Eccles 2005: 109). Students' interest in tasks or activities (*intrinsic value*/*interest*) and students' perceptions of a task as useful and relevant (*utility value*) are such values that influence domain-specific attitudes and career intentions and are therefore addressed in this chapter (e.g., Harackiewicz, Durik, Barron, Linnenbrink-Garcia and Tauer 2008; Harackiewicz, Rozek, Hulleman and Hyde 2012; Nagy, Trautwein, Baumert, Köller and Garrett 2006; Watt, Shapka, Morris, Durik, Keating and Eccles 2012). There are two other components of subjective task value – students' personal importance of doing well on the task (*attainment value*) and the negative aspects of engaging in the task, such as performance anxiety or lost opportunities (*cost*) (Eccles, Wigfield and Schiefele 1998). Given the high importance of individuals' competence beliefs and values, it is noticeable that both competence beliefs (e.g., Jacobs, Lanza, Osgood, Eccles and

Wigfield 2002; Wigfield et al. 1997) and values (e.g., Fredricks and Eccles 2002; Watt 2004) decline significantly from childhood to adolescence.

Parents tend to play a decisive role in the motivational development of children and adolescents and shape children's early achievement-related orientations and perceptions (e.g., Eccles and Jacobs 1986; Frome and Eccles 1998; Pomerantz, Grolnick and Price 2005; Pekrun 2001; Wild 2009) as well as children's development of competence beliefs and values across domains (e.g., Eccles 1993, Eccles et al. 1998; Fredricks and Eccles 2002). As the decline in motivation is particularly steep in mathematics and science (e.g., Wigfield, Eccles, Schiefele, Roeser and Davis-Kean 2006), empirical work has often focused on the role that parents play in students' motivational development in mathematics and science (e.g., Eccles and Jacobs 1986; Harackiewicz et al. 2012; Jacobs 1991). Recent motivational theories have drawn on a few specific parent-related factors that are central for children's motivation. Eccles and colleagues (Eccles et al. 1998: 1054), for example, proposed the importance of *parents' general beliefs and behaviors* (e.g., gender-role stereotypes, efficacy beliefs, parenting styles) and *child-specific beliefs* (e.g., ability-related expectations, perceptions of a child's interest) as predictors of children's competence beliefs and values. *Self-determination theory* (Deci and Ryan 1985) highlights the importance of parental behaviors that support students' feelings of *competence, autonomy, and relatedness*. Self-determination theory suggests that behaviors that satisfy these three intrinsic psychological needs facilitate the development of students' intrinsic motivation (e.g., Deci, Vallerand, Pelletier and Ryan 1991; Ryan and Deci 2000), which is theoretically related to the constructs of interest and intrinsic value (see Eccles 2005: 114).

In this chapter, we provide an overview of the roles that parents play in shaping children's and adolescents' competence beliefs and values, particularly in the domains of mathematics and science. Parents are important for their children's development in many spheres of life (e.g., Wild and Lorenz, 2009; Youniss 1982). However, given the thematic focus of this book, we concentrate in this chapter on parents' influences on students' school-, classroom-, and learning-related competence beliefs and values. Thereby each section of this chapter focuses on how parents influence the following specific parts of the Eccles' and colleagues expectancy-value model (Eccles et al. 1983): competence beliefs, utility value and intrinsic value. Thus we do not focus on attainment value and cost. This is due to a lack of research on how parents impact adolescents' attainment value and cost. The chapter aims to combine research and educational practice by reviewing empirical findings but also by focusing on interventions that target parents' beliefs and behaviors. In the first section, we outline effects of parental beliefs on children´s mathematics-related self-concept of ability. In the second section, we present an intervention study that facilitates parents' utility beliefs and related behaviors in science and math and thereby enhances students' perceptions of the utility value of these disciplines. In the third section, we present empirical results on the effects of parents' beliefs and behaviors on whether their children have interest in math and science and view math and science as having intrinsic value.

THE EFFECTS OF PARENTAL BELIEFS AND EXPECTATIONS ON CHILDREN´S MATH-RELATED SELF-CONCEPT

Previous literature has strongly suggested that students' achievement-related beliefs play an important role in academic environments by directing behavior and effort in learning situations (e.g., Atkinson 1964; Bandura 1986, 1997; Eccles et al. 1983; Wigfield, et al. 2006). There have been several ways to define these achievement-related beliefs, such as "perceived competence" (Harter 1982) and "self-concept of ability" (e.g., Nurmi and Aunola 2005). Despite the different definitions used, all of them, in general, refer to students' own understanding of their abilities and competencies in academic situations (for a review, see Bong and Skaalvik 2003). More precisely, task-specific achievement-related beliefs refer to students' perceptions and understanding of their abilities in a particular subject area, such as math or reading (Wigfield and Eccles 2000). Although a large number of different constructs have been defined, different theories seem to share the same basic idea about the role of these beliefs and expectancies in educational settings: Students who believe that they are capable and that they can and will do well on a task are much more likely to be motivated than students who do not believe in their abilities and expect to fail on a certain task (Bandura 1997; Eccles et al. 1998; Pintrich and Schunk 2002). In this section, we use the term self-concept of ability when referring to subject-specific ability beliefs.

Parental effects on children´s ability self-concept from the viewpoint of Eccles´ Expectancy-value model

The expectancy-value model of achievement motivation developed by Eccles and colleagues (Eccles et al. 1983; Wigfield and Eccles 1992, 2000) offers a broad framework for understanding how children's self-concept of ability develops in a wider social and cultural context. In general, children's self-concepts are shaped by various kinds of interactions with other people (see Dermitzaki and Efklides 2000). For example, experiences in early learning situations (see Bong and Skaalvik 2003) and comparisons to classmates and the skill level in the classroom (Marsh 1987; Skaalvik and Skaalvik 2002; Trautwein, Lüdtke, Marsh and Nagy 2009) impact the development of self-concept of ability.

However, Eccles' expectancy-value model (Eccles et al. 1983) suggests that parents, teachers, and other important adults play a significant role in the formation of children's self-concept of ability. Research concerning parents has shown that positive parental beliefs in children's skills and success have a positive impact on children's subject-specific self-concept of ability (Eccles Parsons, Adler and Kaczala 1982; Lau and Pun 1999; MacGrath and Repetti 2000; Phillips 1987), and this impact might even be stronger than the effect of children's previous success in academic situations. Thus, parental beliefs have been reported to be positively related to children´s self-concept of math ability (Eccles et al. 1982; Jacobs 1991). And the other way around, in the realm of mathematics, it has been shown that parents who think their children will not succeed in math and believe that math is difficult for their children have children whose math-related self-concept is particularly low (Eccles et al. 1982).

According to the expectancy-value model (Eccles et al. 1983), the links between parental beliefs and youths´ achievement-related behaviors can be explained by multiple mechanisms (Eccles et al. 1983; Simpkins, Fredricks and Eccles 2012). The model proposes that parents´ beliefs predict parents´ behaviors, which then predict youths´ motivational beliefs (Eccles et al. 1998). There is some empirical support for this assumption, at least in the case of mathematics (Simpkins et al. 2012). However, only a few empirical studies have tried to identify these parental behaviors by determining which parents´ beliefs are transferred to their children. The expectancy-value model (Eccles et al. 1983) proposes that role modeling, communicating expectations, and providing differential experiences are examples of these kinds of behaviors (Eccles et al. 1983; Simpkins et al. 2012). In addition to parental behaviors, parents´ perceptions might affect children's self-concept of ability by acting as a mediator between children´s grades and their self-perceptions. According to Frome and Eccles, (1998) parents´ perceptions of their children´s success influence children's interpretations of how their grades represent their abilities.

The importance of parental beliefs for mathematics self-concept in children of different ages

Although the role of parental beliefs in the formation of children's self-concept of math ability is widely acknowledged, it is likely that the role of parental beliefs with respect to students´ self-concept varies with age (e.g., Gniewosz, Eccles and Noack 2012). Furthermore, recent studies have suggested that the influence of parents on children's self-concept of ability might actually be small compared with the influence of teachers at least during the early years of children's school careers (Pesu, Viljaranta and Aunola manuscript in progress). According to Pesu and colleagues (manuscript in progress), it seems that the role of teachers’ beliefs is emphasized in relation to children’s ability self-concepts. They found that teachers´ beliefs had a stronger impact on first graders’ self-concept of math ability than parents´ beliefs did. Moreover, Spinath and Spinath (2005) discovered that the influence of teacher evaluations on children’s general ability self-perceptions increases, whereas the influence of parents’ perceptions decreases in grades 1-4 in elementary school.

These results are not surprising as previous research has shown that feedback given by teachers, such as grades, is a good predictor of students’ self-concept of ability (Wigfield and Eccles 2000). Eccles (1993) pointed out that parents rely heavily on objective feedback (e.g., school grades) when forming their impressions of their children´s abilities. It might be that during the early school years, parents are forming their impressions of their children’s skill levels on the basis of feedback gathered from teachers and school grades. Thus, the early school years may provide an important period for the development of not only children’s self-concepts of ability but also parents’ belief systems concerning their children. This could be one explanation for recent results that have emphasized the role of teachers in addition to the role of parents in the development of children´s self-concept of ability.

However, there are also studies that have shown that the role of parental beliefs increases during the later school years. Gniewosz, Eccles and Noack (2012), for example, found that the effects of maternal competence beliefs on students´ math-related self-concept of ability increased during the secondary school transition, whereas the effect of grades decreased. However, the impact of maternal competence beliefs decreased and the impact of grades increased after the school transition. Gniewosz, Eccles and Noack (2012) pointed out that because of the instability created by school transitions (such as changes in the school and classroom environments), students instead obtain information about their abilities through a source that is stable and valid, thus through parental competence appraisals.

Future directions

Although the role of parental beliefs in the formation of children’s math self-concept is widely recognized, more research on this topic is needed. One important limitation of previous research is that it is mainly mothers´ beliefs that have been studied, whereas fathers´ beliefs and their impact on children´s self-concepts have not been studied as much. However, it might be the case that parental beliefs play a different role (Frome and Eccles 1998; MacGrath and Repetti 2000). Another understudied area is how the nature of parent-child relationships moderates parental effects on children. Lane (2011), for example, highlighted the idea that children are more likely to adopt the attitudes of adults whom they like or with whom they strongly identify. Therefore, we assume that the quality of parent-child relationships might have an effect on the effects of parental beliefs on children’s self-concept of math ability. As a conclusion, the perceptions children have of themselves direct their behavior and choices (see e.g., Jacobs 1991). Thus, parents may play an important role in widening or narrowing the road that children see ahead of them. All possible information about the ways in which parents contribute to children’s futures is therefore more than welcome.

THE EFFECTS OF PARENTS' BELIEFS AND BEHAVIORS ON STUDENTS' PERCEIVED UTILITY VALUE AND COURSE TAKING

According to Eccles' expectancy-value model, parents play a pivotal role in influencing their children's motivational beliefs (Jacobs and Eccles 2000). A large body of survey research and longitudinal studies support this idea, showing that parents' beliefs in educational domains are closely linked to the beliefs and behaviors of their children and that parental involvement is a strong predictor of students' attitudes, values, and academic choices (Jodl, Michael, Malanchuk, Eccles and Sameroff 2001; Simpkins et al. 2012). These studies have suggested that parents may be able to influence their children's perceptions of the utility of different school topics.

Harackiewicz et al. (2012) tested an intervention intended to influence students' perceptions of utility value by intervening with parents in a randomized field study. Specifically, they tested whether an intervention targeted at parents could promote parents' and students' perceptions of utility value and subsequently increase mathematics and science course enrollment. Their utility-value intervention consisted of two brochures mailed to parents and a website that explained the utility value of various STEM topics (STEM = Science, Engineering, Technology, Mathematics). The intervention was targeted entirely at parents, with the intention that they would then communicate the utility-value information to their teens. This represents an indirect utility-value intervention in which parents were given utility- value information, were encouraged to communicate that information to their teens, and were guided on how to do so. Participants in the randomized experiment were 188 (88 girls, 100 boys) adolescents from 108 different high schools and their parents. The first brochure, titled "Making Connections: Helping Your Teen Find Value in School" was mailed to parents in October of the 10th grade. The brochure provided information about the utility of mathematics and science in daily life and for various careers (e.g., how physics and chemistry help us understand how cell phones work and how video game designers use physics to make design decisions). In addition to the utility-value information, the brochure included guidance for parents about how to talk to their children about the connections between mathematics, science, and their children's lives. For instance, the brochure suggested that instead of telling teens how relevant math and science is to their lives and their futures, parents should help teens to discover the connections that are most meaningful to them. The brochure also explained the normalcy of teen resistance to such conversations and suggested utilizing other trusted resources such as mentors, teachers, and coaches.

The second brochure, titled "Making Connections: Helping Your Teen with the Choices Ahead" was sent to each parent separately in January of the 11th grade and included a password-protected website titled "Choices Ahead." Similar to the first brochure, the second one emphasized the connections between mathematics and science to peoples' lives as well as the importance of conveying these connections to students. The second brochure was different from the first in that it placed an increased emphasis on the relevance of STEM courses for preparing students for college and future careers.

The website contained clickable links to a number of different resources about STEM fields and careers in addition to interesting science sites that described the relevance of

STEM topics to everyday life. The website also highlighted excerpts of interviews with current college students who expressed the importance of their high school mathematics and science courses for their college preparation. Parents were also given the option of e-mailing specific links from the website to their teens. Parents in the control group did not receive either of the brochures or access to the website.

Parents reported their perceptions of the utility of mathematics and science for their teens (e.g., “Math and science are important for my teen’s life”) at two separate points: once when the students were in the 9th grade (prior to the intervention) and once when the students were in the 11th grade (after the intervention materials were issued). After the 12th grade, students and parents each completed a survey assessing the extent to which parents and teens had engaged in conversations about the importance of mathematics and science, and teens provided self-reports of their perceptions of the utility value of mathematics and science. The main hypothesis was that students whose parents had received the intervention would enroll in more advanced mathematics and science courses.

The results of this relatively simple intervention were dramatic. Harackiewicz et al. (2012) found that students whose parents received the intervention enrolled in significantly more mathematics and science courses in the 11th and 12th grades than teens whose parents were in the control group. The difference was equivalent to nearly an extra semester of mathematics or science over a two-year period. For most students, these extra courses consisted of advanced elective courses. They also found, consistent with previous findings (Jodl et al. 2001; Simpkins, Davis-Kean and Eccles 2006), that parental education was a significant predictor of STEM course-taking in high school. The two effects were independent, and the size of the intervention effect (β=.16) was comparable to the effect of parental education (β=.17) (see Figure 1).

--Please insert Figure 1 here--

Additional analyses indicated that the intervention significantly increased mothers' perceptions of STEM utility value for their teens as well as students' reports of conversations with parents about the importance of mathematics and science. Thus, the intervention was effective at changing parental values and was also effective in promoting conversations with teens about the value of STEM disciplines. Process analyses indicated that the direct effects of the intervention on mothers' perceptions of STEM utility value and students' reports of conversations with their parents were associated with students' perceptions of STEM utility value after graduation. Overall, these results suggest that an intervention that targeted parents had direct effects on their teens' STEM course-taking in high school and had indirect effects on their teens' perceptions of STEM utility value.

Future directions

The results of this randomized intervention study suggest that parents, a largely untapped resource, can and should be viewed as powerful instruments in the promotion of students' STEM-related motivation. However, more research is needed in order to understand the dynamics involved in parent-teen conversations and their impact on course-taking. For instance, parent-teen relationship quality, parental background in math and science, and gender (both parental gender and teen gender) could each influence the quality and content of parent-teen conversations. The intervention effects reported here might be stronger for some groups than other, and it will be important to explore such moderators in future research. Overall, however, the findings are promising, given that a relatively minimal intervention had such dramatic effects. Indeed, these results suggest that parents are willing and able to influence their children's motivation in STEM courses -- they just need the support and resources to do so.

RELATIONS BETWEEN PARENTS' BELIEFS AND BEHAVIORS AND STUDENTS' INTEREST IN MATHEMATICS AND SCIENCE

Interest and intrinsic value

Academic interest is viewed as a motivational factor that contributes significantly to students' domain-specific competence beliefs (e.g., Denissen, Zarett and Eccles 2007; Marsh et al. 2005), achievement (e.g., Fisher, Dobbs-Oates, Doctoroff and Arnold 2012; Koeller, Baumert and Schnabel, 2001), mastery goals (Harackiewicz, Barron, Tauer and Elliot 2002; Harackiewicz et al. 2008; Hidi and Harackiewicz 2000; Hulleman, Durik, Schweigert and Harackiewicz 2008), course choice in high school, and career interests (e.g., Nagy et al. 2006; Watt et al. 2012). Theoretically, interest is characterized as an interactive relation between a person and particular objects in his or her environment, (Hidi and Harackiewicz 2000: 152; Krapp 2007: 8) and it includes affective and cognitive components (e.g., Krapp 1999: 26). Interest research distinguishes two interacting types of interest, namely, situational interest and individual interest (Hidi, 1990; Krapp, Hidi and Renninger, 1992). *Situational interest* has been conceptualized as a psychological state that is suddenly evoked by features of the (learning) environment (Hidi 1990: 551). *Individual interest* has been delineated as a slowly developing and relatively stable affective-evaluative orientation toward certain domains (Schiefele 2009: 198) that develops from situational interest through four phases (Hidi and Renninger, 2006: 113). In their four-phase model of interest development Hidi and Renninger (2006) conceptualized situational interest as a basis for an emerging individual interest. Thereby the early phases of interest development are characterized as consisting of focused attention and positive feelings. The later phases consist of positive feelings as well as both stored value and knowledge (Hidi and Renninger 2006: 114). In Eccles and colleagues' *expectancy-value theory*, the concept of interest is related to *intrinsic value*, which is described as the enjoyment one gains or expects to gain while engaging in a task (Eccles 2005: 111). Thus 'interest' in expectancy-value theory as 'situational interest' in the four-phase model refers to positive feelings while engaging in a task as a main characteristic of interest. Another approach is the *person-object theory of interest* of Krapp (1999), which also distinguishes between situational interest and individual interest and which conceptualizes interest as consisting of values and feelings. He relates interest to the concept of *intrinsic motivation* (Deci and Ryan 1985) by emphasizing its self-intentional and intrinsic character. This means that an interest-related goal is compatible with one's preferred values and ideals of the growing self (Krapp 1999: 16).

Although the conceptualization of interest differs across theoretical approaches, it is typically assumed that socializers' attitudes and behaviors are important determinants of students' interest (e.g., Hidi and Renninger, 2006; Jacobs and Eccles, 2000; Krapp, 1999). Hidi and Renninger (2006: 112) state that "…without support from others, any phase of interest development can become dormant, regress to a previous phase, or disappear altogether….". Referring to the theory of self-determination (Deci and Ryan, 1985), Krapp (1999) assumes that learning environments facilitate interest if they foster feelings of competence, autonomy, and social relatedness. Based on these theoretical assumptions, the next sections focus on parents' behaviors, expectancies, and beliefs as predictors of students' interest, perceptions of intrinsic value, and intrinsic motivation in mathematics and science.

Parents' beliefs and students' interest

Eccles et al. (1998: 1057f) outlined several dimensions of parental beliefs that are assumed to be important for children's interest and motivation: (1) causal attributions for children's performance, (2) perceptions of task difficulty for their children, (3) expectations of their children's ability and success, (4) value beliefs regarding particular tasks and activities, (5) achievement standards across domains, and (6) beliefs about external barriers to success and strategies that can be applied to overcome these barriers. In this section, we focus on *children-specific parental ability and difficulty beliefs* and *task-specific value beliefs* as these beliefs have been shown to be related to students' interest. Tenenbaum and Leaper (2003), for example, demonstrated that *mothers' perceptions of science as difficult for their children* led to low levels of interest in science when their children were in secondary school. Mothers' high ratings of *science as an interesting domain* were associated with high levels of interest in science in secondary school. No such effect occurred with regard to fathers' beliefs.

There is also empirical evidence that *mothers' expectations about their children's mathematics ability* are significantly related to children's own interest in mathematics (Eccles 1993). Lazarides and Ittel (2013) showed that when secondary students perceived that their *parents valued and enjoyed mathematics*, this significantly predicted mathematics interest, but only for girls. Thus, some research has led to the conclusion that the effect of parental values on students' interest might depend on parents' and students' gender. Furthermore, empirical findings have prompted the idea that effects of parental values might depend on whether interest development or a current level of interest is considered and may also depend on the intensity of parents' influence. Frenzel, Goetz, Pekrun and Watt (2010), for example, found that when *parents valued mathematics as an important and interesting domain*, this contributed to students' level of interest at the ages of 5-9 but did not prevent the decline in interest during secondary school. Findings by Eccles (1993) suggest that an excessive attempt of parents to influence their children's interest in mathematics might prevent children from developing this interest.

Concerning the mechanisms through which parents' beliefs and values impact their children's values, in their model of parent socialization, Eccles and colleagues (1998) explain that parents transfer their values to their children through their behaviors. In contrast to these assumptions, cross-sectional studies have not found significant relations between parenting practices (e.g., involvement in school) and children's values (Jodl et al. 2001; Noack 2004). However, longitudinal research has shown that parents' child- and math-specific value beliefs directly influence their subsequent child-specific behavior, and through this, subsequently affect their children's values (Gniewosz and

Noack 2012a; Gniewosz and Noack 2012b; Simpkins et al. 2012). Simpkins and colleagues (2012) furthermore showed that youths' valuing of math in turn predicted their subsequent activities and math courses in high school. Given that parents' behaviors play an important role in shaping whether their children value mathematics, the next section points out several parental behaviors that are associated with students' interest, intrinsic motivation, and task-values.

Parents' behaviors and students' interest

Jacobs and Bleeker (2004: 7) outlined several ways by which parents may transfer their beliefs and values about a specific domain to their children: (1) by playing the role of "interpreters of reality" via the messages they provide regarding their perceptions of their children's experiences; (2) by providing particular opportunities such as toys, games, or activities; (3) by being involved in activities with their children; and (4) by acting as role models by engaging in valued activities.

In line with these assumptions, research has provided evidence that certain parental behaviors are central prerequisites for a positive development of students' academic interest, values, and intrinsic motivation. Some examples are parental encouragement and praising children's learning success (e.g., Ginsburg and Bronstein 1993; Ferry, Fouad and Smith 2000), engaging in cognitively demanding parent-child conversations (Daniels 2008; Tenenbaum 2009), engaging in joint activities (e.g., Noack 2004), providing cognitive stimulation at home (e.g., Gottfried, Fleming and Gottfried 1998), providing autonomy-supportive behaviors (e.g., Aunola, Viljaranta, Lehtinen and Nurmi, 2013), or intrinsic motivational practices (e.g., Gottfried et al. 1994, 2009).

Regarding *parents' role as interpreters of reality*, in a cross-sectional study, Ferry and colleagues (2000), for example, showed that when *parents encouraged learning and career plans in mathematics and science*, this facilitated students' positive outcome expectancies, which in turn predicted students' interests in mathematics and science. Lazarides and Ittel's (2012, 2013) longitudinal results revealed that *parents' encouragement and interest in students' learning* significantly predicted students' interest in mathematics.

Concerning the effects of parents *providing opportunities* on students' interest in mathematics and science, Gottfried and colleagues (1998) revealed that a *cognitively stimulating home environment* (e.g., exposing children to and providing learning materials, engaging in cognitively stimulating conversations) provided by the parents positively influenced subsequent intrinsic motivation in mathematics from childhood through early adolescence. Daniels' (2008) longitudinal findings suggested a positive impact of *parent-child conversations* about learning, personal problems, and future or career plans on seventh graders' subsequent interest in mathematics. Noack (2004) highlighted that whether students would place a high value on mathematics (importance, utility, and intrinsic quality) was predicted best by their perception of maternal values and *joint leisure activities* (e.g., excursions, conversations, solving mathematical and other problems) between students and their mothers. Jacobs and Bleeker (2004) revealed that such relations might depend on parents' gender, and their results showed that only *mothers' mathematics and science purchases and activities* led to higher subsequent interest in mathematics by their children. With regard to the effects of parents providing mathematics and science activities and students' interest, Jacobs and Eccles (2000) assume that parents' behaviors are also influenced by their children's behaviors and suggest that future research should take into account the complexity of such interactive relationships.

Studies drawing on *parents' involvement* in their children's learning activities often focus on parental autonomy-support. Aunola and colleagues (2013) demonstrated positive effects of maternal *support behaviors on feelings of autonomy (encouraging independent problem-solving)* on first graders' subsequent mathematics interest. In their study, maternal support of *competence (high ability expectations) and relatedness (warmth/affection in interactions)* also predicted mathematics interest. Gottfried and colleagues (2009) showed that parents' use of *task-extrinsic motivational practices* were associated with low initial intrinsic motivation in mathematics and science in elementary school and were not related to students' motivational development from childhood throughout adolescence. Parental task-extrinsic practices apply to parents' behaviors that, for example, emphasize external control, diminish autonomy, and devaluate competence (Gottfried et al. 1994: 104). Parents' *task-intrinsic motivational practices* were positively related to children's initial intrinsic motivation in math and science and inhibited the developmental decline in intrinsic motivation. *Parental task-intrinsic practices* hereby refer to encouraging enjoyment, curiosity, involvement, and persistence in learning processes (Gottfried et al. 2009: 730).

Referring to *parents as role models*, research has often focused on the effects of parents' education and occupation on students' career choices rather than on students' motivation (e.g., Eccles 1993; Dryler 1998). Dryler's (1998) results, for example, showed that students' career plans in technology and engineering were strongly influenced by their parents' occupation. Boys' career plans were thereby particularly strongly influenced by their fathers' occupations.

Future directions

While parents' beliefs and behaviors have been identified as crucial for children's beliefs and later career choices, research has suggested that the effect of parents' values on students' interest might depend on parents' and students' gender. However, studies have rarely focused on the effects of mothers' and fathers' beliefs and behaviors on daughters' and sons' beliefs and behaviors separately. Furthermore, there is a need to differentiate between the effects of parents' beliefs and behaviors on children's current level of interest and the development of children's interest. Beyond that, Jacobs and Eccles (2000) point out that reciprocal effects should be taken into account by examining the effect of children's behaviors on parents' behaviors and vice versa.

PREDICTORS OF PARENTS' BELIEFS AND BEHAVIORS

Research has suggested that parents' beliefs and behaviors depend to a large degree on social-contextual and child-specific factors such as family demographic characteristics, age and gender of the child, or children's ability level (Eccles 1998; Eccles and Harold 1993; Gottfried et al. 1998; Grolnick, Benjet, Kurowski and Apostoleris, 1997). *Family demographic characteristics* such as parents' education, parents' financial resources, or parents' occupation influence how successfully parents translate their child-specific beliefs and values and their support of their children's talents (Eccles 1993; Eccles and

Harold 1993). Gottfried and colleagues (1998) demonstrated that cognitive stimulation at home depended on families' socioeconomic status (SES) such that families with higher SES are more likely to provide a cognitively stimulating home environment. Grolnick and colleagues (1997) revealed that families with higher SES tend to be more involved in school. Eccles (1993) reported that parents from low-risk neighborhoods are more likely to support their children's talents than parents from high-risk neighborhoods. The latter, thus, were more likely to be putting their efforts toward protecting their children from danger. However, Grolnick and colleagues (1997) highlighted that mothers' personal involvement was not associated with SES, suggesting that affective parental involvement does not depend on parents' occupation and education. Another important factor that influences parents' beliefs and behaviors is students' *age*. Parents' gender-stereotyped expectancies of their child's ability in mathematics increase with the child's age (Frome and Eccles, 1998). Conversely, parents' school involvement decreases dramatically after children's transition to secondary school (Eccles and Harold 1993). A large amount of research has examined the relations between *students' gender* and parents' beliefs and behaviors (e.g., Crowley, Callanan, Tenenbaum and Allen 2001; Eccles 1993; Eccles and Jacobs 1986; Gunderson et al. 2012; Jacobs and Bleeker 2004). Preference tends to be given to boys with regard to, for example, parents' promotion of math- and science-related activities and their purchasing of math and science items (Jacobs and Bleeker 2004), parents' explanatory talks in math and science disciplines (Crowley et al. 2001), parents' child-specific ability, talent, and difficulty beliefs as well as their expectations of children's interest in science (e.g., Eccles et al. 1990; Eccles and Jacobs 1986; Tenenbaum and Leaper 2003), and parental encouragement to participate in math and science disciplines (e.g., Simpkins et al. 2012). Parents of girls, however, tend to be more strongly involved in girls' math and science activities (e.g., Grolnick et al 1997; Jacobs and Bleeker 2004) and tend to perceive girls as more diligent (Stöckli 1997).

CONCLUSIONS

The research presented in this chapter showed how various dimensions of parents' beliefs guide parents' behaviors and how parents' behaviors then impact children's own beliefs. Children's beliefs in turn were shown to influence their later course choices and career interests (e.g., Gniewosz and Noack 2012a, b; Simpkins et al. 2012). This chapter thereby highlights the importance of such empirical research results for educational practice. Theory-based interventions yield highly positive effects on parents' supportive behaviors in math and science, and by this, influence students' later choices. Harackiewicz and colleagues (2012) emphasized that a utility-value intervention that targeted parents' ability to communicate the importance of math and science to their teens facilitated students' utility-value beliefs and thus enhanced later high school math and science enrollment. More research is needed to examine the effects of such interventions in various subgroups, for example, in different gender groups. Furthermore, there is a need to investigate how to include both mothers and fathers in research as parental effects on students' beliefs might differ depending on the gender of the parent (e.g., Frome and Eccles 1998; MacGrath and Repetti 2000; Tenenbaum and Leaper 2003). The research presented in this chapter indicates that the importance of parents for children's math-related beliefs and behaviors might depend on children's gender (e.g., Gottfried et al., 2009; Lazarides and Ittel 2013) or age group (Gniewosz, Eccles and Noack 2012; Pesu, Viljaranta and Aunola manuscript in progress; Spinath and Spinath 2005).. This chapter elucidated the idea that different dimensions of parental beliefs and behaviors impact students' beliefs and behaviors through complex developmental mechanisms that depend on multiple characteristics of parents, children, and the social context. Further research needs to address these mechanisms in greater detail for example by analysing parental effects on their children's attainment value and cost. Such research is needed to provide a detailed understanding of parent-child motivational processes.

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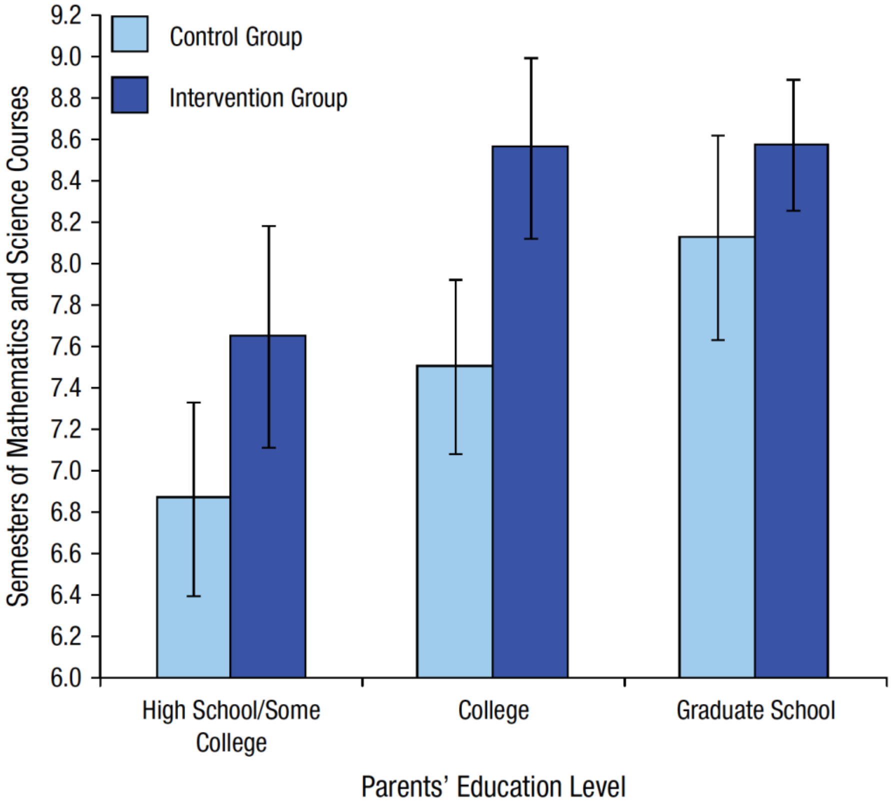

Figure 1. Effects of the utility-value intervention and parents' educational level on the number of semesters in which students enrolled in math and science.