

Investigating Associations Between Family Background and Students' Academic Outcomes: The Role of Parents' Motivation

Dissertation

zur Erlangung des Doktorgrades

der Wirtschafts- und Sozialwissenschaftlichen Fakultät

der Eberhard Karls Universität Tübingen

vorgelegt von

Dipl.-Psych. Isabelle Häfner

aus Bad Friedrichshall

Tübingen

2015

Tag der mündlichen Prüfung: 17.12.2015

Dekan: Prof. Dr. rer. soc. Josef Schmid

1. Gutachter: Prof. Dr. Ulrich Trautwein

2. Gutachter: Prof. Dr. Benjamin Nagengast

ACKNOWLEDGMENTS

First of all, I want to express my great appreciation to my supervisors Prof. Ulrich Trautwein and Prof. Benjamin Nagengast for their support and guidance throughout my dissertation project. Thank you for reading my articles with lightning speed, for your great ideas, and for always finding the right amount of autonomy, challenge and support.

I am also deeply grateful for spending two months with Prof. Judy Harackiewicz in Madison. Thank you for your support, your encouragement, and for giving me the chance to experience an inspiring time with you. Working with you deepened my passion for research even more.

Special thanks go to Barbara Flunger, who was deeply involved into my whole dissertation and probably knows parts of my papers by heart. I did not only benefit from your high level feedback and help with statistics, but also from your encouragement and support to a great extent. Your moral support made this dissertation a lot easier and helped me to hang tough! A big thank you also goes to Anna-Lena Dicke who always helped with great ideas and supportive assistance. I learned a lot from you and it is always great working with you!

I could not have done this work without the support of my colleagues. My need for social relatedness was highly satisfied by working in the “MoMa” (Motivation in Mathematics) project with Brigitte Brisson and Hanna Gaspard. I learned a lot from both of you! Thank you very much for your great support, inspiring discussions, and being friends. Many other colleagues contributed to this dissertation. Special thanks go to Evelin Herbein, Katharina Allgaier, and to all our student assistants.

I would also like to thank my colleagues from the Hector Research Institute for Educational Sciences, the LEAD graduate school, and the Cooperative Research Training Group. Discussions and exchanging experiences during multiple retreats was always a highlight and very enjoyable! Special thanks go to Norman Rose for his statistical help – I always learned a lot from you- as well as to everyone who read, commented, and helped with my dissertation – especially to Heide Kneißler for helping during the last stages of this dissertation. A special thank you goes to Jenna Cambria for her professional, emotional, and language support – you have a special place in my heart!

A big thank you also goes to all my friends – near or far – for always being there for me and for getting my head off of my dissertation from time to time☺.

In particular, I want to thank Markus Engelberth, who experienced it all: the highs and lows during these almost four years. Thank you for always being there for me! Your invincible optimism always pulled me up and helped me to push through. Thank you for everything!

Last but not least, a great thank you goes to my family and in particular to my parents. As my dissertation empirically shows, parents have a huge influence on their children's career paths. I would not be here without you – your infinite support is invaluable. Thank you for always believing in me!

ABSTRACT

Family Background is a crucial factor for the development of students' motivation and academic achievement (Coleman et al., 1966). Whereas former research mainly focused on structural family characteristics, such as the socioeconomic status (Sirin, 2005), recent research highlighted the importance of more process-related family characteristics for students' academic outcomes (Eccles, 2007; Lazarides, Harackiewicz, Canning, Pesu, & Viljaranta, 2015). Of the various process-related family characteristics investigated, parents' motivation seems to be especially important for the development of student motivation (Lazarides et al., 2015). However, a number of questions with regards to the importance multiple family characteristics still remained unanswered. The present dissertation consists of three empirical studies investigating the associations between structural and process-related family characteristics with students' academic motivation and achievement. In addition, a specific focus is put on the mostly understudied motivational family characteristics (i.e., parents' own motivation). Applying a multidimensional, process-related approach of family background, the dissertation focuses on three questions: (1) how the interplay of multiple process-related family characteristics are associated with students' outcomes next to structural family characteristics; (2) how parent and student motivation are bidirectional related and how they affect students' career paths, (3) how motivational gaps between students from families with more and less advantageous motivational family characteristics can be counteracted.

Investigating the interplay of multiple process-related family characteristics and their associations with student motivation and achievement, Study 1 applied a person-centered approach. Using data of 1,571 ninth-grade students of 82 classrooms of 25 academic track schools and their parents, latent profile analyses considering parents' motivation, child's need for support, academic involvement, parent-child relationship, and parents' time and energy, identified five profiles of family characteristics: *indifferent*, *motivated and engaged*, *motivated and disengaged*, *involved*, and *average* families. The results indicated that students from families classified as *motivated and engaged* and *motivated and disengaged* showed higher initial levels of motivation and achievement and higher achievement and grades over five months compared to students from average families. By contrast, students from *involved* families (characterized by medium

motivation but high involvement), got worse grades than students from *motivated and disengaged* families.

Due to the particular importance of parents' motivation, Study 2 investigated interrelations between parents' and students' motivational beliefs (utility value and ability beliefs), and their associations with students' courses taken, achievement, and career aspirations from middle school through college. The results of path analyses of 301 families indicated that mothers' perceptions of students' ability in 7th grade predicted students' motivational beliefs, course-taking, and achievement in high school. Students' achievement during 10th grade predicted mothers' value beliefs in high school. Finally, mothers' value beliefs even predicted students' future motivation, course-taking, and career aspirations in college—over and above what was predicted by students' motivational beliefs, course-taking, and achievement in high school.

Based on the substantial associations of parents' motivational beliefs with students' academic outcomes, Study 3 examined whether motivational interventions can be used as a tool to counteract motivational gaps between students from distinct family backgrounds (socioeconomic status and motivational family characteristics). Eighty-two classrooms were randomly assigned to either one of two intervention conditions or a control group. Using data of 1,522 students and their parents, differential intervention effects depending on family background on students' motivational beliefs six weeks and five months after the intervention were investigated. The intervention was especially effective in promoting students' value beliefs for students whose parents reported lower levels of interest and intrinsic value five months after the intervention. No differential intervention effects were found for socioeconomic status.

Then, the findings of the three empirical studies are summarized and discussed in relation to the broader current state of research. In the end, implications for future research and educational practice and policy are derived.

ZUSAMMENFASSUNG

Der familiäre Hintergrund von Schülerinnen und Schülern hat einen großen Einfluss auf die Entwicklung der Schülermotivation und –leistung (Coleman et al., 1966). Während sich die Forschung in der Vergangenheit mehrheitlich auf strukturelle Merkmale von Familien konzentrierte, betont die heutige Forschungsliteratur die Wichtigkeit von prozessbezogenen familiären Bedingungen für die Schulleistungen (Bronfenbrenner & Morris, 2006; McLoyd, 1998). Unter den verschiedenen prozessbezogenen familiären Merkmalen scheint vor allem die Motivation der Eltern eine wichtige Rolle für die Entwicklung von Schülermotivation zu spielen (Lazarides et al., 2015). Jedoch bleiben noch einige Fragen zu den verschiedenen Prozessmerkmalen von Familien unbeantwortet. Die vorliegende Dissertation besteht aus drei empirischen Studien, welche die Zusammenhänge zwischen strukturellen und prozessbezogenen familiären Merkmalen mit der Motivation und Leistung von Schülerinnen und Schülern untersuchen. Besondere Aufmerksamkeit kommt dabei den eher wenig untersuchten motivationalen Merkmalen von Familien (d.h. der elterlichen Motivation) zu. Mithilfe einer multidimensionalen und prozessorientierten Konzeption des familiären Hintergrundes beschäftigt sich die Dissertation mit drei Fragen: (1) Inwiefern hängt das Zusammenspiel von verschiedenen prozessbezogenen familiären Merkmalen unter Einbezug von strukturellen Merkmalen mit der Schülermotivation und –leistung zusammen; (2) Wie hängen Eltern- und Schülermotivation bidirektional zusammen und wie beeinflussen sie gemeinsam den Werdegang von Schülerinnen und Schülern; (3) Wie können motivationalen Unterschieden zwischen Schülerinnen und Schülern mit besseren und schlechteren motivationalen familiären Charakteristika entgegen gewirkt werden?

Studie 1 untersucht die Wechselwirkung von verschiedenen familiären Charakteristika und deren Zusammenhang mit Schülermotivation und –leistung mithilfe eines personen-zentrierten Ansatzes. Die Studie bezieht sich hierbei auf Daten von 1.571 Neuntklässlern aus 82 Klassen von 25 Gymnasien. Unter Einbezug der elterlichen Motivation, der Unterstützungsbedürftigkeit des Kindes, akademischer Involviertheit der Eltern, der Eltern-Kind Beziehung sowie der elterlichen Zeit und Energie ergaben latente Profilanalysen fünf Muster an familiären Charakteristika: gleichgültige, motiviert und engagierte, motiviert und nicht engagierte, involvierte und durchschnittliche Familien. Die Ergebnisse zeigten, dass Schülerinnen und Schüler aus Familien, welche als motiviert

und engagiert oder als motiviert und nicht engagiert charakterisiert wurden, im Vergleich zu Schülerinnen und Schülern aus durchschnittlichen Familien ein höheres Maß an Motivation sowie bessere Leistungen zu Beginn zeigten sowie bessere Leistungen und Noten nach fünf Monaten hatten. Im Gegensatz dazu erhielten Schülerinnen und Schüler aus involvierten Familien (gekennzeichnet durch mittlere Motivation aber hohe Involviertheit) schlechtere Noten als Schülerinnen und Schüler aus motiviert und nicht engagierten Familien.

Aufgrund der besonderen Bedeutung der elterlichen Motivation untersuchte Studie 2 die wechselseitigen Zusammenhänge zwischen Eltern- und Schülermotivation (Nützlichkeitseinschätzungen und Fähigkeitsüberzeugungen) und deren Zusammenhang mit den belegten Kursen, der Leistung und den Karriereaspirationen von Schülerinnen und Schülern von der ‚middle school‘ bis zum ‚college‘. Die Ergebnisse der Pfadanalysen von 301 Familien zeigten, dass die mütterlichen Einschätzungen der Fähigkeiten ihres Kindes in Klasse sieben die Schülermotivation, die belegten Kurse sowie die Leistung der Schülerinnen und Schüler in der zwölften Klasse vorhersagten. Die Schulleistung in Klasse zehn sagte die mütterlichen Wertüberzeugungen in Klasse zwölf vorher. Schließlich sagten die mütterlichen Wertüberzeugungen auch die zukunftsorientierte Motivation, die belegten Kurse sowie die Karriereaspirationen im College vorher—unter Kontrolle der motivationalen Überzeugungen, der belegten Kursen sowie der Leistung der Schülerinnen und Schülern in der 12. Klasse.

Aufgrund der substantiellen Zusammenhänge zwischen der elterlichen Motivation und der Schülermotivation untersuchte Studie 3, ob Motivationsinterventionen genutzt werden können, um die motivationalen Unterschiede von Schülerinnen und Schülern mit unterschiedlichem Hintergrund (sozioökonomischer Status und motivationale familiäre Merkmale) entgegen zu wirken. Hierzu wurden 82 Klassen randomisiert einer von zwei Interventionsbedingungen oder einer Kontrollgruppe zugewiesen. Mithilfe der Daten von 1.522 Schülerinnen und Schülern sowie ihrer Eltern wurden differenzielle Effekte der Intervention in Abhängigkeit des familiären Hintergrundes auf die Motivation von Schülerinnen und Schülern nach sechs Wochen und fünf Monaten untersucht. Die Intervention war besonders erfolgreich darin, die Motivation von Schülerinnen und Schüler, deren Eltern ein niedrigeres Interesse und einen niedrigeren intrinsischen Wert berichteten, fünf Monate nach der Intervention zu fördern. Es wurden keine differenziellen Effekte in Abhängigkeit des sozioökonomischen Status gefunden.

Anschließend werden die Befunde der drei empirischen Studien zusammengefasst und in Bezug auf die aktuelle Forschungslandschaft diskutiert. Zum Schluss werden Implikationen für zukünftige Forschung sowie die Praxis abgeleitet.

CONTENT

1	INTRODUCTION AND THEORETICAL FRAMEWORK.....	1
2	STUDY 1 HOW FAMILY CHARACTERISTICS PROMOTE STUDENTS’ ACADEMIC OUTCOMES: A PERSON-CENTERED APPROACH	57
3	STUDY 2 STEM CAREER PATHS FROM MIDDLE SCHOOL TO COLLEGE: PARENT AND STUDENT INTERRELATIONS.....	103
4	STUDY 3 ROBIN HOOD EFFECTS ON MOTIVATION IN MATH: FAMILY BACKGROUND MODERATES THE EFFECTS OF RELEVANCE INTERVENTIONS	135
6	GENERAL DISCUSSION	185

1

Introduction and Theoretical Framework

1 Introduction and Theoretical Framework

The role parents play in the socialization of children's academic motivation and behavior has been of interest to developmental, educational, and psychological researchers for a long time (Winterbottom, 1958). In particular, when results of the PISA study demonstrated high social disparities in academic abilities especially in Germany (Baumert & Schümer, 2001; OECD, 2001), the interest on family influences on students' academic outcomes in politics and research intensified. Since then, questions on how to conceptualize family background appropriately and how to foster students from more disadvantaged families informed research lines on students' academic outcomes.

When investigating relations between family background and students' academic outcomes, the differentiation of structural and process-related family characteristics has been made (Bronfenbrenner & Morris, 2006; Eccles, 2007; McLoyd, 1998). Structural family characteristics refer to the social background of a family (Bronfenbrenner, 1986), such as parent education, socioeconomic background, or ethnicity, and thereby describe relatively stable characteristics of the family. Whereas associations between structural family characteristics and student outcomes can diagnose social disparities in educational systems, they cannot explain them. Thus, researchers argued to investigate process-related family characteristics, through which structural family characteristics influence students' academic outcomes (Bronfenbrenner & Morris, 2006; Eccles, 2007; McLoyd, 1998).

One prominent framework to investigate structural and process-related family characteristics in particular is the expectancy-value theory of achievement related choices by Eccles and colleagues (EVT; 1983) and, more specifically, the parent socialization model (Eccles, 2007; Jacobs & Eccles, 2000), which is embedded within EVT. The parent socialization model postulates a broad spectrum of potentially relevant process-related family characteristics that shape the development of students' motivational beliefs, such as parents' own motivation, their perception of their child's ability, and their behavior (Eccles, 2007; Jacobs & Eccles, 2000). One of the most promising process-related family characteristics for students' academic motivation and achievement seem to be motivational family characteristics, that is, parents' own motivation (Lazarides et al., 2015).

The present dissertation focuses on family influences on students' academic motivation and achievement and addresses some open questions that are highly relevant for research on family influences in general, but also for policy and practice. First of all, to be able to investigate family background effects, a systematic conceptualization of family background is necessary, which has often been missing in previous studies (Bradley & Corwyn, 2002). A multidimensional, process-oriented approach to family background is proposed in this dissertation to yield new insights into the relative importance of structural and process-related family characteristics for students' academic outcomes. Moreover, it has been argued that taking into account multiple family characteristics and examining their interplay might be a more comprehensive approach to family background as families are complex inter-personal systems (Eccles, 2007; Simpkins, Fredricks, & Eccles, 2012). Thus, Study 1 adopts a person-centered approach to explore configurations of multiple family characteristics to learn more about the interplay between different process-related family characteristics next to structural family characteristics. Second, motivational family characteristics have been found to be especially relevant for students' academic outcomes. However, only few studies systematically investigated how parent and student motivation influence each other and how these associations shape students' career paths in a longer perspective (Simpkins, Fredricks, & Eccles, 2015)—yet, this might yield new insights into the development of student motivation and parental influences on it. Therefore, bidirectional associations between parent and student motivation as well as their associations with students' career aspirations and choices have been examined. Finally, as motivational family characteristics are associated with student motivation and predict students' career paths, there is a need to find ways to counteract these motivational deficits (Lazarides et al., 2015). Therefore, the present dissertation examines if a motivational intervention in the classroom context can be used as a tool to decrease motivational gaps between students from families with less and more advantageous motivational characteristics.

Since our everyday-life as well as the economic system is more and more defined by the fast developing processes in science, technology, engineering, and math (STEM), this becomes a central challenge for societies to compete in the global market. Education in STEM subjects plays a key role in this world-wide trend. However, there is an increasing concern regarding the educational pipeline in STEM disciplines (National Science Board, 2007). In addition, student motivation in mathematics and sciences

declines dramatically during secondary school (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004) – yet, math and sciences are important prerequisites for STEM careers (National Science Board, 2007). Therefore, the present dissertation focuses on STEM motivation and achievement and parental influences on it.

The present dissertation is structured in the following way: In the introductory chapter, the three empirical studies will be located within a broader theoretical research context. In the first section, family background will be defined and structural as well as process-related family characteristics will be differentiated and explored in detail. Next, the parent-socialization model included in EVT will be described. Herein, different process-related family characteristics and theoretical relations to other theories focusing on family influences in education will be discussed. A differentiated and sophisticated assessment of student motivation is necessary to systematically investigate the associations with family background. Therefore, the third part of the introduction focuses on the definition of student motivation based on EVT and parental influences on the development of student motivation and students' career paths. In the fourth section, interventions to specifically foster academic outcomes for students from families with a more disadvantaged background will be reviewed. Then, utility value interventions will be explained in more detail and their potential to specifically foster motivation for students from families with low motivational characteristics will be discussed. The introductory chapter will end by introducing the research questions guiding the three empirical studies. The next three chapters will present the three empirical studies conducted within this dissertation: The first study adopts a person-centered approach to examine cross-sectional and longitudinal associations between different family characteristics and students' academic motivation and achievement. The second study focuses on bidirectional relations between parent and students motivation and examines their influences on students' motivation, career aspirations, and achievement-related behavior in college. The third study investigates if a motivational intervention can be used as a tool to decrease motivational gaps between students from families with more and less advantageous motivational characteristics. The final chapter of this dissertation summarizes the findings of the three empirical studies and integrates the results into the broader conceptual framework. Lastly, implications for future research and educational practice of this dissertation are discussed.

1.1. A Process-oriented Conceptualization of Family

Background

Although student motivation and achievement are influenced by various factors at the school, classroom, and teacher level (Hattie, 2009), the family they are socialized in is one factor that affects children the most (Bornstein, 2015; Maccoby, 1992). Regarding students' academic development, Coleman et al. (1966) highlighted family background as the most crucial factor for students to be successful in school. Coleman's (1966) work initiated an overwhelming amount of studies investigating family influences on students' academic outcomes. But what is meant by family background or parental influences? According to Bornstein, family influences, or more specifically "parenting remains a somewhat mystifying subject about which few people agree, but about which almost everyone has opinions." (Bornstein, 2015, p. 2). In educational research, particular emphasis was put on the socioeconomic status (SES) of a family, which refers to a "family's ranking on a hierarchy according to access to or control over some combination of valued commodities such as wealth, power, and social status" (Sirin, 2005, p. 418; see also Mueller & Parcel, 1981) and thereby combines financial, educational, and cultural aspects of family background (Bourdieu, 1983). Meta-analyses (see meta-analyses by Sirin, 2005; White, 1982) and literature reviews (Bradley & Corwyn, 2002; McLoyd, 1998) consistently come to the conclusion that there is a positive associations between the socioeconomic status and academic achievement. More specifically, in his meta-analysis, Sirin (2005) found medium to large associations between family socioeconomic status and students' academic achievement (see also White, 1982). These achievement gaps between students from families with a higher and lower socioeconomic background have been found as early as children enter school (Lee & Burkam, 2002). Nowadays, family influences on students' academic outcomes still play a key role in educational research, demonstrating that students from families with low socioeconomic status show lower levels of academic achievement and motivation (e.g., Dotterer, McHale, & Crouter, 2009; Dumont et al., 2012; Dumont, Trautwein, Nagy, & Nagengast, 2014; Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Steinmayr, Dinger, & Spinath, 2012).

To investigate family influences on students' academic outcomes, a systematic conceptualization of family background is necessary. Thus, the following sections define

family background and review the historical developments of structural and process-related family characteristics.

1.1.1. Structural family characteristics

When researchers started to investigate family influences on students' academic outcomes, associations between structural family characteristics and students' academic achievement were the center of attention. Structural family characteristics refer to stable characteristics of the family, such as parent education, socioeconomic background, or ethnicity. Measuring these structural characteristics is a tradition in educational research and is mostly operationalized via the socioeconomic status of a family (Bornstein & Bradley, 2003). The construct socioeconomic status goes back to sociological research on the stratification of societies by dimensions such as income, power, and knowledge (Smith & Graham, 1995). Whereas researchers mainly focused on economic capital of a family as the socioeconomic status in the beginning, Bourdieu (1983, 1986) suggested a broader conceptualization in his sociological theory of social capital. Bourdieu (1983) distinguished between three different forms of capital when investigating the structural status of family: According to his conceptualization, *economic capital* is directly and immediately transferrable into money and thereby describes the financial resources of a family. In contrast, *cultural capital* refers to acquired abilities, capabilities, and knowledge of a person. Cultural capital can be further distinguished into different forms: incorporated cultural capital (also known as 'human capital'), which is directly bound to the person (e.g., education, abilities) and mostly takes time to acquire; objectified cultural capital such as cultural possessions (e.g., books, paintings); and institutionalized cultural capital such as acquired certificates (e.g., diplomas). Lastly, *social capital* can be understood as actual and potential resources from a lasting network of more or less institutionalized relationships. These relationships are mostly based on group memberships (e.g., family, coworkers).

Coleman (1988) further investigated social capital and defined it as social structures, which enable and facilitate actions within its structure. It develops through relationships between different persons within these structures. According to Coleman (1988), social capital can be differentiated into different types: First, commitments, expectations, and mutual trust enable mutual help (e.g., lending loans) and are based on the concept of reciprocity. Second, channels of information can involve social capital. In

a network of relationships, each member has different information and knowledge which can be shared with other members. Since information is necessary for successful action, the shared knowledge of different members is of great importance. Third, social norms contain social capital, since they prevent unwanted actions. To conclude, according to Bourdieu and Coleman, family background influences students' academic achievement not only through economic family characteristics, but also through social and cultural characteristics of the family. However, Bourdieu's and Coleman's conceptualization of social capital still mainly focuses on structural family characteristics.

Historically, Bronfenbrenner's (1979) psychological theory Ecology of Human Development, which focuses on social influences on human development, also initiated a broader conceptualization of family background. Bronfenbrenner (1979) specifically focused on the environments in which individuals develop and suggested that children's development is influenced by environments nested in each other. The environments most proximal to children's development are microsystems, such as the family and the school. The microsystems' mutual influences on children's development represent the mesosystems. Exosystems represent environments distal to the child which influence children's development through the meso- and microsystems, such as parents' social network. Eventually, the macrosystem includes cultural and social norms. Thereby, this theory also extended the classical concept of structural family characteristics to social influences and the interactions between them.

In line with Bourdieu's (1983) work, researchers started to acknowledge the multidimensional nature of SES (Bradley & Corwyn, 2002; McLoyd, 1998; Sirin, 2005) and mostly focused on parents' income, occupation, and education (Bradley & Corwyn, 2002; Mueller & Parcel, 1981; Smith & Graham, 1995). Relating these indicators of SES to Bourdieu's (1983) forms of capital, income and occupation are indicators of economic capital (Bradley & Corwyn, 2002) and education is an indicator of cultural capital (Bourdieu, 1986). Regarding parental education, Entwisle and Astone (1994) recommended using mothers' education as the main indicator of cultural capital. Thus, in contrast to economic capital (i.e., income and occupation) and cultural capital (education), family's social capital is still rather understudied—potentially due to the fact that the operationalization of social capital is complex and has been inconsistent across studies (Dika & Singh, 2002). Moreover, there is still a debate about which indicator of family background is most useful in education research (Entwisle & Astone, 1994) and what

precisely is represented by SES (Bradley & Corwyn, 2002). However, parental occupation and education are associated with students' academic outcomes to a similar degree (Effect size (occupation) = .28; Effect size (education) = .30; see Sirin, 2005). Instead, the source of information seems to be more important: Higher associations between SES and students' academic outcomes have been found when information on SES was assessed by parents than by students (Sirin, 2005). Moreover, the associations between SES and students' academic outcomes seem to be slightly higher for math outcomes, and during middle and high school (Sirin, 2005).

To combine information on parents' occupation, income, and education, Ganzeboom, De Graaf, Treiman, and De Leeuw (1992) created an index of SES based on parents' occupation that captures both aspects of income and education, called the ISEI (see also Ganzeboom & Treiman, 2003). By combining aspects of income, occupation, and education, the ISEI measures a person's socioeconomic position within the societal hierarchy and is probably the most widely used indicator of socioeconomic status nowadays.

1.1.2. Process-related family characteristics

Although research convincingly demonstrated the importance of structural family characteristics for students' academic outcomes (Sirin, 2005; White, 1982), these findings can only describe the amount of social disparity. As structural family characteristics represent rather stable and distal indicators of family background and thus family's status within society, there is a need to investigate more proximal, process-related family characteristics explaining the associations between SES and students' academic outcomes (Grolnick, Friendly, & Bellas, 2009; Maccoby, 1992; McLoyd, 1998). Concurrently, Bronfenbrenner further improved his theory to the Bioecological Model of Human Development and started to include and to highlight the importance of proximal processes influencing children's development (Bronfenbrenner & Morris, 2006). These proximal processes describe "particular forms of interaction between organism and environment [...], that operate over time and are posited as the primary mechanisms producing human development." (Bronfenbrenner & Morris, 2006, p. 795). In line with this call, researchers started to focus on more process-related family characteristics to investigate the associations between family background and students' achievement (Davis-Kean, 2005; Desimone, 1999; Hoover-Dempsey & Sandler, 1997; Lareau, 2003). Correspondingly,

Reay (2000) suggested to extent Bourdieu's classical conceptualization of social capital framework (1983) by including the concept of emotional capital. Reay adapted Allatt's (1993) definition of emotional capital as "emotional resources passed on from mother to child through processes of parental involvement" (Reay, 2000, p. 569), which can be seen as a more process-related family characteristics. Another process-related family characteristic investigated to explain differences of students' academic achievement due to structural family characteristics (e.g., SES) was "cultural cultivation" (Lareau, 2003). Parents with higher SES were assumed to engage in "concerted cultivation", which describes parents' educational investments in terms of a better structure of children's everyday life, more sophisticated language use, higher academic and cognitive engagement, and successful interactions with schools. These mechanisms in turn are supposed to explain higher academic achievements of students from families with higher SES in contrast to their counterparts. In line with these assumptions, parents' educational investments in terms of concerted cultivation have been found to partially explain the achievement gaps between students from high and low SES families, and even predicting the growth of achievement over time (Cheadle, 2008). Similarly, Davis-Kean (2005) investigated multiple process-related family characteristics, such as parents' expectations and behavior, and investigated if these characteristics can explain the association between structural family characteristics (parent education and family income) and students' academic achievement using cross-sectional data. Accordingly, the authors found that parents' expectations and behaviors mediated the effects of family income on student motivation (Davis-Kean, 2005). However, a significant direct effect of parental education on students' achievement remained.

Despite the endeavor to capture proximal family processes, most researchers focused on different topics of family influences and did not construct comprehensive theories on process-related family characteristics. Thereby, process-related family characteristics investigated vary from model to model (e.g., Crosnoe & Huston, 2007; Davis-Kean, 2005; Entwisle & Alexander, 1990; Grolnick & Slowiaczek, 1994; Hoover-Dempsey & Sandler, 1995). Additionally, clear definitions of constructs are often missing and the terminology of the different constructs is often inconsistent (Bradley & Corwyn, 2002). Moreover, some studies were based on research designs which are limited to interpretation (e.g., cross-sectional analyses; Davis-Kean, 2005). From a bioecological developmental systems perspective, "parenting is part of a complex multivariate system

that encompasses parents' and children's own capacities and proclivities (intellect, personality), their social relationships (with siblings, peers, teachers, neighbors), and contexts (home, school, neighborhood, socioeconomic class, culture)" (Bornstein, 2015, p. 32). Thus, a comprehensive model to capture the influences of structural and process-related family characteristics would enable a systematic assessment and comparison of family influences on students' academic outcomes.

To conclude, since structural family characteristics are relatively broad constructs and distal to students' academic outcomes, researchers called for an investigation of more proximal, process-related family characteristics through which structural family characteristics influence student outcomes (e.g., Baumert, Watermann, & Schümer, 2003; Davis-Kean, 2005; Hoover-Dempsey & Sandler, 1995; McLoyd, 1998). A broad and general model, which distinguishes and defines important structural and process-related family characteristics for students' development of academic motivation and achievement is the parent socialization model (Eccles, 2007; Jacobs & Eccles, 2000). This social cognitive model of parental influences shares some similarities to other proposed models (Bronfenbrenner & Morris, 2006; Entwisle & Alexander, 1990; Goodnow & Collins, 1990; Grolnick & Slowiaczek, 1994), but as it focuses specifically on students' academic motivation and achievement and includes other research lines on parental influences, it is used as the theoretical background of the present dissertation.

1.2. The Parent Socialization Model

In educational and motivational research, the importance of process-related psychological family characteristics for the development of student motivation and achievement has been increasingly reported (Frenzel, Goetz, Pekrun, & Watt, 2010; Grolnick et al., 2009; Lazarides et al., 2015; Simpkins et al., 2012). One model designed to systematically conceptualize both structural and process-related family characteristics is the parent socialization model (Eccles, 2007; Jacobs & Eccles, 2000). In this model, process-related family characteristics represent the psychological processes within a family through which structural family characteristics influence students' academic outcomes. Thus, process-related family characteristics are assumed to influence students' academic outcomes more directly than structural characteristics and seem to be more amenable to change (Eccles, 2007; Grolnick et al., 2009; Harackiewicz et al., 2012).

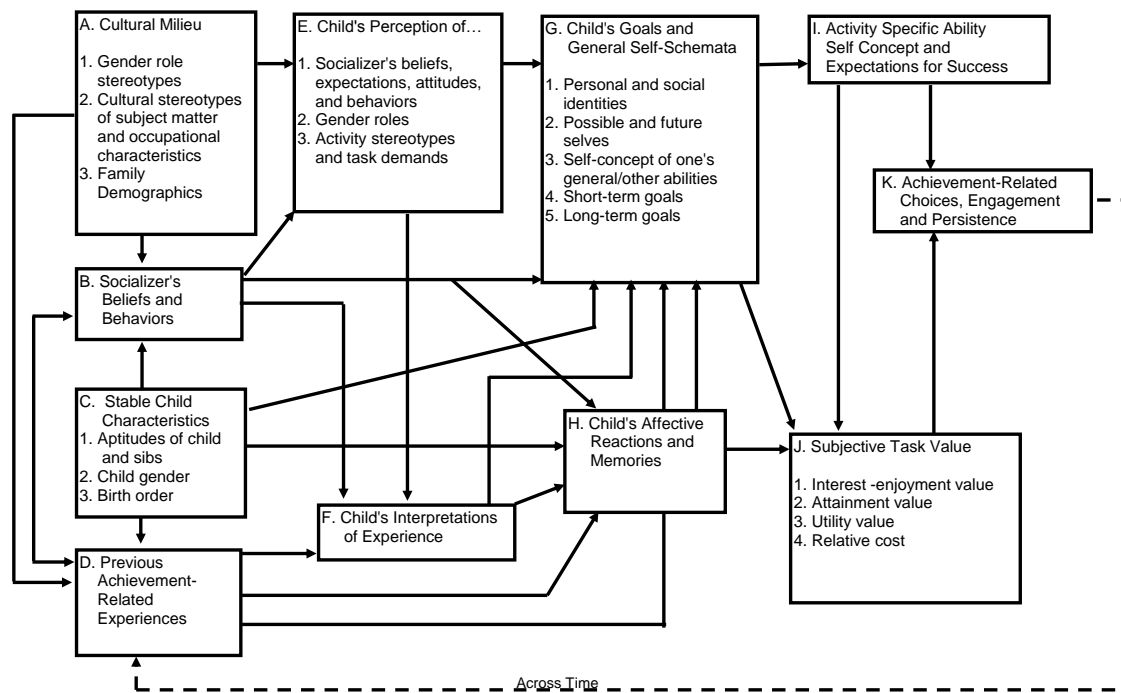


Figure 1.2.1. Eccles et al. expectancy-value theory of achievement-related choices (from Simpkins, Fredricks, & Eccles, 2015)

The parent socialization model is embedded within the expectancy-value model of achievement-related choices by Eccles and colleagues (1983). The expectancy-value model specifies the most important influences on students' academic outcomes and combines psychological and social influences on students' academic outcomes. The

model is based on Atkinson's (1964) expectancy-value theory, which focuses on expectancy beliefs to master a task and students' values administered to a task as the most influential factors of task performance. The most recent version of the model of achievement-related choices can be found in Figure 1.2.1 (Eccles & Wigfield, 2002; Wigfield, Tonks, & Klauda, 2009).

On the left side of the model, the most distal components influencing students' achievement-related choices and behaviors are shown. Structural family characteristics are displayed in box A labeled cultural milieu on the left side of the model. Process-related family characteristics are shown in box B labeled socializers' beliefs and behaviors. Together with stable characteristics of the student and students' previous achievement-related experiences, structural and process-related family characteristics are assumed to influence students' perceptions of their socializers and students' interpretations of achievement-related experiences. Moving towards the psychological components of the model, these perceptions and interpretations in turn influence students' goals and self-schemata as well as students' affective reactions and memories of achievement-related experiences. Finally, students' goals, reactions, and memories influence students' expectancy and value beliefs, which are the most proximal influences of students' achievement-related choices and behaviors. In the end, a feedback loop from students' achievement-related choices and behaviors to students' previous experiences describes the reciprocal processes over time.

By distinguishing between these different psychological processes, the model is also suited for explaining the development of stereotypic gender beliefs and gender differences in students' motivational beliefs and achievement-related behaviors (Eccles et al., 1983; Eccles & Wigfield, 2002). Yet, this model mainly focuses on the psychological processes within a student through which students' expectancy and value beliefs are influenced (e.g., Simpkins et al., 2015).

To examine and conceptualize the influence of process-related family characteristics on students' motivation and behavior, Jacobs and Eccles (2000) further elaborated the socialization component of the expectancy-value model in the parent socialization model (see also Eccles, 2007; Simpkins et al., 2015). More specifically, the parent socialization model further differentiates socializers' beliefs and behaviors (see box B in Figure 1.2.1.) and elaborates on the psychological processes between process-

related family characteristics. The most recent version of the parent socialization model can be found in Figure 1.2.2.

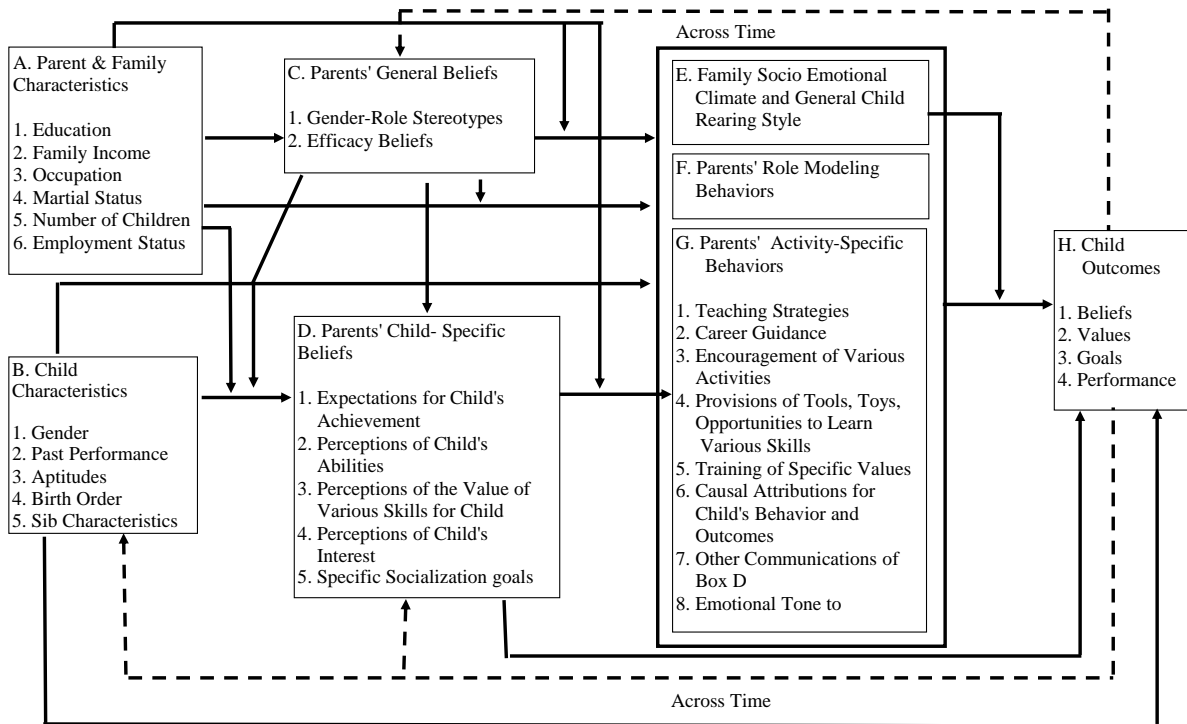


Figure 1.2.2. Eccles et al. parent socialization model (from Simpkins, Fredricks, & Eccles, 2015)

In line with EVT, structural family characteristics including parents' income, education, and occupation can be found on the left side of the model (see box A in Figure 1.2.2.). In contrast to the general expectancy-value model, the parent socialization model further differentiates process-related family characteristics. Parents' beliefs are differentiated into parents' general beliefs, such as parents' general and specific values, as well as parents' child specific beliefs, which include parents' expectations for their child's achievement and perceptions of their child's abilities. Parents' general and child-specific beliefs in turn influence parents' behaviors, which are differentiated into the family socio-emotional climate, parents' role modeling behavior, and parents' activity-specific behaviors. Finally, the family climate and behaviors predict students' academic outcomes. Thus, students' academic outcomes (see box H in Figure 1.2.2.) are defined in the general expectancy-value model. In the end, a feedback loop from students' academic outcomes to parents' general and child-specific beliefs and students' past performance describes the reciprocal processes accruing over time. As can be seen in Figure 1.2.2, several mediations and moderations between the different family characteristics are

proposed (Eccles, 1993). Thus, family background, according to the parent-socialization model, is conceptualized as a multifaceted process model in which different family characteristics interact and thus shape the social environment children grow up in. However, as can be seen from the studies on family influences described in the following sections, most studies only focused on one specific family characteristic (e.g., parents' child-specific beliefs), and studies investigating the dynamic processes between multiple family characteristics are mainly missing (Eccles, 2007; Simpkins et al., 2015).

By specifying a broad spectrum of relevant process-related family characteristics and their influences on students' academic outcomes, the parent socialization model includes different important processes and incorporates different lines of research on family influences on students' academic outcomes. Moreover, as will be seen in the following sections, the parent socialization model received convincing empirical support (e.g., Simpkins et al., 2012, 2015). Thereby, the parent socialization model is the most comprehensive and empirically supported model on family influences on students' academic motivation. In the following, research investigating these process-related family characteristics will be discussed and related constructs and theories will be explained.

1.2.1. Parents' general and child-specific beliefs

In the parent socialization model, parents' beliefs are differentiated into general (see box C in Figure 1.2.2.) and child-specific beliefs (see box D in Figure 1.2.2.). Both are assumed to mediate the processes through which structural family characteristics influence parents' behavior, which in turn influence students' motivational beliefs. However, some studies suggest that parents' general and child-specific beliefs influence students' motivational outcomes alongside with structural family characteristics (Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001).

Parents' general beliefs

In contrast to parents' child-specific beliefs, parents' general beliefs do not specifically relate to their child, but reflect parents' beliefs in general. Parents' general beliefs relate to parents' stereotypic beliefs, parents' own values, and ability beliefs (Eccles, 2007). However, because the present dissertation does not focus on gender differences and research recently started to highlight the importance of parents'

motivational beliefs for students' academic outcomes (Eccles, 2007; Harackiewicz et al., 2012; Lazarides et al., 2015), this section is going to focus on parents' motivational beliefs.

Parents' own motivational beliefs include parents' own value and expectancy beliefs (Eccles, 2007; Jacobs & Eccles, 2000; Simpkins et al., 2015). Expectancy beliefs describe the expectancy of doing well on an upcoming task and are influenced by ability beliefs (Eccles & Wigfield, 2002). Ability beliefs, such as the individual self-concept, describe an individual's evaluation of their competence in a domain (Marsh, 1993). Although some researchers were able to empirically differentiate between ability and expectancy beliefs (Bong & Clark, 1999; Bong & Skaalvik, 2003), it has been shown difficult to differentiate between them in real-world achievement situations (Eccles, Midgley, et al., 1993; Eccles & Wigfield, 1995; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006). Therefore, the present dissertation utilizes ability beliefs, such as self-concepts, as an indicator for expectancy beliefs.

Value beliefs describe the importance or value an individual experiences with different tasks or objects (Eccles, 2005) and can be differentiated into four components: *utility value* refers to the perceived individual usefulness of a task in the short- or long-term future. Students' *intrinsic value* describes the enjoyment of doing a task and *attainment value* is defined as the personal importance of mastering a task. Finally, *cost* is conceptualized as the negative consequences of engaging in a task (Eccles, 2005; Wigfield & Eccles, 1992).

Although the parent-socialization model suggests that parents' value beliefs predict students' own value beliefs, this question has only recently been addressed empirically (e.g., Simpkins et al., 2015). According to the parent-socialization model, parents act as role models and thus pass on their own value beliefs to their children (Bandura & Walters, 1963; Jacobs & Eccles, 2000). The importance of parents' own value beliefs for the development of students' academic motivation has started to receive empirical support (for an overview, see Lazarides et al., 2015): If parents value a subject themselves, the chances are higher that the child also values the subject (Dabney, Chakraverty, & Tai, 2013; Frenzel et al., 2010; Gniewosz & Noack, 2012; Jodl et al., 2001). Moreover, Dotterer and colleagues (2009) demonstrated that mothers' academic interest seems to buffer the decline of students' academic interest linked to the transition to junior high school. Similarly, Jodl and colleagues (2001) found direct and indirect

effects (though students' value beliefs) of parent value beliefs on students' occupational aspirations.

According to the parent socialization model, parents' own ability beliefs are supposed to influence the development of students' motivational beliefs as well. Yet, research investigating the associations between parents' own ability beliefs and students' ability beliefs is scarce. However, research suggests that parents' own motivational beliefs predict their behavior: Hyde, Else-Quest, Alibali, Knuth, and Romberg (2006) found that mothers with high ability beliefs in math were more able to adequately help their child solving a math problem. Moreover, Green, Walker, Hoover-Dempsey, and Sandler (2007) found that parents' with high ability beliefs were more likely to get involved into their children's academic lives (see also Grolnick, Benjet, Kurowski, & Apostoleris, 1997; Simpkins et al., 2012). Yet, there are even more processes through which parents' ability beliefs can influence students' self-concept: if parents hold high ability beliefs, it is more likely that they perceive a specific task as easy, which influences children's expectancy to succeed in the task (Eccles, 1993).

Although there is convincing evidence for the importance of parents' motivational beliefs for students' motivational outcome, several issues remain to be investigated: First, there are inconsistencies in the operationalization of motivational family characteristics. Most studies investigating the importance of families' motivational characteristics mainly assessed parents' general value beliefs without differentiating between value components (e.g., Davis-Kean, 2005; Frenzel et al., 2010; Jodl et al., 2001; Simpkins et al., 2012, 2015). Some studies measured one specific indicator of parents' value beliefs (e.g., Harackiewicz et al., 2012). Therefore, it is an open question on which of these motivational family characteristics are specifically relevant. Second, most studies did not include both parents' value and ability beliefs when investigating associations with students' motivational beliefs. However, this would yield valuable insights into which motivational family characteristics are most important for the development of students' value and ability beliefs. By distinguishing between different value and ability beliefs, the parent socialization model is a valuable framework to investigate this question. Third, in the parent socialization model it is assumed that student and parent motivation are reciprocally related (Eccles, 2007). However, most studies solely focused on pathways from the parent to the child (Davis-Kean, 2005; Frenzel et al., 2010; Jodl et al., 2001; Simpkins et al., 2012). In addition, only few studies used longitudinal data and included

both indicators of student and parent motivation at the same time points. One exception is the investigation of bidirectional relations between student and parent motivation during elementary and early middle school by Simpkins et al. (2015). Yet, in this time period, parents mainly influenced children rather than vice versa.

Parents' child-specific beliefs

Parents' child specific beliefs include parents' perceptions of their child's abilities and expectations of child's achievement (Eccles, 2007). Parents influence their children's development of ability as they act as interpreters of experiences and reality through their own perceptions of the child's abilities (Frome & Eccles, 1998; Jacobs & Eccles, 2000; Simpkins et al., 2015). Constructs related to parents' perceptions of their child's abilities are parents' aspirations or expectations for their children's academic achievements which can be defined as "parents maintain[ing] high expectations of the student's ability to achieve at high levels." (Jeynes, 2007; p. 89). However, the conceptualization of parents' aspirations or expectations varies. Other researchers define parents' expectations as the "maximum level of studies parents expect for their children." (Castro et al., 2015; p. 37). Several meta-analyses investigating family influences on students' academic outcomes found that parents' aspirations or expectations show strong relationships with students' academic achievement (Castro et al., 2015; Fan & Chen, 2001; Jeynes, 2007). As a next step, researchers started to investigate variables explaining this relationship and found that students' academic motivation partially mediated the effects of parents' perceptions of children's abilities on students' academic achievement (e.g., Davis-Kean, 2005; Neuenschwander, Vida, Garrett, & Eccles, 2007). Parents' perceptions of children's abilities seem to be especially important for the development of students' ability beliefs: Parents' perceptions of students' abilities related to students' self-concept (Jacobs & Eccles, 1992) and even predicted changes in students' self-concepts over time (Simpkins et al., 2015). When parents perceived their child as having high abilities, slower declines in students' self-concept throughout grades 1 to 12 were found (Fredricks & Eccles, 2002). Moreover, Frome and Eccles (1998) demonstrated, that parents' perceptions partially mediated the association between students' grades and their self-concept and even concluded that mothers' perceptions of child's abilities are more important for students' self-concept than grades.

To conclude, there is convincing empirical support that parents' positive beliefs in children's abilities are important predictors of students' own ability beliefs and achievement (Alexander, Entwisle, Blyth, & McAdoo, 1988; Frome & Eccles, 1998; Neuenschwander et al., 2007). Yet, the conceptualization of parents' perceptions of their child's ability varies from study to study. Regarding bidirectional relations between parents' perception of child ability and students' academic outcomes, Simpkins and colleagues (2015) found that parents' perceptions of their children's ability were predicted by students' achievement. In contrast, students' motivational beliefs did not influence parents' motivational beliefs. Thus, evidence suggests that the direction of influence from elementary school to high school mainly flows from parents to students.

1.2.2. Parents' behavior, child rearing, and the family climate

Next to parents' general and child-specific beliefs, parents' behavior, child rearing style and the socio-emotional family climate are assumed to influence students' motivational outcomes. These constructs are subsumed under a common box, as these family characteristics are assumed to interact and together shape everyday family life and thus influence parent-child interactions most directly. Relating these constructs to Coleman's (1988) conceptualization of social capital, several researchers suggested parent behavior and the general climate within the family as indicators of family's social capital (Dika & Singh, 2002; Yan & Lin, 2005).

Family socio-emotional climate and general child rearing style

There are several constructs that describe and influence the socio-emotional family climate as well as the general child rearing style. Research investigating the socio-emotional family climate mostly focused on constructs such as parental warmth. Warmth describes parents' affection, sensitivity, acceptance, and involvement, and thereby also shapes the parent-child relationship (Bornstein, 2015). Warmth has often been related to successful parental socialization (Jacobs & Eccles, 2000). Moreover, positive associations between students' feeling of connectedness to their parents and students' successful psychological and behavioral development have been found (Eccles, Early, Fraser, Belansky, & McCarthy, 1997). Evidence from a twin study even suggests that parental warmth influences the development of cognitive skills and competencies (Petrill & Deater-Deckard, 2004). A construct related to parental warmth is the parent-child

relationship: the higher parental warmth, the better the parent-child relationship (Bornstein, 2015). Although only few studies exist that relate the parent-child relationship to students' academic outcomes, it seems as if a positive relationship is associated with positive academic outcomes (Learner & Kruger, 1997; Yan & Lin, 2005).

Regarding the general child rearing style, researchers investigated the associations between different parenting styles, such as authoritarian and authoritative parenting (e.g., Baumrind, 1971; Steinberg, Lamborn, Dornbusch, & Darling, 1992), and students' academic outcomes. According to Baumrind's (1991, 2013) conceptualization of parenting styles, two dimensions of parent behavior, namely responsiveness (or warmth) and demandingness (or control; Maccoby & Martin, 1983), can be found when investigating parenting. Thus, four parenting styles can be defined as different combinations of these two dimensions: authoritative, authoritarian, permissive, and rejecting-neglecting. *Authoritative* parents are characterized by both highly demanding (high on control) and highly responsive (high on warmth) parenting. They monitor and supervise their children and confront their child about disobediences, but at the same time, foster children's individuality, autonomy, self-regulation, and are affectionate and supportive. In contrast, *authoritarian* parents are described by high demandingness, but low responsiveness: they are restrictive, give no explanation of rules, and are obedience and are status-oriented, but not responsive. On the other hand, *permissive* parents show nondirective but responsive parenting behavior. They avoid confrontation and allow high levels of self-regulation. *Rejecting-neglecting* parents hold low levels of control and warmth: They do not structure or monitor and are not supportive. Considering the associations of parenting styles with students' academic outcomes, the advantages of authoritative parenting have been empirically supported: their children show higher levels of academic motivation, self-control, self-confidence, and higher achievement (Jeynes, 2007; Steinberg, 2001).

To conclude, a positive family climate and a child-adaptive child rearing style involves the appropriate levels of challenge and autonomy combined with affectionate parental support (Baumrind, 1971). Consequently, Wang and Eccles (2012) found positive effects of parental social support on students' valuing of learning and other important indicators of school engagement in a longitudinal study—over and above peer and teacher support. In addition, since children's developmental needs and competencies

change, parents need to be able to continuously adjust their own behavior (Eccles & Midgley, 1989).

Parents' role modeling and activity-specific behavior

Historically, several lines of research investigated parent behavior as a primary influencing factor of students' academic outcomes. In the parent socialization model, different types of parent behavior, such as role modeling, encouragement, provision of activities, and parent-child coactivity, are distinguished. In line with the theoretical assumptions, Gottfried, Marcoulides, Gottfried, and Oliver (2009) found that parental behaviors (e.g., encouragement) were positively associated with the level of children's intrinsic value and predicted a smaller decline in students' intrinsic value from age 9 to 17. Theoretically, it is assumed that parents' behavior is predicted by and reciprocally related to parents' beliefs over time (Simpkins et al., 2015). In one of the first studies investigating these processes proposed in the parent socialization model, Simpkins and her colleagues (2012) found that mothers' motivational beliefs (importance, efficacy, and perception of child ability) predicted mothers' behavior (modeling, encourage, provision, event coactivity, and daily coactivity) one year later and were associated with students' motivational beliefs in sports, music, and math. Students' subject-specific value beliefs and ability beliefs, in turn, predicted students' time spent on reading, math, sport, music, and math courses taken four years later. Using cross-lagged models, the same processes were found over a 12-year period (Simpkins et al., 2015): parental beliefs and behaviors predicted students' motivational beliefs, which resulted in students' academic behavior. Although some researchers argue that the association between parents' beliefs and student outcomes are mediated by parent behavior, Jodl and colleagues (2001) found direct effects of parents' value beliefs on students' value beliefs, which were not mediated by parent behavior.

Another line of research predominantly investigated parental involvement, which can be differentiated into school-based and home-based parental involvement (Hoover-Dempsey & Sandler, 1997). Parental involvement is defined as the "dedication of resources by the parent to the child within a given domain" (Grolnick & Slowiaczek, 1994, p. 238). Regarding educational research, two different lines of research on parental involvement can be found: Whereas some researchers focused on the amount and frequency (i.e., the quantity) of parental involvement (e.g., Castro et al., 2015; Hill &

Tyson, 2009), other researchers highlight the importance of the quality of parental involvement (e.g., Grolnick, Deci, & Ryan, 1997; Grolnick et al., 2009), especially when assessing home-based parental involvement. Regarding the quantity of parental involvement, results of four meta-analyses suggest evidence of positive associations between general parental involvement and students' academic outcomes (Castro et al., 2015; Fan & Chen, 2001; Hill & Tyson, 2009; Jeynes, 2007). However, upon closer examination, the picture gets more complex: Hill and Tyson (2009) found only a very small positive association between parents' general involvement and middle school students' academic outcomes ($r = .04$). In contrast, studies which assessed parental involvement as the extent of specific types of parental involvement, such as communication, homework-help, activities at home, rules, and supervision (e.g., Fan & Chen, 2001; Hill & Tyson, 2009), found small or even negative associations with students' academic outcomes ($r = -.11$, Hill & Tyson, 2009). Thus, some researchers came to the conclusion that "the overall effect of parent involvement in homework was small and often not significant" (Patall, Cooper, & Robinson, 2008, p. 1087). Moreover, when distinguishing between different types of parental involvement (i.e., communication, homework involvement, etc.) mostly no significant associations were found when controlling for student characteristics such as gender (Jeynes, 2007).

Regarding the quality of parental involvement, a particular focus is set on parents' support of children's needs. According to self-determination theory (SDT; Deci & Ryan, 1985; Grolnick, Deci, et al., 1997), humans hold three basic psychological needs that need to be fulfilled to experience intrinsic motivation: the need for *autonomy*, which describes perceiving oneself as the agent of an action and the experience of choice; the need for *competence*, which refers to the satisfaction when mastering a task; and the need for *relatedness*, meaning the relatedness to others and the experience of warmth and security. Researchers within SDT argue that the satisfaction of these needs can be promoted or undermined by the social context and children's socializers (Grolnick, 2009; Grolnick, Deci, et al., 1997): Parents can support their children's sense of autonomy by providing autonomy support (e.g., providing choice, minimizing control). Similarly, by structuring the learning environment, parents can foster students' sense of competence (e.g., communicating expectancies, rationale, and informational feedback). Finally, students' sense of relatedness can be increased by parents' interpersonal involvement (e.g., showing interest in child's activities, providing warmth). On the other hand, if parents get

too involved into their children's academic lives, students' might feel controlled and therefore not autonomous, thereby undermining students' intrinsic motivation (Grolnick, 2003; Pomerantz, Grolnick, & Price, 2005; Pomerantz, Moorman, & Litwack, 2007). Correspondingly, Grolnick, Ryan, and Deci (1991) found associations between perceived autonomy support and involvement and students' competence beliefs and autonomy, which in turn predicted students' performance. Similarly, autonomy support and providing structure is positively associated with students' perception of competence, motivation, engagement, and achievement (Grolnick et al., 2014). In contrast, perceived control, which can be seen as the opposite of autonomy support (Grolnick & Pomerantz, 2009), is negatively associated with achievement (Karbach, Gottschling, Spengler, Hegewald, & Spinath, 2013).

Additionally, there are numerous studies applying the self-determination theory to parental involvement in children's homework. These studies indicate that homework involvement in line with students' basic needs is positively associated with students' motivation and achievement (e.g., Grolnick et al., 1991; Katz, Kaplan, & Buzukashvily, 2011; Pomerantz et al., 2005). Similarly, Dumont and colleagues (2014) analyzed reciprocal effects of parental involvement and students' academic outcomes longitudinally. They found that the lower students' academic functioning, the more controlling parental involvement was observed two years later. On the other hand, students' high academic functioning predicted more parental responsiveness and structure two years later. When investigating precursors of parents' need supportive homework involvement, Katz and colleagues (2011) found that parents' motivation, perceived ability, and attitudes predicted parents need supportive behavior, which in turn was associated with students' autonomous motivation.

From a theoretical perspective, parents' need supportive behavior shows overlaps with authoritative parenting (Baumrind, 1991): these parents monitor their children and set clear standards, which is described by structure in SDT. Moreover, they do not intrude, foster individuality and are described as autonomy supportive (Baumrind, 2013). Also, these parents are supportive and affectionate and acquiescent to their child's needs and demands (Baumrind, 1991), which should theoretically foster students' need for relatedness.

Although Eccles included work on parents' need supportive behavior in the parent-socialization model, some differences need to be acknowledged. In contrast to the

basic assumptions of SDT, Jacobs and Eccles (2000) argued that the fulfillment of children's basic needs might not be enough to foster motivation: Although parents' need supportive behavior is seen as necessary and critical for the development of students' long term engagement, it is not seen as sufficient for students to actually value a task.

Parents' Time and Energy

Eccles (2007) argued that students' academic outcomes can be influenced by SES through parents' resources, such as parents' time and energy. Thereby, Eccles included research on parental involvement, suggesting that parents' perceived time and energy to get involved in their children's academic lives shape the quality of parent-child interactions (Hoover-Dempsey & Sandler, 1997; Jackson, Brooks-Gunn, Huang, & Glassman, 2000). Similarly, Grolnick, Benjet, et al. (1997) postulated among others family stress and resources as factors shaping the quality of parental involvement. By reducing the time parents' have to get involved into their children's lives, less activities fostering students' motivational beliefs take place. At the same time, parents with lower SES face more external stressors than their counterparts and thus perceive to have less time and energy to get involved into their children's lives. Thereby, children from families with lower SES are also exposed to more external stressors and show less positive motivational beliefs (e.g., McLoyd, 1998).

Although parents' perceived time and energy is a process-related, psychological variable, Eccles (2007) did not specify it explicitly in a box of her model. Therefore, the present dissertation extends the parent-socialization model by including a separate box with parents' time and energy. Relying on previous research described above, parents' time and energy is assumed to be associated with parents' behavior and thus contributes to the general socioemotional climate within the family.

1.2.3. Conclusion

The parent socialization model, thus, is a useful model to investigate family influences on students' academic outcomes as it distinguishes between different structural and process-related family characteristics. Moreover, there is convincing empirical support for the importance of the different assumed process-related family characteristics for students' academic outcomes. As related lines of research can be incorporated into the factors that are considered in this model, the model provides a systematic theoretical

framework to examine multiple family influences. Despite the convincing accomplishments from previous studies examining family influences, there are still some unanswered questions. First, only few studies included both structural and process-related family characteristics at the same time (Eccles, 2007), therefore the relative importance of structural and process-related family characteristics is mostly unexplored. However, evidence from correlational research suggest that process-related family characteristics, such as parents' motivational beliefs, might even be more important for students' academic outcomes than structural family characteristics (Cheadle, 2008; Dumont et al., 2012).

Second, most studies focused on one specific process-related family characteristic, such as parents' child-specific beliefs (see also Eccles, 2007; Simpkins et al., 2015 for a similar discussion) and only few studies tried to capture the multidimensionality of family influences. In addition, the operationalization of constructs such as parents' child-specific beliefs and parental behavior differs from study to study, exacerbating comparisons across studies.

Third, it is not only one family characteristic that influences students' development, but the combination and interplay of different family characteristics. Similarly to Baumrind's (1971) conceptualization of different parenting styles depending on two dimensions of parental behavior (warmth and control), it is possible that specific combinations of process-related family characteristics exist that are differentially associated with student outcomes. Thus, several researchers have argued for a more holistic and integrated approach to capture students' family influences (Eccles, 2007; Lazarides et al., 2015; Simpkins et al., 2015).

Last, most studies investigating interrelations between parent and student motivational beliefs used cross-sectional data (e.g., Davis-Kean, 2005; Jodl et al., 2001) or did not include both parents' and students' motivational beliefs at the same time points (e.g., Fredricks & Eccles, 2002; Frome & Eccles, 1998; Simpkins et al., 2012). Therefore, only few studies adequately investigated the bidirectional interrelations between parents' and students' motivational beliefs—those who did focused on interrelations during middle or high school (Simpkins et al., 2012, 2015). Investigating interrelations between parents' and students' motivational beliefs and their influences on students' career aspirations in older age groups might yield new insights into the development of students' career paths (Simpkins et al., 2015).

1.3. Focusing on a Multidimensional Approach to Student Outcomes

When investigating associations between process-related family characteristics and students' academic outcomes, it is necessary to define a systematic conceptualization of student motivation and achievement-related behavior. Studies exploring the associations of family characteristics with students' academic outcomes have focused on different indicators of student motivation or achievement. Researchers have most frequently measured either students' general achievement (e.g., GPA) or subject-specific achievement (e.g., math grades or reading achievement test scores) as an indicator of academic outcomes (Davis-Kean, 2005; Hill & Tyson, 2009; Sirin, 2005). Studies solely focusing on students' achievement did not consider students' motivational beliefs as important student outcomes. However, students' motivational beliefs (i.e., value and ability beliefs) predict their academic outcomes, such as effort, achievement, and academic choices (Durik, Vida, & Eccles, 2006; Meece, Wigfield, & Eccles, 1990; Nagengast, Trautwein, Kelava, & Lüdtke, 2013; Simpkins, Davis-Kean, & Eccles, 2006). Moreover, students' motivational beliefs predict academic achievement over and above students' previous achievement (e.g., Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005).

Some researchers have investigated the associations between family characteristics and students' motivation, but they have used different indicators of student motivation across studies. Some used a general indicator of students' motivation, not distinguishing further between different motivational constructs (e.g., Katz et al., 2011). Others have focused on only one motivational variable, such as students' self-concept (e.g., Frome & Eccles, 1998; Grolnick, 2015; Neuenschwander et al., 2007), value beliefs (e.g., Gniewosz & Noack, 2012; Gottfried et al., 2009; Harackiewicz et al., 2012), or interest in a subject (e.g., Dabney et al., 2013; Frenzel et al., 2010). By using different indicators of student motivation across studies, this work cannot explore whether the associations between family characteristics and students' motivation differ depending on the indicator of student motivation looked at. In addition, it has been argued that family characteristics do not only shape the development of students' motivational beliefs, but are also a major influence on students' career choices (Trusty, 1996). Correspondingly, studies have found associations between process-related family characteristics and

students' achievement related-choices (e.g., their course-taking; Hill & Wang, 2015; Rozek, Hyde, Svoboda, Hulleman, & Harackiewicz, 2015), engagement and persistence (e.g., Ing, 2014; Wang & Eccles, 2012; Wang & Sheikh-Khalil, 2014), and career aspirations (e.g., Hill & Wang, 2015; Jodl et al., 2001).

To conclude, studies on family influences have focused on multiple student outcomes. As these studies either did not measure student motivation at all or did not measure multiple indicators of student motivation simultaneously, this leads to results that are difficult to compare. Therefore, it would be fruitful to systematically assess several indicators of students' academic outcomes simultaneously. For this purpose, it is necessary to systematically conceptualize student motivation and to acknowledge how different motivational constructs are related to each other.

1.3.1. Defining students' academic outcomes

Regarding student motivation, Eccles' EVT (1983) is one of the most prominent theories on student motivation in educational research. EVT integrates research on both, beliefs about the expectancy of mastering a task, and beliefs about the value of engaging in it (Pintrich, Marx, & Boyle, 1993). According to EVT, student motivation can be understood as students' value beliefs for a task or subject, referring to the question 'Why should I do this task?', and students' expectancy beliefs of mastering a task or doing well in a subject, relating to the question 'Can I do this task?'. Value and expectancy beliefs are both considered to be task-specific or subject-specific (Eccles et al., 1983). As described earlier, value beliefs can be differentiated into four value components (Eccles et al., 1983): attainment, utility, and intrinsic value, and cost. Although these value components are highly correlated, they are empirically distinguishable when using adequate measurement scales (Conley, 2012; Trautwein et al., 2012).

By differentiating between the four value components, it is possible to relate value beliefs to other important motivational constructs. As described above, some studies investigated associations between family characteristics and students' interest. According to the four phase model of interest development (Hidi & Renninger, 2006), two types of interest can be distinguished: situational interest, which relates to interest arising out of task characteristics, and personal interest, which is well-developed and can be seen as more stable and trait-like (Eccles, Fredricks, & Epstein, 2015; Hidi & Renninger, 2006). Relating these constructs to EVT, situational interest is related to intrinsic value as both

are situation-specific. Personal interest, on the other hand, is broader than intrinsic value, as the interest becomes part of the identity (Eccles, 2009; Eccles et al., 2015), thereby also involving components of attainment value. Thus, interest can be seen as a broader construct including feeling-related and value-related valences (Schiefele, 2009) with intrinsic value as a situational component (Hidi & Renninger, 2006; Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Lazarides et al., 2015). Moreover, task value can trigger interest: If students value a course topic, they are likely to develop more interest, perform better, and take more courses in that topic (Durik & Harackiewicz, 2007; Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000; Hulleman et al., 2008; Wigfield, 1994).

How do students' value and ability beliefs relate to other academic outcomes, such as course-taking and career choices? Whereas students' value beliefs are closely related to their academic choices such as course-taking and career aspirations (e.g., Bong, 2001; Meece et al., 1990; Nagy, Trautwein, Baumert, Köller, & Garrett, 2006; Updegraff, Eccles, Barber, & O'Brien, 1996), students' expectancy beliefs are amongst the strongest psychological predictors of their achievement (e.g., Marsh et al., 2005; Meece et al., 1990; Trautwein et al., 2012; Wigfield & Cambria, 2010). Similarly to students' value beliefs, interest predicts students' course-taking and eventual choice of academic major (Harackiewicz, Barron, Tauer, & Elliot, 2002). Additionally, students' value and expectancy beliefs predict students' engagement, which can be operationalized as the amount of effort students put into a task or subject. Student engagement thereby is a key marker of the quality of their achievement-related behavior (Skinner, Kindermann, & Furrer, 2008). Students' engagement is characterized by being actively committed and involved in a task (e.g., Fredricks, Blumenfeld, & Paris, 2004) and is related to achievement, dropout rates, and psychological well-being (e.g., Cole, Bergin, & Whittaker, 2008; Fredricks et al., 2004; Trautwein, Lüdtke, Roberts, Schnyder, & Niggli, 2009).

1.3.2. The role of parents in the development of student motivation

Students' value and expectancy beliefs develop early on, and students are able to distinguish between expectancy and value beliefs within one subject, and compare these beliefs across different subjects, from elementary school on (Eccles, Wigfield, Harold, & Blumenfeld, 1993). Concerning different value components, it seems as if younger

students base their value for a subject mainly on enjoyment (i.e., intrinsic value; Wigfield & Eccles, 1992). Over time, value beliefs get more differentiated so that the four value components can be differentiated from fifth grade on (Eccles & Wigfield, 1995; Wigfield et al., 2009).

Students' value and ability beliefs emerge from early interactions with different tasks or topics over time. Simpkins and colleagues (2006) examined the development of students' motivational beliefs and found that participation in math and science activities during elementary school was related to students' subsequent ability and value beliefs in these subjects. Similarly, Wang (2012) found that students' math experiences in 7th grade predicted their value and ability beliefs, which in turn predicted their course-taking and career aspirations, in high school. Parents are the most important initializers of children's activities, because they have control over the experiences of their children and how they spend their time, particularly in the early developmental years. For example, they engage in behaviors such as buying books that support children's skill development (Eccles, 1993). Thus, parents' influence on students' motivational beliefs seem to be particularly strong during elementary school, especially since children's formation of value and ability beliefs are developing during this period (e.g., Eccles & Midgley, 1989). As children grow older, they have a higher need for autonomy and start to self-regulate their leisure time and select their own activities (Eccles & Midgley, 1989). In addition, the amount and influence of parental involvement decreases throughout adolescence (Singh et al., 1995), and the influence of peers increases (Ryan, 2001; Simmons & Blyth, 1987). Thus, some researchers argued that family influences might decrease when children grow older (Eisenberg, Wolchik, Goldberg, & Engel, 1992). Correspondingly, Crosnoe and Huston (2007) found a general decline of students' parental consultation from middle school to the end of high school. However, other findings suggest that parents' motivational beliefs still play a role in students' motivation through high school (Rozek et al., 2015; Simpkins et al., 2015). Therefore, how parents' motivational beliefs are associated with students' motivation in college is still an open question.

1.4. Decreasing Motivational Gaps Between Students from Families with More and Less Motivational Resources

Given the substantive motivation and achievement gaps between students from families with more and less advantageous motivational characteristics, the questions emerges whether interventions can be a tool to close these gaps. Yet, educational interventions have often found to even increase gaps between students from more and less advantageous family backgrounds (Ceci & Papierno, 2005). This effect, in which students with better initial conditions profit most, is called the Matthew effect (Walberg & Tsai, 1983). One approach to prevent such Matthew effects would be to design interventions specifically targeting students from families with less advantageous motivational characteristics. However, this would require to identify students from families with low motivational resources first, which is time consuming and difficult. Classroom based interventions that are administered to all students but specifically foster motivation for students from families with less advantageous motivational characteristics would be easier to apply.

So far, there are no studies that investigated the effectiveness of interventions to close motivational gaps between students from families with different motivational characteristics. Yet, there are several different types of motivational interventions that were able to foster students' motivation particularly for student from less advantageous family backgrounds, such as minority students, without creating Matthew effects (Cohen, Garcia, Apfel, & Master, 2006; Harackiewicz et al., 2013; Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, in press; Miyake et al., 2010). These interventions are based on different theoretical backgrounds such as social belonging (Walton & Cohen, 2011), self-affirmation (Cohen et al., 2006), and EVT (Harackiewicz et al., in press). Interventions targeting students' sense of belonging and fostering students' self-affirmation try to decrease students' reactions to stereotype threat (Cohen & Garcia, 2008; Yeager & Walton, 2011). Stereotype threat (Steele, Spencer, & Aronson, 2002) describes the psychological phenomenon that emerges when students belong to a social group associated with negative stereotypes concerning an upcoming task. When students are reminded of this group membership, they experience more stress, distraction, and anxiety during the task. This leads to lower performance during the task and thereby confirms the negative stereotype.

Whereas social belonging and self-affirmation interventions are particularly useful when targeting students from minority groups (e.g., women, minority, and first-generation students), it is doubtful that these interventions would also be helpful to decrease gaps between students from families with more and less favorable motivational characteristics. There is no empirical evidence that students from families with less motivational resources (i.e., lower parental motivational beliefs) should experience stereotype threat in performance situations due to their family background. Moreover, students from families with lower motivational resources show lower academic motivation themselves (Lazarides et al., 2015). Thus, stereotype threat is unlikely to account for their decreased motivation.

In contrast to interventions fostering students' self-affirmation and social-belonging, interventions based on EVT address students' subject-specific value beliefs (Durik, Shechter, Noh, Rozek, & Harackiewicz, 2014; Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009), and therefore, might be especially helpful for students from families with low motivational resources. Thus, the general mechanisms of interventions based on EVT will be explained in the following. Subsequently, results of these interventions related to family background will be elaborated and the potential of these interventions to decrease motivational gaps between students from families with less and more motivational resources will be discussed.

1.4.1. Previous value intervention studies

Researchers started to develop EVT based value interventions because students' value beliefs predict students' academic effort, achievement, and choices (e.g., Nagengast et al., 2013; Simpkins et al., 2006; for a review, see Wigfield et al., 2009) and previous research has shown a decrease of students' value beliefs during secondary school (Jacobs et al., 2002; Watt, 2004). These interventions specifically target students' value beliefs (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009) as it has been argued that ability beliefs are harder to influence by external interventions (Harackiewicz, Tibbetts, Canning, & Hyde, 2014). More specifically, these interventions target students' utility value beliefs, which are more extrinsic in nature than the other value components (Eccles & Wigfield, 2002). Utility value beliefs can be seen as extrinsically regulated (Simons, Vansteenkiste, Lens, & Lacante, 2004), since they extend beyond the task itself and connect it to personal goals (Wigfield & Eccles, 1992). Thus, influencing utility value

beliefs from the outside and getting students to value the relevance of a task or subject for their own lives seems easier than triggering students to intrinsically enjoy or identify with a task (Harackiewicz et al., 2014). Within the literature, there has been a controversy about promoting extrinsic motivation (Harackiewicz & Sansone, 1991; Lepper, Greene, & Nisbett, 1973). It has been shown that if a person engages in a task as a means for achieving extrinsic goals, intrinsic motivation can be harmed (Lepper et al., 1973). Similarly, Self-determination theory suggested that extrinsic motivation is the opposite of intrinsic motivation (Deci & Ryan, 1985). However, when promoting students' utility value beliefs, students connect the task to a personal goal. Thus, utility value information can connect a former unrelated task to an intrinsically regulated personal goal, thereby fostering interest (Harackiewicz et al., 2014).

Value interventions targeting students' utility beliefs have become a quite promising tool to promote students' motivation to learn and have been found to be effective in the laboratory as well as in the classroom (for reviews, see Durik, Hulleman, & Harackiewicz, in press; Harackiewicz et al., 2014). In interventions, students' utility beliefs can be promoted by highlighting the relevance of a subject for students' future goals, such as careers, occupations, and everyday life (e.g., Woolley, Rose, Orthner, Akos, & Jones-Sanpei, 2013). Several empirical studies demonstrated that such interventions can promote not only students' motivational beliefs, but also enhance students' ability beliefs, interest, and achievement in psychology, mathematics, and science (Brisson et al., 2015; Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Gaspard et al., 2015; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009).

To increase students' utility value beliefs, the relevance of what students learn for their own lives has been highlighted in different ways: students were either provided with information about the relevance of a learning task for their own life (see study 2 in Durik & Harackiewicz, 2007; Shechter, Durik, Miyamoto, & Harackiewicz, 2011; Woolley et al., 2013) or were encouraged to self-generate reasons for the relevance of a task by writing an essay (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). Based on the few existing studies, Durik et al. (in press) speculated about an emerging pattern of intervention effects depending on the type of manipulation and students' initial conditions: In three of the studies in which students were encouraged to generate utility beliefs by themselves (e.g., through writing an essay), students with lower initial levels of ability beliefs and interest profited more (Hulleman et al., 2010; Hulleman &

Harackiewicz, 2009). The opposite pattern was observed in two other studies, in which students were directly provided with utility information: No or even negative effects of the intervention were found for students with initial lower levels of ability beliefs or lower initial interest (Durik & Harackiewicz, 2007; Durik et al., in press).

In the laboratory, Canning and Harackiewicz (2015) systematically compared the different processes at play when encouraging students to write about the utility or providing directly-communicated utility value information. The authors found a negative effect of directly communicated utility information on students' interest and performance for students with low ability beliefs (Canning & Harackiewicz, 2015; study 1). In contrast, self-generating utility information was especially effective in fostering performance for students with low ability beliefs. A combination of directly communicated and self-generated utility information resulted in synergistic effects and was especially beneficial for students with low ability beliefs (Canning & Harackiewicz, 2015; study 2). However, only including information about the utility of a task for everyday-leisure activities (thereby removing career-related information) offset the negative effects for students with low ability beliefs (Canning & Harackiewicz, 2015; study 3).

Durik et al. (2014; study 1) also found negative effects on students' interest when providing students with information about the relevance of a task for students with low expectancy beliefs. Yet, when students received an expectancy boost before receiving the utility intervention, these students also profited in term of their performance and interest (Durik et al., 2014; study 2). These results highlight the importance of students' ability beliefs: Providing students with information about the relevance of a task can result in negative effects and put students under pressure if they do not expect to be able to master the task (see Canning & Harackiewicz, 2015).

To conclude, interventions targeting students' utility value beliefs seem to be a promising approach to foster students' motivation. When administering such interventions, including an expectancy boost to counteract negative effects for students with low ability beliefs seems necessary.

1.4.2. Value interventions and family background

Recently, researchers started to investigate the interrelations between value interventions and family background. As a first study to address the importance of family characteristics in intervention studies, Harackiewicz et al. (2012) conducted an value

intervention directed at students' parents. In this study, information about the relevance of science, technology, engineering, and mathematics (STEM) courses for their children's future was mailed to parents using brochures and a link to a website. Students whose parents received these information materials took nearly one semester more STEM courses than students in the control group. In further analyses with the same data set, Rozek and colleagues (2015) showed that the effect of this value intervention was mediated through changes in mothers' STEM utility value perceptions, thereby demonstrating the importance of parents' utility value perceptions for students' academic choices. Additionally, Harackiewicz et al. (2012) investigated the effects of family socioeconomic status on students' course taking and found that students whose parents reported higher levels of education also took more STEM courses. Concerning the intervention effects on students' course taking, all students profited from the intervention in the same way, regardless of their parents' educational level.

Although the value intervention from Harackiewicz et al. (2012) again supports the importance of parents' motivational beliefs for students' academic outcomes, it does not yield insights into whether value interventions foster students' relevance beliefs can also be used as a tool to decrease motivational gaps between students from families with more and fewer motivational resources. A first study to address the question if value interventions targeting students' utility beliefs can counteract racial and social-class achievement gaps in higher education was administered by Harackiewicz et al. (in press). The authors examined the effectiveness of an intervention targeting students' value beliefs to reduce achievement gaps and to disentangle the interaction with race and social-class. Using a value intervention in which students were asked to self-generate reasons for the relevance of a university course (i.e., having students write a text about the personal relevance of the course material), they found that the intervention was especially beneficial in reducing the achievement gap for those minority students who were also first-generation students. However, they found that the value intervention was not especially effective for students with high poverty during high school.

To conclude, there are some attempts to investigate interventions targeting students' utility beliefs as a tool to close achievement gaps for students with different family background. However, given the motivational gaps between students from families with more and less motivational resources (i.e., higher motivational beliefs), the question emerges if value interventions can be used as a tool to counteract these

differences (Lazarides et al., 2015). So far, there are no studies that investigated the effectiveness of interventions fostering utility beliefs to close motivational gaps between students from families with different motivation characteristics. However, it is possible that these interventions would be especially effective for students from families with lower motivational resources, as these students might receive new information about the relevance of a subject they did not encounter within their families. Moreover, since value interventions can be easily administered within the classroom (Gaspard et al., 2014; Harackiewicz et al., in press; Hulleman & Harackiewicz, 2009), it would be an effective tool to target all students in need, as it would not be necessary to specifically diagnose whose students come from families with low motivational resources.

1.5. Research Questions of the Present Dissertation

The present dissertation systematically investigates the role of family background for students' academic motivation and achievement. A process-oriented conceptualization of family background is adopted by including structural and process-related family characteristics in all three studies within this dissertation. In addition, multiple indicators of students' academic outcomes are included and longitudinal data sets are used to investigate the associations between family characteristics and student outcomes more precisely. More specifically, the importance of motivational family characteristics for students' academic motivation, achievement, and their career paths is examined. So far, only few studies investigated how parent and student motivation influence each other and how these associations also shape students' career paths in a longer perspective (Simpkins et al., 2015). Moreover, the present dissertation examines if a motivational intervention in the classroom context can be used as a tool to decrease motivational gaps between students from families with less and more advantageous motivational characteristics.

The empirical studies underlying this dissertation use the expectancy-value theory of achievement-related choices (Eccles et al., 1983) as a theoretical framework. More specifically, the three studies in this dissertation focus on the parent socialization model embedded within EVT (Eccles, 2007; Jacobs & Eccles, 2000). Since both EVT and the parent socialization model are well-grounded in theory and highly supported by empirical research, the dissertation builds on a large body of literature. Research has clearly demonstrated the meaningfulness of these models to examine family influences on student motivation and achievement (see section 1.2.). Yet, there are still some unanswered questions and a systematic conceptualization of family background has often been missing in previous studies (Bradley & Corwyn, 2002; Lazarides et al., 2015). Moreover, there is some evidence that motivational family characteristics might be especially relevant for students' academic outcomes over and above SES (Jodl et al., 2001; Neuenschwander et al., 2007). However, only few studies investigated bidirectional relations between parent and student motivation and how these associations also shape students' career paths (Simpkins et al., 2015)—however, this might yield new insights into the development of student motivation and parental influences on it. Finally, as motivational family characteristics are associated with student motivation and predict

students' career paths, there is a need to find ways to counteract these motivational deficits (Lazarides et al., 2015).

The present dissertation aims at extending previous research on the parent socialization model embedded within EVT by adapting a process-oriented investigation of the associations between family characteristics and student outcomes: First, applying a process-oriented approach, the interplay between motivational family characteristics and other relevant process-related family characteristics is examined. This is in line with a recent call for a more holistic and integrated approach in which combinations of different family characteristics and their associations with students' academic outcomes are investigated (Lazarides et al., 2015; Simpkins et al., 2015). Moreover, systematically differentiating between process-related and structural family characteristics is necessary to investigate the relative importance of each (see section 1.1). Second, bidirectional relations between parents' and students' value beliefs and their associations with students' career aspirations and course-taking from middle school to college are investigated to yield valuable insights in the development of not only academic motivation but also major transitions and career aspirations. Third, due to the importance of motivational family characteristics, ways to counteract motivational gaps between students from families with more and less advantageous motivational characteristics are investigated.

Study 1 (*The Role of Family Characteristics for Students' Academic Outcomes: A Person-centered Approach*) investigated cross-sectional and longitudinal associations between patterns of family characteristics (parents' general beliefs, child-specific beliefs, academic involvement, parent-child relationship, and parents' time and energy) and students' academic motivation and achievement. This study answers the call of researchers to apply person-centered approaches to investigate different family characteristics in conjunction with each other. To this end, this study was based on data from the MoMa (Motivation in Math) study (Brisson et al., 2015; Gaspard et al., 2015). More specifically, data from 1,571 ninth-grade students of 82 classrooms of 25 academic track schools and their parents was collected over a period of five months. A parent questionnaire was used to assess structural and process-related family characteristics at the pretest. Students answered questionnaires assessing students' value beliefs, self-concept, and effort at the pretest and five months later. In addition, students' grades were collected and achievement tests were administered. Thus, this data was useful

to investigate whether meaningful patterns of family characteristics can be found and how these distinct family patterns are associated with student motivation and achievement cross-sectional and over a period of five months.

Study 2 (*STEM Career Paths from Middle School to College: Parent and Student Interrelations*) investigated associations between parents' motivational beliefs and students' science, technology, engineering, and mathematics (STEM) motivational beliefs (utility value and ability beliefs), course-taking, achievement, and career aspirations. Since college is a major step into students' career paths, investigating the precursors of students' motivation and career aspirations in college can yield valuable insights in the development of major transitions. Specifically, this study focused on motivational family characteristics as recent research and the results of Study 1 highlighted the particular importance of parents' motivation. The study examined bidirectional relations of mothers' and students' value and ability beliefs, students' course taking and achievement, as well as career aspirations from middle school through high school graduation to the first two years of college. Study 2 used data on mothers and students from the large longitudinal Wisconsin Study of Families and Work (WSFW; for details of recruitment, see Hyde, Klein, Essex, & Clark, 1995). Containing detailed information on value and ability beliefs of students and their mothers, this data set enabled the investigation of bidirectional relationships between mothers' and students' motivation beliefs from middle school to college as well as predictions of students' ongoing motivation and career aspirations.

Study 3 (*Robin Hood Effects on Motivation in Math: Family Background Moderates the Effects of Relevance Interventions*) examined whether a motivational intervention affected students' value beliefs, self-concept, and effort in math differently depending on family background (socioeconomic status, family interest, parental utility and intrinsic value). As Study 1 and Study 2 demonstrated the importance of motivational family characteristics for students' career paths, there is a need to find ways to counteract motivational gaps between students from families with more and less advantageous motivational characteristics. This study again used data from the MoMa study. In this large cluster randomized controlled trial study, a relevance intervention was implemented in ninth grade classrooms in 25 academic track schools in Germany. Using a randomized controlled field trial design, 82 ninth grade classes were randomly assigned to either one of two intervention conditions or a waiting-control group. In addition to students' self-

report measures before the intervention, six weeks, and five months after the intervention, data on different family characteristics were obtained from parents via parent questionnaires at the pretest. Thus, this study design enabled the investigation of differential intervention effects depending on family background.

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The Role of Family Characteristics for
Students' Academic Outcomes:
A Person-centered Approach

Häfner, I., Flunger, B., Dicke, A.-L., Gaspard, H., Brisson, B. M., Nagengast, B. & Trautwein, U. (submitted). The Role of Family Characteristics for Students' Academic Outcomes: A Person-centered Approach. *Child Development*.

Abstract

Using data from 1,571 ninth-grade students ($M_{age} = 14.62$) and their parents, latent profile analyses considering parents' motivation, child's need for support, academic involvement, parent-child relationship, and parents' time and energy, identified *indifferent, motivated and engaged, motivated and disengaged, involved, and average families*. Cross-sectional and longitudinal associations with students' motivational (self-concept, effort, and interest) and achievement outcomes (achievement test and grades) in math were analyzed. Students from families classified as *motivated and engaged* and *motivated and disengaged* showed higher initial levels of motivation and achievement and higher achievement and grades over 5 months compared with students from *average families*. By contrast, students from *involved* families (medium motivation but high involvement), got worse grades than students from *motivated and disengaged* families.

Keywords: academic motivation, achievement, family background, person-centered approach

The Role of Family Characteristics for Students' Academic Outcomes: A Person-centered Approach

Students are socialized within their families and thus, family background influences the development of students' academic motivation and achievement (Eccles, 2007; Sirin, 2005). But what is meant by family background? Recently, researchers increasingly highlighted the importance of process-related, psychological family characteristics which shape students' academic outcomes. Consequently, associations between students' academic outcomes and parents' own motivation (e.g., parents' self-concept and interest), parents' child-specific beliefs (perception of child ability), parents' behavior (e.g., academic involvement), the parent-child relationship, and parents' resources have been found (Castro et al., 2015; Eccles, 2007; Lazarides, Harackiewicz, Canning, Pesu, & Viljaranta, 2015). However, family background is not just the sum of its parts, but the combination of multiple family characteristics. Accordingly, Simpkins, Fredricks, and Eccles (2015) recently argued that a "holistic or pattern-centered approach holds promise for assessing the more synergistic nature of families. In this methodological approach, individual factors are examined in conjunction with other factors" (Simpkins et al., 2015, p. 30).

But what are the benefits such an approach might promise? Investigating specific configurations of multiple family characteristics could help to explain differences in students' academic outcomes (e.g., Simpkins et al., 2015). Considering research on parental academic involvement, different meta-analyses have found a great deal of variability in the effect sizes of the amount of involvement (e.g., Castro et al., 2015; Fan & Chen, 2001; Jeynes, 2007). When investigating specific types of academic involvement by parents, such as homework involvement, sometimes even negative associations with student outcomes have been reported (e.g., Hill & Tyson, 2009; Patall, Cooper, & Robinson, 2008). Yet, it might not be the amount of parents' academic involvement alone that determines the academic development of a child. Investigating specific configurations of the amount of academic involvement with other important family characteristics could help to explain differences in students' academic outcomes.

In the present article, we used a large data set of 1,571 ninth-grade students and their parents to assess whether meaningful configurations of family characteristics could be identified. First, applying a person-centered approach, we were able to investigate the configurations of several important family characteristics and academic involvement.

Second, using data from two measurement points, we investigated cross-sectional associations between the differential configurations of family background and several concurrent indicators of students' motivational and achievement outcomes. Third, in addition to applying cross-sectional analyses, we analyzed how these different types of families were associated with students' motivation and achievement in mathematics after a 5-month period.

Conceptualizing Family Background: Which Characteristics Influence Students' Academic Outcomes?

What defines students' family background? Previous research has focused mostly on demographic family characteristics. In particular, socioeconomic status (SES; Sirin, 2005), which refers to a "family's ranking on a hierarchy according to access to or control over some combination of valued commodities such as wealth, power, and social status" (Sirin, 2005, p. 418) has been extensively studied. Students from families with low SES have been found to show lower levels of academic achievement (e.g., Sirin, 2005). However, as SES is a relatively broad and distal dimension of students' family background, researchers have recently begun to focus on more proximal dimensions that describe the psychological processes through which family background influences student outcomes (e.g., Davis-Kean, 2005; Hoover-Dempsey & Sandler, 1995). A plethora of studies have highlighted the importance of multiple family characteristics for students' academic outcomes, such as students' interest, self-concept, effort, and academic achievement (Eccles, 2007; Lazarides et al., 2015). Expectancy-value theory (EVT; Eccles, 2007; Eccles et al., 1983), more specifically the parent socialization model embedded in EVT (Eccles, 2007; Jacobs & Eccles, 2000), postulates a broad spectrum of potentially relevant family characteristics that influence the development of students' motivational beliefs and achievement (see Figure 1 for a working model of the family characteristics considered in the present paper). According to the parent socialization model, psychological family characteristics, such as parents' beliefs, behaviors, the parent-child relationship, and parents' resources (see boxes on the left side of Figure 1) influence students' motivational beliefs and their academic achievement (Eccles, 2005, 2007; Jacobs & Eccles, 2000; Lazarides et al., 2015). Accordingly, empirical support for the importance of these process-related family characteristics for students' motivation and achievement has been found (Jacobs & Eccles, 2000; Lazarides et al., 2015; Simpkins,

Fredricks, & Eccles, 2012; Simpkins et al., 2015). In the following sections, we present research on how parents' behavior (i.e., parents' academic involvement), parents' beliefs (including parents' motivational as well as child-specific beliefs), the parent-child relationship, and parents' resources (i.e., parents' time and energy) are associated with students' academic outcomes.

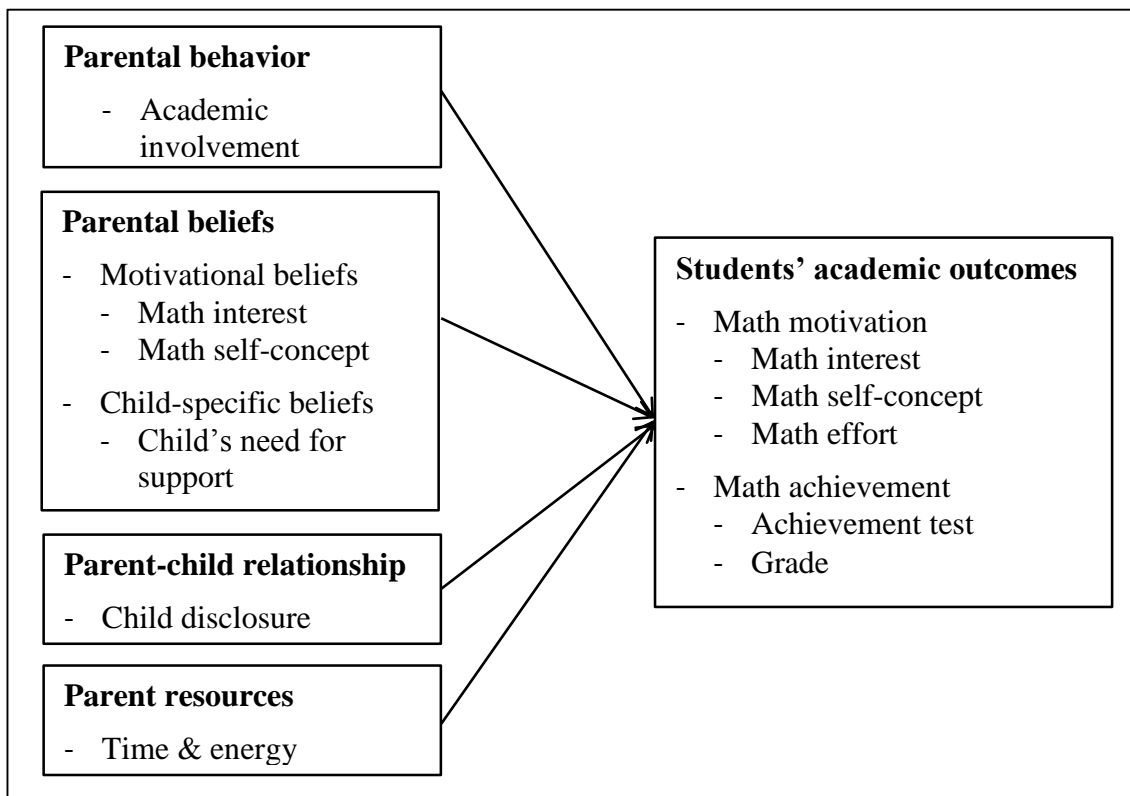


Figure 1. Theoretical conceptualization of students' family background and associations with students' academic outcomes.

Parents' behavior. One central aspect of parents' behavior is parents' academic involvement, that is, "parents' interactions [...] with their children to promote academic success" (Hill et al., 2004, p. 1491). At first glance, the results of four different meta-analyses seem to provide evidence of positive associations between the amount of parents' academic involvement and students' achievement (Castro et al., 2015; Fan & Chen, 2001; Hill & Tyson, 2009; Jeynes, 2007). However, upon closer examination, the picture becomes more complex, and the results of different studies appear to conflict with each other: Hill and Tyson (2009) found only a very small positive association between the quantity of academic involvement and middle school students' achievement ($r = .04$). In addition, whereas most studies found a small to moderate positive relation between

academic involvement and students' achievement, when actual academic involvement, such as homework involvement, was considered, small or even negative effects were found on students' academic outcomes ($r = -.11$, Hill & Tyson, 2009). In their research synthesis on parental involvement, Patall et al. (2008) even concluded that "the overall effect of parent involvement in homework was small and often not significant" (p. 1087). Relying on self-determination theory (Deci & Ryan, 1985; Grolnick, Deci, & Ryan, 1997), one explanation of these mixed results is the quality of academic involvement: if parents' academic involvement supports students' need for autonomy, competence, and social relatedness, positive associations with students' motivation and achievement have been found (e.g., Dumont, Trautwein, Nagy, & Nagengast, 2013; Grolnick, Ryan, & Deci, 1991; Katz, Kaplan, & Buzukashvily, 2011). However, if parental involvement is not autonomy supportive, but perceived as controlling by the child, it is negatively associated with achievement (e.g., Karbach, Gottschling, Spengler, Hegewald, & Spinath, 2013). Moreover, the quality of academic involvement is also influenced by the student: the worse students' academic functioning, the more parents tend to get involved in a controlling way, which, in turn, decreases students' academic functioning (Dumont et al., 2013).

Another explanation might be that the quantity of academic involvement is differently associated with students' motivation and achievement, depending on other family characteristics. Studies have yet to investigate whether the effects of academic involvement depend on other family characteristics, such as the family climate and parents' own motivational beliefs.

Parents' beliefs. According to the parent socialization model (Eccles, 2007; Jacobs & Eccles, 2000), parents' beliefs can be differentiated into parents' general and child-specific beliefs (Eccles, 2007; Jacobs & Eccles, 2000). Parents' general beliefs include parents' motivational beliefs, such as parents' self-concepts and interests. Parents' self-concept describes parents' perceptions of their own competencies in a specific subject and parents' interest in a subject (e.g., Eccles, 2007). It has been suggested that if parents' self-concept is high, it is more likely that parents perceive a specific task as easy, which in turn influences students' self-concept (Eccles, 1993). Moreover, parents' own self-concept is also a predictor of parental involvement (Green, Walker, Hoover-Dempsey, & Sandler, 2007; Grolnick, Benjet, Kurowski, & Apostoleris, 1997). In addition to parents' self-concept, family interest is an indicator of parents'

motivational beliefs. As parents act as role models, they pass on their interests to their children (Frenzel, Goetz, Pekrun, & Watt, 2010; Jacobs & Eccles, 2000). Thus, researchers using different theoretical frameworks agree on the importance of parents' motivational beliefs (e.g., Grolnick, Benjet, et al., 1997; Hoover-Dempsey & Sandler, 1997; Katz et al., 2011) as families provide an important socialization context for the development of student motivation.

In comparison, parents' child-specific beliefs reflect parents' perceptions of children's abilities and expectations of children's achievement (Eccles, 2007). Parents influence students' self-concept development as they act as interpreters of experiences and reality through their own perceptions of the child's abilities (Frome & Eccles, 1998; Jacobs & Eccles, 1992; Simpkins et al., 2015). Parents' perceptions of students' abilities even predict changes in students' self-concepts over time (Simpkins et al., 2015) and are associated with students' academic achievement (Castro et al., 2015; Jeynes, 2007).

Parent-child relationship. According to the parent-socialization model, the parent-child relationship is part of the socio-emotional climate in a family (Eccles, 2007; Jacobs & Eccles, 2000). Although it has not been studied often, the parent-child relationship seems to be positively related to students' self-concept and achievement (Learner & Kruger, 1997; Yan & Lin, 2005). When assessing the parent-child relationship as reported by parents, child disclosure has been shown to be a suitable indicator (Stattin & Kerr, 2000).

Parents' resources. Eccles (2007) argued that students' academic motivation and achievement can be influenced by SES through parents' resources, such as parents' time and energy. Moreover, the time and energy parents have for getting involved in their children's academic lives shapes the quality of parent-child interactions (e.g., Grolnick, Benjet, et al., 1997; Hoover-Dempsey & Sandler, 1997). Parents' time and energy have also been highlighted as important factors shaping parents' involvement (Grolnick, Benjet, et al., 1997; Hoover-Dempsey & Sandler, 1997; Yan & Lin, 2005).

Conceptualizing Family Background: A Multi-Dimensional Approach

Although research has highlighted the importance of psychological family characteristics, only few studies included multiple family characteristics and investigated their associations with student outcomes (Simpkins et al., 2012, 2015). Accordingly, several researchers have argued for a more holistic and integrated approach in which the

combination of different family characteristics and their associations with students' academic outcomes are investigated (Lazarides et al., 2015; Simpkins et al., 2015).

What combinations of family characteristics would one expect? Results from Grolnick (2015) highlight the importance of parents' intrinsic motivation for their involvement. If mothers' got involved because they enjoyed it, they showed more positive affect and higher levels of involvement, which, in turn, predicted students' competence beliefs and achievement. Similarly, Green et al. (2007) found that parents' self-efficacy beliefs predict the amount of parental involvement. Therefore, we argue that it is reasonable to expect to find patterns of high levels of involvement combined with high parental interest and self-concept. On the other hand, it is possible that some parents get involved although they have a low self-concept and low interest: some parents might get involved because they perceive their child to be in need for support (Hoover-Dempsey & Sandler, 1997), or because they think it is expected of them (Green et al., 2007). Potentially, these combinations of multiple family characteristics might be differentially related to student outcomes. Thus, we argue that further insights into family background can be uncovered by considering several family characteristics simultaneously. More specifically, more could be learned about the thus far rather inconsistent associations between amount of academic involvement and students' academic outcomes.

Focusing on a Multidimensional Approach: Defining Students' Academic Outcomes

To explore the associations between students' family characteristics and students' academic outcomes, the most frequently used indicators of academic outcomes are either a general indicator of students' achievement (e.g., GPA) or a subject-specific indicator (e.g., math grades; Hill & Tyson, 2009; Sirin, 2005). Student motivation is another important factor that shapes students' long-term academic experiences and predicts academic achievement over and above students' previous achievement (e.g., Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). In addition, motivational constructs are associated with other important academic outcomes, such as career choice and well-being (Fredricks, Blumenfeld, & Paris, 2004; Simpkins, Davis-Kean, & Eccles, 2006). Students' academic motivation can be conceptualized as students' expectancy beliefs and their reasons to engage (Eccles & Wigfield, 2002). Students' expectancy beliefs reflect students' beliefs about the probability of mastering a task and are often operationalized as students' *self-concepts*, which describe students' evaluations of their competence in a

domain (Eccles et al., 1983; Eccles & Wigfield, 2002). One of the most important reasons for students to engage in a subject is their interest (Eccles & Wigfield, 2002). Interest is content-specific and describes the extent to which students value a specific task or domain, enjoy it, and have knowledge about it (Hidi & Renninger, 2006). Moreover, interest influences students' academic course selection and career choice, thereby shaping students' future academic pathways (e.g., Köller, Baumert, & Schnabel, 2001). Students' expectancy beliefs and interests shape students' achievement-related behavior. A key marker of the quality of students' achievement-related behavior is the amount of effort they put into a task or subject (Skinner, Kindermann, & Furrer, 2008). Student's effort is characterized by high levels of positive engagement in a task (e.g., Fredricks et al., 2004) and is related to students' achievement, dropout rates, and psychological well-being (e.g., Fredricks et al., 2004; Trautwein, Lüdtke, Roberts, Schnyder, & Niggli, 2009). Distinguishing between important family characteristics as well as students' academic outcomes is necessary to uncover potential differential effects: Whereas students' expectancy beliefs in particular might profit from parents' high perceptions of their child's abilities (e.g., Frome & Eccles, 1998), students' value beliefs might be more closely associated with parents' interest in a subject (e.g., Frenzel et al., 2010), and parental behavior might be especially beneficial for students' effort (Dumont et al., 2013).

The Present Study

In the present study, we investigated the associations between family characteristics and students' academic outcomes in the domain of mathematics, as there is increasing concern regarding the structural soundness of the educational pipeline in STEM disciplines. Math is an important prerequisite for STEM careers (National Science Board, 2007) and students' interests, self-concepts, and engagement are main predictors of students' career choices (Durik, Vida, & Eccles, 2006; Hill & Wang, 2015).

To obtain a better understanding of the associations between parents' academic involvement and student outcomes, we investigated configurations of family characteristics and their mutual interplay by applying latent profile analyses (LPA). To investigate how specific configurations of family characteristics can describe different types of families, the following dimensions of family background were used: parents' motivational beliefs (math interest and self-concept), parents' child-specific beliefs (child's need for support in math), parents' behavior (academic involvement in math), the

parent-child relationship (e.g., child disclosure), and parents' resources (parents' time and energy). We expected students from families characterized as distinct family types to differ in academic outcomes (both motivation and achievement); that is, we assumed that a high amount of academic involvement may be associated with favorable academic outcomes only in combination with high family motivation (e.g., Grolnick, 2015).

Hence, our research hypotheses were the following: First, we expected to find positive associations with students' math motivation and achievement if the family was characterized by high parental self-concept and high interest (Lazarides et al., 2015). Parents' motivation can foster students' motivation during parent-child interactions, as parents act as role models (Eccles, 2007). Second, when parents showed high levels of academic involvement and invested a lot of time and energy in their children's academic life while simultaneously holding low child-specific and motivational beliefs, students from these families might experience this involvement as controlling, which was then expected to lead to detrimental effects on students' motivation and achievement (e.g., Dumont et al., 2013; Hill & Tyson, 2009). Third, when parents showed high academic involvement while simultaneously holding high motivational and child-specific beliefs (e.g., Katz et al., 2011) and the family context provided them with adequate resources (e.g., Green et al., 2007), we expected favorable academic outcomes for students (e.g., Jeynes, 2007). Moreover, we expected to find that the family types would have the same associations with the development of students' motivation and achievement in math over a period of 5 months.

To better understand the associations between family characteristics and students' academic outcomes, the present study (a) included several important parent-reported family characteristics next to parents' academic involvement, (b) used a person-centered approach to explore the configurations of the distinct indicators of students' family background, (c) assessed multiple dimensions of student-reported motivational (self-concept, effort, and interest) and achievement outcomes (achievement test and grades), and (d) used longitudinal data from a large sample of 1,571 ninth-grade academic track students from a naturalistic setting as well as data provided by their parents.

Method

Sample

Data from students and their parents were collected as part of a large longitudinal study “Motivation in Mathematics” (MoMa) in German academic track schools in 2012/13. The data set used in the current study involved 1,978 ninth-grade students enrolled in 82 classrooms in 25 schools. Students’ mean age was $M = 14.62$ ($SD = 0.47$), and 53.5% of the students were female. Participation was voluntary; students’ parents provided active parental consent for participation (96% response rate).

Data from both students and parents were collected via separate questionnaires. Parental participation was high (79.5%). For the present study, we used students’ data only when their parents’ data were available, resulting in a subsample of 1,571 students and their parents. For the follow-up, 89.7 % of these students were present and filled out the student questionnaire. For the parent questionnaire, we asked the parent who was most involved in the child’s homework to fill out the questionnaire: 56.3% of the questionnaires were filled out by students’ mothers, 23.6% by mothers and fathers together, and 16.7% by fathers (0.4% were filled out by a different person). Because the data were collected from students from the highest educational track in Germany, our sample was positively selected with respect to parents’ educational level, with 46.6% of mothers and 47.0% of fathers holding qualifications for college education (i.e., obtained the *Abitur* certificate), but the sample comprised students with parents from a broad range of educational backgrounds. Regarding immigrant background, 10.8% of students came from families with both parents born outside Germany (predominantly in Turkey; rest mostly in east European countries).

Instruments

Family background measures were assessed at the beginning of the ninth grade (T1) using the parent questionnaire. Except for family interest and SES, all family characteristics refer to the parent filling out the questionnaire. Students’ motivation was measured at T1 and 5 months later (T2). Students’ achievement was measured with students’ grades at the end of Grade 8, the middle of Grade 9, and the end of Grade 9. In addition, students completed achievement tests at both time points. All items and sources can be found in the Supplementary Appendix.

SES. Occupational status was based on information about parents' occupations provided by both students and parents. Occupations were first coded using the *International Standard Classification of Occupations* (ISCO; ILO, 2012) and transferred into the *International Socio-Economic Index of Occupational Status* (ISEI; Ganzeboom & Treiman, 2003). The ISEI is an international standard measure indicating the status of the occupation, ranging from 16 to 90. For the analyses, we included the highest occupational status score, which could come from either the father or the mother.

Family characteristics

All measures of students' psychological family characteristics were assessed using the parent questionnaire. A 4-point Likert-type scale ranging from 1 (*completely disagree*) to 4 (*completely agree*) was used for all items assessing students' family characteristics, except parents' academic involvement.

Parents' beliefs. Parents' motivational beliefs were operationalized as *family math interest* (with three items; $\alpha = .92$) and *parental math self-concept* (using four items; $\alpha = .91$). Parents' child-specific beliefs were assessed by parents' perceptions of the child's *need for support* and measured using four items ($\alpha = .74$).

Academic involvement. Parents' academic involvement in their children's academic life in the subject of mathematics was measured using a five-item scale ($\alpha = .87$). Parents were asked how often they got involved in their child's academic life on a 5-point response scale ranging from 1 (*never or almost never*) to 5 (*several times a week*).

Parent-child relationship and parents' resources. *Child disclosure* was used as an indicator of the parent-child relationship and was assessed using five items ($\alpha = .77$). Parents' *time and energy* to get involved in their child's academic life was measured with three items ($\alpha = .74$).

Student motivation. Students' motivation was assessed at two time points via the student questionnaire. For all items, a 4-point Likert-type scale ranging from 1 (*completely disagree*) to 4 (*completely agree*) was used as the response format. *Students' mathematical self-concept* was assessed with five items ($\alpha_{t1} = \alpha_{t2} = .93$); *students' effort in math* was measured with five items ($\alpha_{t1} = .82$; $\alpha_{t2} = .87$), and *students' interest in math* was assessed with six items ($\alpha_{t1} = .86$; $\alpha_{t2} = .87$).

Student achievement

Math grades. Students' math grades were provided by the teacher. We collected students' math grades at the end of Grade 8, in the middle of Grade 9, and at the end of Grade 9. Grades were coded so that higher scores indicate better grades.

Achievement tests. Two different achievement tests were used to assess students' achievement in mathematics. The achievement test at T1 was conducted at the beginning of Grade 9 and is a standardized math achievement test administered to all ninth-grade students in the state. It is a curricularly valid test developed by the state assessment agency. The assessment and evaluation of this test is highly standardized across classes and schools. Test scores were obtained from administrative records. The achievement test at T3 was a speed test (Schmidt, Ennemoser, & Krajewski, 2012), which consisted of 50 exercises including typical math operations and measured the fluency of solving math operations ($\alpha = .89$).

Covariates. Students' cognitive abilities were considered as a control variable. To assess students' cognitive abilities, we used the Figure Analogies subscale ($\alpha = .81$) from the Cognitive Abilities Test 4 – 12 + R (Heller & Perleth, 2000).

Statistical Analyses

All analyses used the robust maximum-likelihood estimator in Mplus 7.1, which corrects test statistics and standard errors for non-normality in the manifest variables (Muthén & Muthén, 1998-2012). Following recommendations by Graham (2009), full information likelihood estimation (FIML) was used to account for missing data, which ranged from 0.4% to 11.2% across all variables. Before running the analyses, all continuous variables were standardized to facilitate the interpretation of the results.

Due to the multilevel structure of our data—students' nested within classes—we controlled for the nested structure of the data (Raudenbush & Bryk, 2002). The standard errors of the regression coefficients were adjusted with the design-based correction of standard errors and fit statistics (“type=complex” procedure) in Mplus.

Preliminary analyses. We specified all indicators of family characteristics and students' motivation as latent variables. Before conducting the longitudinal analyses, longitudinal confirmatory factor analyses (CFAs) were conducted to test for measurement invariance across time (Widaman & Reise, 1997), including all indicators of students' motivation (interest, self-concept, and effort) and increasing the invariance constraints.

The test of measurement properties confirmed strict measurement invariance across time (Widaman & Reise, 1997) and following Chen (2007) resulted in an acceptable model fit (see table S1 in the supplemental material for fit indices and more detailed information). In addition, we determined the structural validity of our scales with CFAs that simultaneously included all indicators of family characteristics (six latent variables, each for one family characteristic) and all indicators of student motivation (three latent variables, each for one indicator of student motivation) at both time points. Confirmatory factor analyses resulted in a satisfactory fit of the measurement model (see table S1 in the supplemental material for fit indices).

Latent Profile Analyses. To investigate the number of different family types and the composition of family characteristics in these distinct types, we conducted cross-sectional Latent Profile Analyses (LPAs). LPA is a person-centered approach that groups families with similar family characteristic profiles into distinct types (e.g., Vermunt & Magidson, 2002). Using parents' response patterns concerning the different family characteristics, LPA estimates the probabilities of the profile memberships for each family. In addition, the profile-specific means of the different indicators of family characteristics were estimated for the profile of each family (Lanza & Collins, 2008). The conditional independence assumption was used for reasons of parsimony (Vermunt & Magidson, 2002); that is, the correlations between the different family characteristics were assumed to be fully explained by the different latent profiles, and no residual correlations were permitted.

Statistical and theoretical criteria were considered to determine the number of family types (Nylund, Asparouhov, & Muthén, 2007). First, the Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-adjusted Bayesian information criterion (SABIC) were used to assess the model fit, with lower indicator values suggesting a better model fit. In addition, we used the Vuong–Lo–Mendell–Rubin likelihood ratio test (VLMR; implemented in Mplus) as the statistical criterion for choosing the best-fitting model, with low p -values for the VLMR suggesting a better fit of the model with one additional class. Second, the classification quality displayed in entropy values (ranging from 0 to 1) was used with values $> .70$ indicating a good classification accuracy (Reinecke, 2006). Third, we considered the composition of the family types: When additional class(es) reflected only minor variations or subtypes of family types already identified in a solution with fewer classes, the solution with fewer

types of families was preferred (e.g., Meeus, Van De Schoot, Keijsers, Schwartz, & Branje, 2010). Fourth, we considered the theoretical reasonableness and interpretability of the different solutions of family types when comparing different solutions.

Testing the association of family types with students' motivation and achievement.

To test the cross-sectional and longitudinal associations between the family types and students' academic outcomes, we estimated separate structural equation models for each outcome. Dummy variables indicating the different family types were specified as the independent variables with *average families*—families with medium levels on all family characteristics—as the reference group. Group membership was decided via modal assignment based on the posteriori probabilities obtained from the LPA. Thus, parents were classified as the family type for which the posteriori probabilities were the highest (following Goodman, 2007). Students' motivational outcomes were specified as latent variables. For the cross-sectional analyses, we regressed students' outcomes at T1 on the four dummy variables. Simultaneously, we controlled for SES, students' gender, IQ, and math grade at the end of grade 8 because we wanted to analyze the associations between family types and student motivation over and above these potential third variables. For the longitudinal analyses, again, family types were used to predict students' academic outcomes at T2 while additionally controlling³ for students' initial levels on the respective outcome at T1. As data were collected in an intervention study, we additionally controlled for the effects of the intervention using two dummy variables (0 = control group, 1 = the specific experimental groups), indicating two different intervention conditions (see Gaspard et al., 2015). Adjusted means depending on group membership on outcome variables at T2 were calculated from the structural equation models (again controlling for the intervention, students' initial levels on the respective outcome at T1, SES, students' gender, IQ, and math grade at the end of grade 8). Group differences in adjusted means were tested using the Wald- χ^2 tests.

Results

Overview of Analyses

We first present the results of the LPA to identify the different types of families. Subsequently, the cross-sectional and longitudinal associations between family types and

student motivation and achievement are presented. The descriptive statistics for the scales (Means, SDs, ICCs) are summarized in see Table S2 in the Supplemental Material; correlations at T1 are presented in Table S3.

Identifying Types of Families with LPA

We tested LPA models with two to eight latent profiles (see Table S4 in the Supplemental Material). Although the information criterion values (e.g., BIC and AIC) of the six-, seven-, and eight-type solutions continued to decrease, the five-type solution was preferred as additional classes represented only variations of classes that had already been identified (see Meeus et al., 2010). In addition, using the Vuong–Lo–Mendell–Rubin likelihood ratio test, the five-type solution was significant at $p < .10$, implying a better fit of the five-type solution ($p_{\text{VLMR}} = .052$). Latent profile probabilities for the most likely latent class assignment of the five-type solution were satisfactory, resulting in an acceptable entropy value of 0.75 (see Table S5 in the Supplemental Material), indicating a clear classification of the solution with five latent profiles.

The five types of families were labeled according to their mean profiles in the indicator variables (see Table S6 in the Supplemental Material) as average families (average families' refers to families with average levels on the considered family characteristics), indifferent, motivated and engaged, motivated and disengaged, and involved families. Figure 2 graphically displays the five types of families depending on different levels of family characteristics.

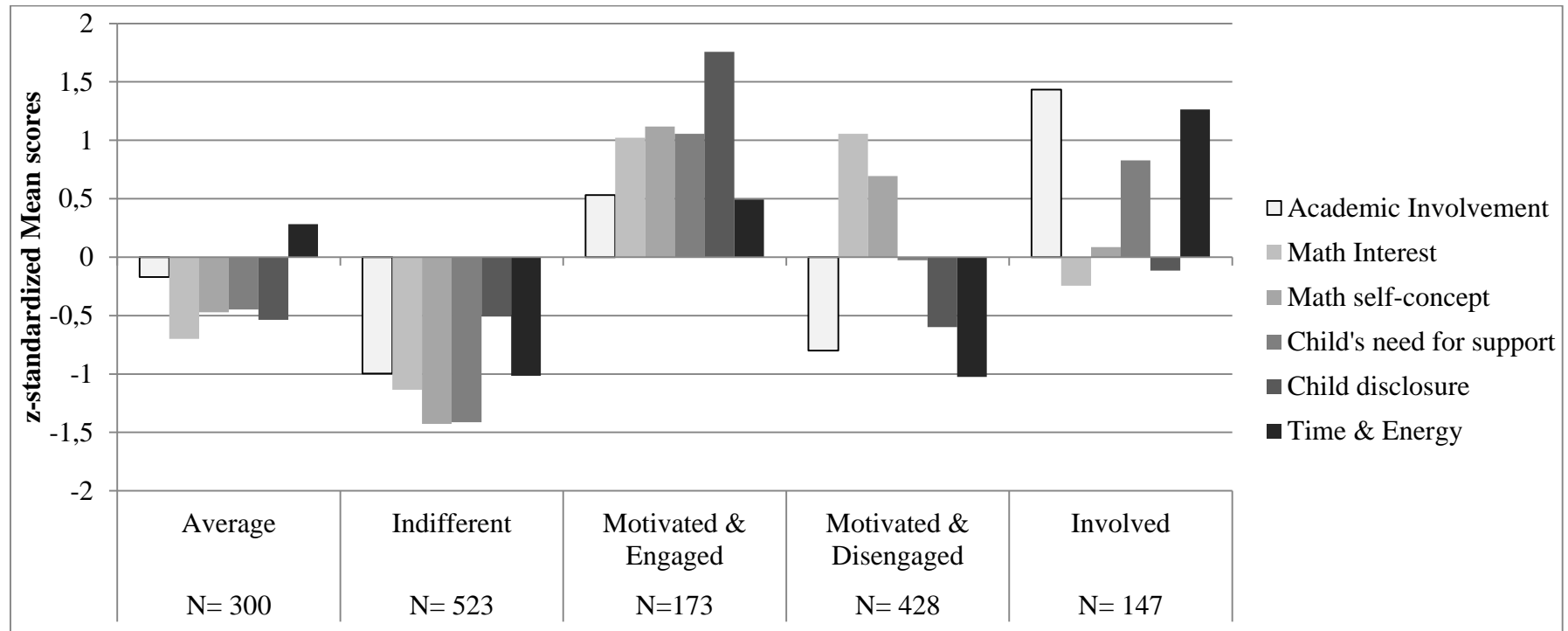


Figure 2. Profiles of family types depending on family characteristics (mean scores z-standardized for presentation).

Average, indifferent, and motivated and involved families differed in their overall levels of family characteristics: Average families (N = 300) were characterized by medium levels of academic involvement, motivation (math interest and self-concept), and family resources (time and energy and parent-child relationship). Indifferent families (N = 523) were classified by low levels of academic involvement, motivation, and family resources, whereas motivated and engaged families (N = 173) were characterized by high levels of academic involvement, motivation, and social resources. In contrast to the motivated and involved families, the motivated and disengaged families (N = 428) were characterized by low levels of academic involvement, perceived their child as having a medium need for support, and at the same time showed high levels of motivation similar to the motivated and engaged families. The involved families (N = 147) showed patterns of family characteristics that were nearly opposite those of the motivated and disengaged families: They were characterized by medium levels of motivation but high levels of academic involvement, time, and energy and perceived their child as needing support.

Cross-Sectional Associations of Family Types with Students' Academic Outcomes

Our second aim was to investigate whether students with different family profiles differed with respect to educational outcomes. The adjusted mean scores of students' outcomes at T1 depending on family type controlling for SES, students' gender, IQ, and math grade at the end of Grade 8 are shown in Figure 3. Students from family types characterized as *average*, *indifferent*, and *involved* showed descriptively medium to low levels of math motivation and achievement. By contrast, students from family types classified as motivated and engaged showed descriptively high levels of motivation and medium levels of achievement. Yet students with the highest levels of motivation and achievement came from families that were classified as motivated and disengaged families.

Regarding the statistical significance of students' differences in outcomes depending on family type, Table 1 displays the results of structural equation modeling with average families as the reference group, controlling for the covariates SES, students' gender, IQ, and math grade at the end of Grade 8.

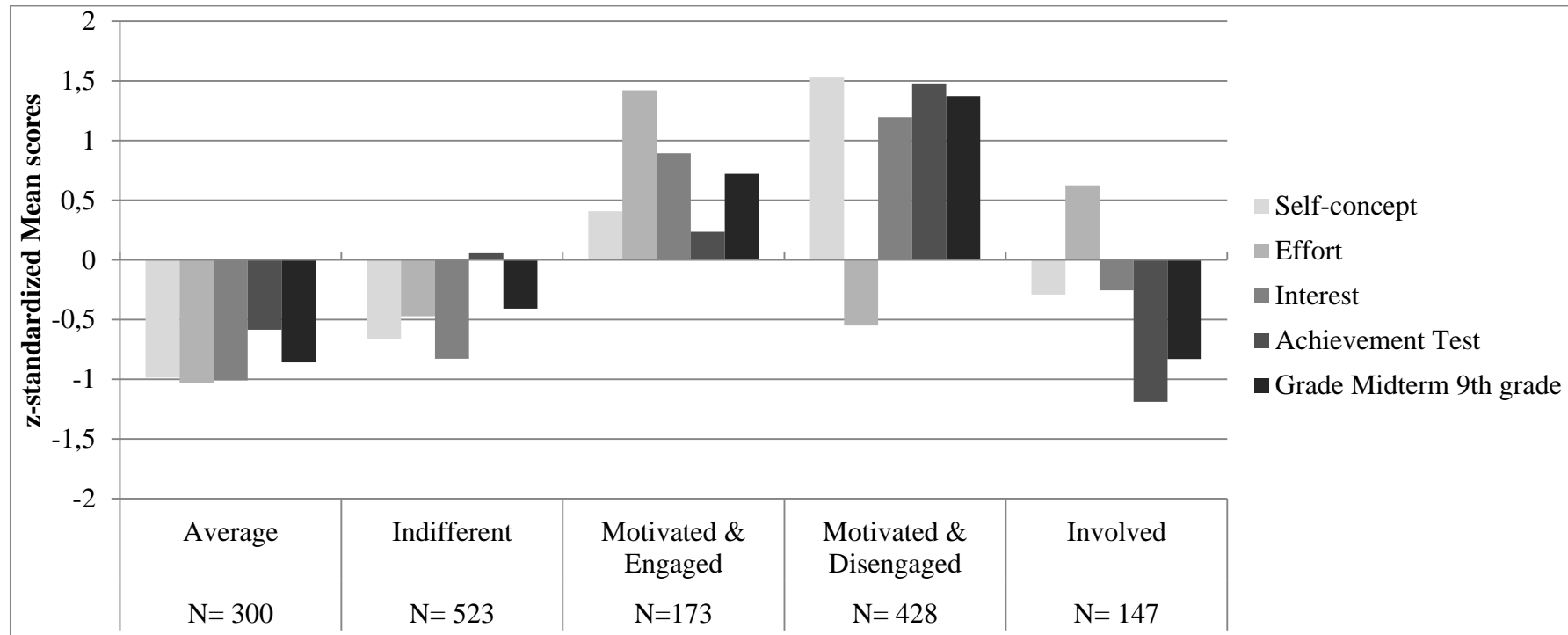


Figure 3. Adjusted mean scores for student outcomes at T1 depending on family type. The mean scores were adjusted by controlling for SES, students' gender, IQ, and math grade in the eighth grade and z-standardizing them for presentation.

Table 1

Standardized Associations between Family Types and Student Outcomes at T1 (upper half) and T2 (lower half).

Variable	Self-concept		Effort		Interest		Achievement test		Math grade	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Cross-sectional</i>										
Indifferent families	.059	(.06)	.062	(.08)	.038	(.07)	.107 †	(.06)	.048	(.05)
Motivated and engaged	.253 **	(.08)	.274 **	(.09)	.389 ***	(.09)	.136 †	(.08)	.168 *	(.07)
Motivated and disengaged	.456 ***	(.06)	.052	(.10)	.452 ***	(.09)	.344 ***	(.06)	.238 ***	(.05)
Involved	.126	(.08)	.185	(.11)	.155 †	(.08)	-.101	(.08)	.003	(.07)
<i>Longitudinal¹</i>										
Indifferent families	.016	(.06)	-.137 *	(.05)	-.018	(.06)	.032	(.07)	.045	(.06)
Motivated and engaged	.084	(.06)	.130 †	(.08)	.084	(.08)	.199 *	(.08)	.141 *	(.07)
Motivated and disengaged	.126 *	(.06)	-.098	(.07)	.093	(.07)	.144 *	(.06)	.193 ***	(.05)
Involved	-.027	(.08)	-.006	(.09)	-.012	(.09)	-.018	(.10)	.040	(.07)

Note. Average families were used as the reference group. The regression coefficients were adjusted by controlling for SES, students' gender, IQ, and math grade in the eighth grade. ¹controlling for the respective outcome at T1

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

In these analyses, we found statistically significantly higher levels of math self-concept, effort, and interest in students from families characterized as motivated and engaged (self-concept: $\beta = .25$; $p = .003$; effort: $\beta = .27$; $p = .004$; interest: $\beta = .39$; $p < .001$) compared with students from average families. Students whose families were classified as motivated and disengaged family types also showed higher levels of self-concept and interest (self-concept: $\beta = .46$; $p < .001$; interest: $\beta = .45$; $p < .001$) compared with students from average families. There were no statistically significant differences in the considered outcomes between students from families classified as indifferent and involved compared with students from families classified as average families.

Concerning students' achievement in math, students from family types characterized as motivated and disengaged performed statistically significantly better on the achievement test ($\beta = .34$; $p < .001$) and earned better midterm grades ($\beta = .24$; $p < .001$) than students from average families. Students from families classified as motivated and engaged also got better midterm grades ($\beta = .17$; $p = .017$) than students from average families. Students from families characterized as indifferent as well as involved did not differ from students from average families in their performance on the achievement test and math grades.

Longitudinal Analyses—Predicting Change in Students' Academic Outcomes

Our third aim was to investigate differential associations of students' math motivation and achievement with different family types while controlling for students' initial values, thereby comparing students with the same initial levels. The adjusted mean scores on students' outcomes at T2 depending on family type are shown in Figure 4. In addition to SES, students' gender, IQ, and math grade in eighth grade, we controlled for the respective student outcome at T1. Descriptively, the same pattern was found as in the cross-sectional analyses: Comparing students with the same initial motivation and achievement, students from families classified as *average families*, *indifferent*, and *involved* families showed lower levels of math motivation and performed worse after 5 months than students from families classified as *motivated and engaged* and *motivated and disengaged*.

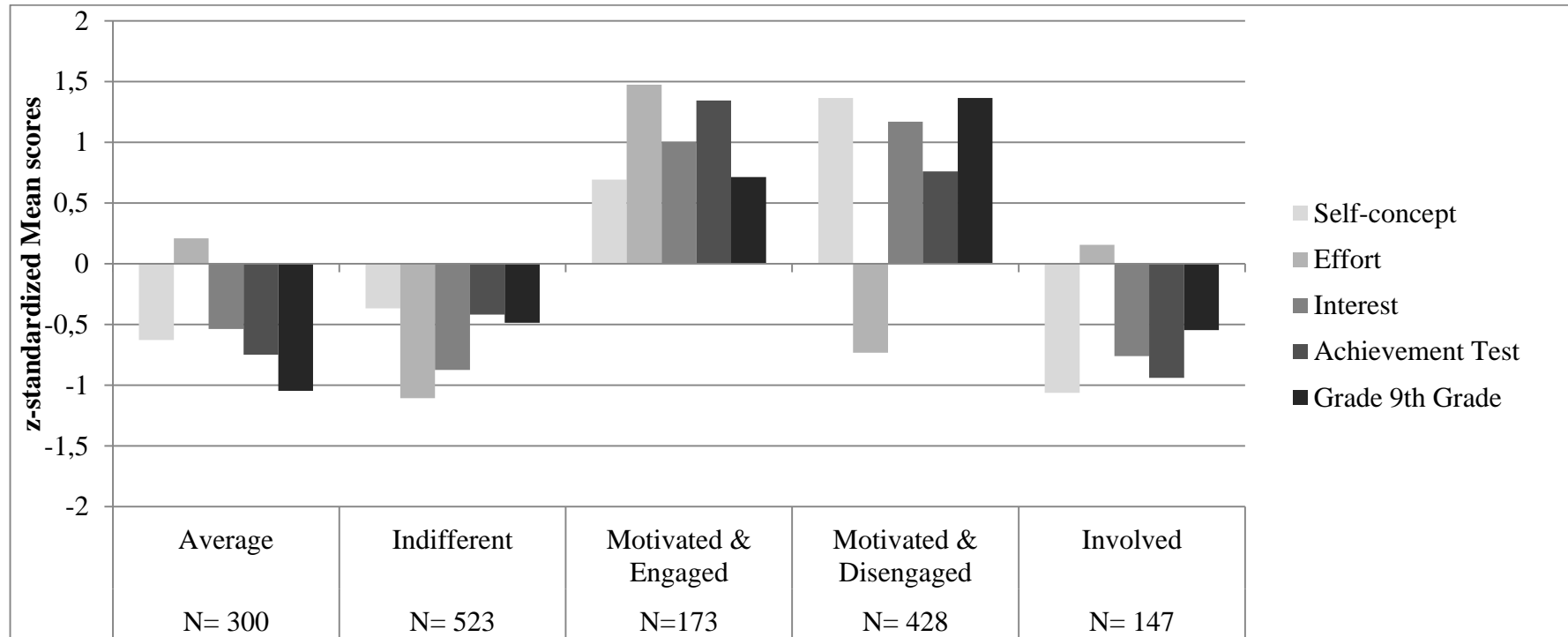


Figure 4. Adjusted mean scores for student outcomes at T2 depending on family type. The mean scores were adjusted by controlling for the respective student outcome at T1, SES, students' gender, IQ, and math grade in the eighth grade and z-standardizing them for presentation.

Investigating the statistical significance of differences between the different types of families, Table 1 presents the results of the structural equation modeling with *average families* as the reference group and controlling for the covariates SES, students' gender, IQ, and math grade at the end of Grade 8 as well as for students' initial values. We found statistically significantly higher levels of math self-concept for students from families characterized as *motivated and disengaged* at T2 ($\beta = .13$; $p = .030$) than for students from *average families*. In other words, students with the same initial self-concept level gained more confidence in their abilities when they came from families characterized as *motivated and disengaged* than from *average families*. By contrast, students from families classified as *indifferent* showed significantly lower levels of effort in math ($\beta = -.14$; $p = .012$) than students from *average families*. In detail, students with the same initial self-concept became less confident when they came from a family classified as *indifferent* compared with *average families*. Students from the other types of families did not differ significantly from students from *average families* in their academic motivation.

Concerning students' achievement outcomes at T2, students from families characterized as *motivated and engaged* performed statistically significantly better on the achievement test ($\beta = .20$; $p = .010$) and got better grades ($\beta = .14$; $p = .038$) than students from *average families*. In other words, students with the same initial performance and the same initial grades showed better achievement test scores and got better grades when they came from families characterized as *motivated and engaged* than from *average families*. The same pattern emerged for students from families characterized as *motivated and disengaged*: Again, controlling for their initial values, they also performed statistically significantly better on the achievement test ($\beta = .14$; $p = .022$) and got better grades ($\beta = .19$; $p < .001$) than students from families classified as *average families*. Students from the other types of families did not differ significantly in their achievement or their math grades compared with students from *average families*.

To further investigate the differential associations of students' outcomes with distinct family types, we calculated the adjusted means for all five family types (see Table S7 in the Supplemental Material). Regarding students' motivational outcomes, we found that students from families characterized as *motivated and disengaged* reported significant higher self-concepts at T2 than students from *average* ($\bar{x}_{\text{diff}} = .09$; $p = .030$) and *indifferent* families ($\bar{x}_{\text{diff}} = -.08$; $p = .029$). Additionally, students from *involved families* showed marginally significant

lower levels of self-concept than students from *motivated and disengaged* families ($\bar{x}_{\text{diff}} = -0.11$; $p = .053$). Students from *motivated and engaged* families showed higher levels of effort at T2 than students from *motivated and disengaged* families ($\bar{x}_{\text{diff}} = 0.12$; $p = .005$).

Regarding students' achievement outcomes at T2, students from *average* families performed significantly worse in the achievement test ($\bar{x}_{\text{diff}} = -.14$; $p = .022$) and got lower grades ($\bar{x}_{\text{diff}} = -.19$; $p < .001$) than students from *motivated and disengaged* families. Students from *indifferent* families ($\bar{x}_{\text{diff}} = -.15$; $p < .001$) and *involved* families ($\bar{x}_{\text{diff}} = -.15$; $p = .027$) also got lower grades than students from *motivated and disengaged* families.

Discussion

Which combination of academic involvement and other family characteristics is the most beneficial for students' academic outcomes? In the present study, we proposed that focusing on parents' academic involvement as a single indicator of family background might not suffice for understanding the possible beneficial or detrimental effects of parental academic involvement on students' academic outcomes. Therefore, we considered parents' motivational and child-specific beliefs as well as the parent-child relationship and parents' time and resources in combination with parents' level of academic involvement using a person-centered approach. When examining the interplay of these family characteristics, we were able to differentiate between five types of families: *average*, *indifferent*, *motivated and engaged*, *motivated and disengaged*, and *involved* families.

Moreover, cross-sectional and longitudinal analyses revealed meaningful differences in students' academic outcomes conditional on family type. In line with our hypotheses, if families were characterized by only high self-concept and high math interest (i.e., *motivated and disengaged*) or by high academic involvement accompanied by high motivational beliefs and enough time and energy (i.e., *motivated and engaged*), favorable motivational outcomes were found for students, and students showed higher levels of achievement and better math grades up to a period of 5 months. By contrast, if families were classified as *involved*—showing high levels of academic involvement and investing a lot of time and energy in their children's academic lives while simultaneously holding low child-specific and motivational beliefs—we did not find any positive associations with children's motivation and achievement. Thus, it seems as if parents' academic involvement is not detrimental or beneficial for students' academic development per se. High levels of parental academic

involvement had a positive effect on students' achievement but only when parents also held high motivational beliefs and had enough time and energy. To conclude, these findings indicate that studying the key aspects of family characteristics together is required for producing more insight into the meaning of parental academic involvement.

Applying a Person-Centered Approach to Family Background

Family background is a construct that cannot be sufficiently represented by one or two factors alone. Answering the call to investigate the synergistic effects of family characteristics in a more integrated way (Lazarides et al., 2015; Simpkins et al., 2015), our results indicate that it is not an isolated family characteristic that determines the development of a child but specific configurations of different family characteristics.

To assess the synergistic effects of several family characteristics on students' academic development in contrast to focusing on the unique influence of single family characteristics, we employed person-centered methods. By using latent profile analysis, we uncovered new insights into the nature of families and acquired a better understanding of how configurations of different family characteristics shape students' family background. Furthermore, our results highlighted the importance of parents' self-concept and family interest and offered a better understanding of the formerly inconsistent findings regarding parents' academic involvement. Moreover, all family types reflected specific levels and combinations of the six family characteristics that were studied. Therefore, a meaningful distinction and valid interpretation of the different family types was possible.

The Key to Understand the Effects of Parental Involvement: Parents' Motivation

Meta-analyses investigating the effects of the amount of parents' academic involvement have found rather inconsistent results (Fan & Chen, 2001; Hill & Tyson, 2009; Jeynes, 2007; Patall et al., 2008). Using a person-centered approach, we were able to show that the effects of academic involvement were shaped by other family characteristics. Parents from *involved* families perceived their child as high in the need for support and showed high levels of academic involvement, although they did not specifically like math and did not think they are particularly good at it. Students from *involved* families showed rather low levels of motivation and performed poorly in math. Why was the amount of parental academic involvement negatively associated with students' academic outcomes when accompanied by

low motivation for the subject and the perception of the child as high in the need for support? As we controlled for students' math grades at the end of eighth grade, we compared students with the same math grade at the end of Grade 8. Therefore, it is not the case that these students were just worse in math from the beginning on thereby leading to higher parental academic involvement. As parents act as role models (Eccles, 2007; Jacobs & Eccles, 2000), parents who hold a rather low self-concept in math themselves and do not particularly like it might pass this attitude on to their children through their involvement. Similarly, research has demonstrated that it is important that parents feel competent and able to get involved (Green et al., 2007; Grolnick, Benjet, et al., 1997). Thereby, a high self-concept enables successful parental involvement. In addition, the measure used to assess academic involvement did not differentiate between qualities of academic involvement. Rather, academic involvement was measured in a more controlling way (see item 'How often does it happen that you control your child's math homework?'). Thus, different findings might evolve when distinguishing between different types of involvement.

On the other hand and in line with our hypothesis, students from families classified as *motivated and engaged* reported high levels of motivation and performed well in math. Therefore, if parents are motivated in a specific subject, get involved in this subject, and have enough time and energy to get involved, students seem to profit from their parents' involvement. A reason why this combination of high involvement and high motivation might be beneficial for students is that high motivation for math might be transmitted to students from families classified as *motivated and engaged* through their involvement because parents pass these values on to their children as they act as role models (Eccles, 2007; Jacobs & Eccles, 2000). Moreover, if parents' enjoy getting involved because they are interested in the subject, they might get involved in more autonomy supportive way (e.g., Grolnick, 2015).

Most meta-analyses have demonstrated small to moderate associations between parental involvement and students' academic outcomes (Castro et al., 2015; Fan & Chen, 2001; Jeynes, 2007), a finding that also suggests that not being involved might be detrimental for students' academic outcomes. Yet, we found that students from families characterized as *motivated and disengaged* (i.e., families with low levels of academic involvement but high self-concept and interest) showed the most favorable motivational and achievement outcomes. Motivated and disengaged families also did not perceive their child as high in the need for support and showed low levels of time and energy. One could assume that children

from these families just performed better in math from the beginning and hence, did not need support. Yet, as we controlled for students' math grades when analyzing the association between family types and students' academic outcomes, we compared students with the same math grade at the end of Grade 8. Because we assessed the parent questionnaire at the beginning of Grade 9, students' math grade at the end of Grade 8 can be seen as the last information about students' math ability that parents received. Therefore, it is not the case that families classified as motivated and disengaged simply have children with better math abilities. Since we measured the amount of academic involvement, it does not mean that parents from families characterized as motivated and disengaged do not get involved into their students' lives at all. Rather, there is a general trend for less parental involvement when students' grow older (Singh et al., 1995). This also applies to average and indifferent families. The pattern of family characteristics of average families was similar to indifferent families—only slightly more positive—and students from average and indifferent families showed similar academic outcomes.

Investigating Associations between Family Types and Different Academic Outcomes

Did the investigation of several dimensions of students' academic outcomes uncover differential associations with family types? Controlling for SES, gender, IQ, and math grades, students from *motivated and engaged* and *motivated and disengaged* families—families in which parents reported high interest and self-concept in math—showed favorable motivational and achievement outcomes than students from *average* families. Moreover, we found differential associations between family types and students' effort in math. In line with our hypothesis, students from *motivated and engaged*—families characterized by high levels of parents' academic involvement—reported higher levels of effort in math than students from other family types (see also Dumont et al., 2013). Yet, this association was only marginally significant in the longitudinal analyses. In contrast, students from *indifferent* families—families characterized by low levels of academic involvement and low levels on all other family characteristics—reported significant lower levels of effort in math after five months. These results suggest that academic involvement might be a way in which parents can foster students' academic engagement (Dumont et al., 2013; Grolnick & Slowiaczek, 1994). However, if parents are not motivated for the subject they get involved in at the same

time, fostering their children's engagement might come at the expense of not promoting students' interest and self-concept.

Limitations and Future Research

With its person-centered approach, our study sheds light on the question of how different family characteristics shape the nature of families and how different configurations of family characteristics are related to students' academic outcomes. However, there are some limitations of our study that should be kept in mind when interpreting our results. First, families are a complex and multifaceted system shaped by various dimensions. Although we attempted to capture a broad variety of different family characteristics that have been identified as important for students' academic lives in several studies using distinct theoretical frameworks, the characteristics used in the present study were not comprehensive, and there might be several other important characteristics, such as the quality of parental academic involvement, that still need to be investigated.

Second, whereas we took a highly sophisticated approach in terms of our analyses and models (e.g., analyzing how academic motivation and the achievement of students from different family types develop over a period of 5 months via structural equation modeling, controlling for their pretest scores and further covariates), causal interpretations, even with our longitudinal models, should be made with caution. Parents interact with their children every day, thereby amassing considerably more information about students' academic development than assessed by our student questionnaire. Thus, it is possible that third variables that may influence students' academic development were neglected by our analyses. That is, parents might anticipate a negative academic development and therefore increase their level of academic involvement to prevent any kind of negative academic development. This change in parental academic involvement might not be reflected in the assessment via student questionnaire. Related to this issue, we only had data from one parent filling out the questionnaire. Future studies might want to include data on both parents to investigate differential patterns.

Third, we used a large sample to investigate the associations between family characteristics and students' academic outcomes; however, the sample in our study was limited to ninth-grade students in the highest track in Germany. Future research should investigate the generalizability of our results by testing whether the five different family types

are replicable in other age groups, different school types, and samples with a different ethnic and socioeconomic background.

Conclusion

In contrast to previous studies that have focused on structural family factors that are hard to change (e.g., SES), our study investigated more proximal family characteristics, which might be more malleable (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012), and tried to capture the intricate nature of families. Our findings suggest that it is not an isolated family characteristic that determines the development of a child but several family characteristics that influence students' development in conjunction with each other. Moreover, intervention programs that focus on increasing parents' academic involvement (for an overview, see Castro et al., 2015) should take into account the importance of parents' own motivational beliefs (e.g., Harackiewicz et al., 2012), as our results highlighted the importance of motivational family characteristics. Taken together, future research might profit from referring to the complex nature of families when investigating the associations between family background and students' academic outcomes.

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Supplement with Results from Additional Analyses

Table 1

Tests of Measurement Invariance for Effort, Interest, and Self-Concept across Time and Overall Structural Validity

Model	χ^2	<i>df</i>	CFI	TLI	RMSEA	SRMR
<i>Measurement invariance across time</i>						
M1: Configural invariance	1588.259	427	.957	.950	.042	.054
M2: Weak measurement invariance	1637.435	440	.956	.950	.042	.055
M3: Strong measurement invariance	1821.225	453	.950	.945	.044	.056
M4: Strict measurement invariance	1904.551	469	.947	.944	.044	.059
<i>Structural validity</i>						
M1: Family characteristics	1219.164	237	.938	.928	.051	.058
M2: Family characteristics and student outcomes	4000.859	1422	.944	.940	.034	.048

Note. Tests across time: $N = 1,560$; Test of Structural Validity $N = 1,571$. For all analyses, correlated residuals were allowed between identical items for analyses across time and for two negatively worded self-concept items and two effort and interest items, respectively.

Table 2
Descriptive Statistics for Family Characteristics and Student Outcomes at All Waves of Measurement

Variable	T1				T2				
	<i>N</i>	<i>M</i>	<i>SD</i>	α	<i>N</i>	<i>M</i>	<i>SD</i>	α	
Parent questionnaire									
Socioeconomic status	1540	65.33	16.14	-	-	-	-	-	-
Family math interest	1508	2.46	0.85	0.92	-	-	-	-	-
Parental math self-concept	1521	2.42	0.86	0.91	-	-	-	-	-
Child's need for support	1519	1.71	0.63	0.74	-	-	-	-	-
Academic involvement	1546	1.93	0.87	0.87	-	-	-	-	-
Child disclosure	1555	3.20	0.55	0.77	-	-	-	-	-
Time and energy	1521	2.75	0.73	0.74	-	-	-	-	-
Student outcomes									
Self-concept	1504	2.73	0.81	0.93	1402	2.79	0.77	0.93	
Effort	1503	2.83	0.55	0.82	1397	2.74	0.63	0.87	
Interest	1500	1.93	0.62	0.86	1398	1.91	0.62	0.87	
Achievement test	1472	49.86	17.40	-	1409	32.12	8.12	0.89	
Student grades									
Grade in the eighth grade	1560	4.26	0.94	-	-	-	-	-	-
Grade in the middle of the ninth grade	1566	4.08	0.97	-	-	-	-	-	-
Final grade in the ninth grade	1518	4.17	0.99	-	-	-	-	-	-

Note. Different achievement tests were used at T1 and T2. The time points for the assessment of students' grades differed from the time points for the other student outcomes.

Table 3

Descriptives and Intercorrelations of Variables Measured at Time 1

Variables	Family characteristics						Students' academic motivation					
	1	2	3	4	5	6	7	8	9	10	11	
1 Socioeconomic status												
2 Family math interest	.19***											
3 Parental math self-concept	.27***	.59***										
4 Child's need for support	.01	-.01	.14***									
5 Academic involvement	-.02	.12***	.31***	.61***								
6 Child disclosure	-.06*	.01	-.02	-.04	.04							
7 Time and energy	.03	.21***	.23***	.13***	.25***	.26***						
8 Students' self-concept	.11***	.36***	.23***	-.33***	-.15***	-.01	.08**					
9 Students' effort	-.07**	.12***	.06*	-.06*	.01	.19***	.12***	.31***				
10 Students' interest	.00	.31***	.16***	-.18***	-.07**	.03	.07**	.59***	.39***			
11 Achievement test	.16***	.25***	.19***	-.31***	-.21***	.03	.05†	.52***	.21***	.32***		
12 Grade in eighth grade	.15***	.23***	.19***	-.34***	-.20***	.12***	.06*	.58***	.27***	.28***	.57***	

Note. Bivariate correlations at the pretest are presented. The pattern of correlations at T2 was comparable.

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

Table 4
Selection Criteria for Model Comparisons with Different Profile Solutions

k	LL	SCF	#fp	AIC	BIC	SABIC	<i>p</i> VLMR
2	-9689.577	1.0235	19	19417.155	19518.985	19458.626	.000
3	-9422.199	1.0946	26	18896.399	19035.745	18953.149	.000
4	-9331.215	1.2933	33	18728.430	18905.293	18800.459	.132
5	-9236.727	1.2867	40	18553.454	18767.832	18640.761	.052
6	-9174.647	1.2553	47	18443.293	18695.188	18545.880	.060
7	-9127.768	1.2275	54	18363.535	18652.947	18481.400	.132
8	-9082.979	1.2411	61	18287.958	18614.885	18421.102	.174

Note. Boldface font indicates the selected model. AIC = Akaike information criterion; BIC = Bayesian information criterion; k = number of latent profiles in the model; LL = model log likelihood; #fp = number of free parameters; SABIC = sample adjusted BIC; *p*VLMR = Vuong–Lo–Mendell–Rubin likelihood ratio test; SCF = scaling correction factor of the robust maximum likelihood estimator.

Table 5

Average Posterior Probabilities (Row) for Most Likely Latent Profile Membership (Column)

	Average	Indifferent	Motivated and engaged	Motivated and disengaged	Involved
1	0.75	0.12	0.04	0.08	0.01
2	0.06	0.88	0.00	0.06	0.00
3	0.11	0.00	0.78	0.05	0.06
4	0.05	0.08	0.01	0.86	0.00
5	0.03	0.00	0.09	0.00	0.88

Note. Boldface font indicates the average posterior probability associated with the clusters to which students were assigned.

Table 6

Results of the LPA: Mean Differences in Family Characteristics between the Five Family Types

	Average <i>n</i> = 300	Indifferent <i>n</i> = 523	Motivated and engaged <i>n</i> = 173	Motivated and disengaged <i>n</i> = 428	Involved <i>n</i> = 147
Mean scores					
Academic involvement	2.13	1.29	2.85	1.49	3.77
Math interest	2.11	1.85	3.15	3.17	2.38
Math self-concept	2.27	1.68	3.26	3.00	2.62
Child's need for support	2.72	2.48	3.10	2.83	3.05
Child disclosure	3.19	3.19	3.26	3.19	3.20
Time and energy	2.04	1.39	2.15	1.38	2.53

Table 7

Adjusted means depending on group membership on student motivation and achievement at T2.

Variable	Self-concept	Effort	Interest	Achievement test	Midterm grade in ninth grade
Average	0.181 _a	-0.075 _{a,b}	0.019 _a	0.299 _a	0.728 _a
Indifferent	0.193 _a	-0.149 _c	0.007 _a	0.330 _{a,c}	0.773 _{a,c}
Motivated & Engaged	0.242 _{a,b}	-0.004 _{a,d}	0.074 _a	0.496 _b	0.869 _{b,c}
Motivated & Disengaged	0.273 _b	-0.128 _{b,c}	0.080 _a	0.441 _{b,c}	0.921 _b
Involved	0.161 _{a,b}	-0.078 _{b,c,d}	0.011 _a	0.281 _{ac}	0.768 _{a,c}

Note. Means within a column with different letters are significantly different at the $p < 0.05$ level. The adjusted means were calculated from the structural equation models controlling for the respective outcome at T1, SES, students' gender, IQ, and math grade in the eighth grade.

Supplementary Appendix

Sample Items and Scale Information.

Scale	Sample item	Origin
Family math interest	<p>In our family we are interested in math.</p> <p>In our family we like to get engaged in math.</p> <p>We can be really enthusiastic about math.</p>	Adapted from PISA study 2003 (Ramm et al., 2006)
Parental math self-concept	<p>If I had taken my child's last math exam, I surely would have gotten a good grade.</p> <p>Even I find it difficult to understand some of my child's math tasks.</p> <p>I am up to the mark in math.</p> <p>If my child made a mistake in math, I can explain what he/she did wrong.</p>	Adapted from Rakoczy, Buff, and Lipowsky (2005)
Child disclosure	<p>My child does not like telling me about his/her leisure activities.</p> <p>My child tells me how he/she is feeling.</p> <p>My child tells me about what happens at his/her school.</p> <p>My child tells me if he/she did something stupid.</p> <p>My child tells me about his/her performance in school.</p>	Kerr and Stattin (2000)
Time and energy	<p>I have enough time and energy...</p> <p>...to talk with my child about his/her school day.</p> <p>...to make sure that my child finishes his/her math homework.</p> <p>...to talk my child through his/her math homework.</p>	Adapted from Walker, Wilkins, Dallaire, Sandler, and Hoover-Dempsey (2005)
Academic involvement	<p>How often does it happen that...</p> <p>...you talk through an exam with your child if he/she got a bad grade?</p> <p>...you help your child correct important mistakes in his/her math homework?</p> <p>...you actively help your child if he/she had trouble understanding something in math class?</p> <p>...you control your child's math homework?</p> <p>...you help your child practice for a math exam?</p>	Adapted from DESI study (Wagner, Helmke, and Rösner, 2009)
Child's need for support	<p>My child needs my help during math homework to be able to do his/her best.</p> <p>My child's math teacher told me that my child needs support to be able to do well in math.</p> <p>The standard in my child's math class is so high that my child would not be able to understand the subject matter without my help.</p> <p>I support my child during homework, so that he/she can reach his/her full potential in math.</p>	Constructed by the authors

Student's mathematical self-concept	<p>I am good at math.</p> <p>I just do not have any talent for math. (recoded)</p> <p>Math just isn't my thing.</p> <p>Math comes naturally to me.</p> <p>I always struggle with math tasks. (recoded)</p>	Adapted from Marsh, Trautwein, Lüdtke, Köller, and Baumert (2005)
Student's effort in math	<p>I am very industrious in math.</p> <p>I give my best in math.</p> <p>I really work hard in math.</p> <p>I work on all math assignments and homework very thoroughly.</p> <p>I participate in math classes as best I can.</p>	Adapted from Trautwein, Lüdtke, Roberts, Schnyder, and Niggli (2009)
Students' interest in math	<p>I am interested in math.</p> <p>I like to occupy myself with books or quizzes related to math.</p> <p>Engaging in math is one of my favorite things to do.</p> <p>I often think it is fascinating what we learn in our math classes</p> <p>I would like to engage myself much more in some questions from my math classes</p> <p>After classes, I am often already curious about the next math lesson.</p>	Pekrun et al. (2002)

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STEM Career Paths from Middle School to
College: Parent and Student Interrelations

Häfner, I., Hulleman, C. S., Harackiewicz, J. M., Rozek, C. S., Nagengast, B., Trautwein, U. & Hyde, J. S. (to be submitted). STEM Career Paths from Middle School to College: Parent and Student Interrelations. To be submitted to *Child Development*.

Abstract

Using longitudinal data, the interrelations between parents' and students' science, technology, engineering, and mathematics (STEM) motivational beliefs (utility value and ability beliefs), and their associations with students' courses taking, achievement, and career aspirations are investigated. Students and parents were followed from middle school through high school and college. The results of path analyses of 301 families indicate that mothers' perceptions of students' ability in 7th grade predicted students' motivational beliefs, course-taking, and achievement in high school. Students' achievement during 10th grade predicted mothers' value beliefs in high school. Finally, mothers' value beliefs even predicted students' future STEM motivation, course-taking, and STEM career aspirations in college—over and above students' motivational beliefs, course-taking, and achievement in high school.

Keywords: academic motivation, STEM, utility value, career aspirations, course-taking

STEM Career Paths from Middle School to College: Parent and Student Interrelations

Why do some students aspire to careers in science, technology, engineering, and mathematics (STEM) whereas other students opt out? What keeps students motivated in STEM subjects throughout high school and into college? According to expectancy-value theory (EVT; Eccles, 2007; Eccles et al., 1983), students value beliefs and ability beliefs (i.e., motivational beliefs) influence students' achievement-related behaviors and choices. In turn, the parent socialization model embedded within EVT (Eccles, 2007; Jacobs & Eccles, 2000) suggests that parents play a major role in shaping students' motivational beliefs (for an overview, see Lazarides, Harackiewicz, Canning, Pesu, & Viljaranta, 2015). More specifically, parents' own value beliefs and their perceptions of their child's ability are expected to influence students' value and ability beliefs and thus students' achievement-related choices cumulatively over time (Rozek, Hyde, Svoboda, Hulleman, & Harackiewicz, 2015; Simpkins, Fredricks, & Eccles, 2015).

The impact of parents' motivational beliefs on students' beliefs is not merely a one-way street, as students' motivational beliefs and achievement may also influence their parents' attitudes about future educational and career options (Eccles, 2007; Simpkins et al., 2015). However, there is only scant evidence of such bidirectional relations in the literature. Moreover, the question emerges of how parents' value beliefs and perceptions of their child's ability influence students' career aspirations and students' academic choices through students' own value and ability beliefs. As college is a major step into adolescents' career paths, investigating the bidirectional relations between parents' and students' motivational beliefs on students' career aspirations and courses taken in college would yield valuable insights in the development of academic motivation and also major transitions and career aspirations.

The aim of the present study, thus, is to examine the bidirectional relationships between parents' and students' motivational beliefs in STEM subjects and to investigate their predictive power on students' college outcomes in STEM subjects. To this end, we used data from a longitudinal study and investigated interrelations between mothers' and children's value and ability beliefs, students' course-taking, achievement, as well as career aspirations from middle school to high school graduation to the first two years of college.

Parents' and Students' Motivational Beliefs

According to EVT, students' academic outcomes and choices are influenced by students' value beliefs regarding a task and ability beliefs about the probability of mastering a task (Eccles & Wigfield, 2002). Value beliefs include utility value, which describes the perceived individual usefulness of a task. Utility value is closely related to the subjective importance of a task (e.g., Durik, Vida, & Eccles, 2006; Gaspard et al., 2014). According to the parent socialization model embedded within EVT (Eccles, 2007; Jacobs & Eccles, 2000), the development of students' value beliefs is influenced by parents' value beliefs as parents act as role models and thus pass on their own value beliefs to their children (Jacobs & Eccles, 2000). Correspondingly, studies found that if parents value a subject themselves, the chances are higher that the student also values the subject (Frenzel, Goetz, Pekrun, & Watt, 2010; Gniewosz & Noack, 2012; Häfner et al., 2015b; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001; Lazarides et al., 2015).

Students' ability beliefs reflect students' evaluation of their competence in a domain (Eccles & Wigfield, 2002). According to EVT, parents play a major role in shaping students' ability beliefs as they act as interpreters of experiences and reality through their own perceptions of the child's abilities (Frome & Eccles, 1998; Jacobs & Eccles, 2000; Simpkins et al., 2015). In line with this assumption, Jacobs and Eccles (1992) found that mothers' perceptions of child's abilities mediated the influence of past performance on children's ability beliefs. Moreover, the impact of parents' perceptions of children's ability on students' ability beliefs might even be stronger than the effect of students' previous grades (Frome & Eccles, 1998). Overall, there is convincing empirical support that parents' positive beliefs in children's abilities are associated with ability beliefs in students (Frome & Eccles, 1998; Jacobs & Eccles, 1992; Neuenschwander, Vida, Garrett, & Eccles, 2007).

While previous literature has mostly investigated the influences of parents' beliefs on students' beliefs, the direction of influence might be bidirectional: Researchers highlight the theoretical importance of bidirectional relations between parent-child influences (e.g., Bronfenbrenner, 1986; Simpkins et al., 2015). Yet, most studies investigating parent-child associations used cross-sectional data (e.g., Jodl et al., 2001) or did not include both parents' and students' value beliefs at the same time points, so that bidirectional relations could not be investigated (e.g., Fredricks & Eccles, 2002; Frome & Eccles, 1998; Simpkins, Fredricks, & Eccles, 2012). In one of the few

exceptions, Simpkins et al. (2015) found that during elementary and early middle school parents mainly influence children rather than vice versa. As parents' influence on students decreases throughout adolescence (Milgram & Toubiana, 1999; Simpkins et al., 2015; Singh et al., 1995) and students' motivational beliefs consolidate during adolescence, student influences on parents might increase during middle and high school (Simpkins et al., 2015). More specifically, it has been argued that parents' motivational beliefs might be predominantly affected by students' achievement and not students' motivational beliefs (Neuenschwander et al., 2007; Simpkins et al., 2015). So far, this has not been systematically investigated so far.

Moreover, adolescence is a critical period in which the specialization of students' interest emerges and students' career aspirations develop (Wigfield, Tonks, & Klauda, 2009). The development of students' motivational beliefs in high school is therefore especially important for students' career paths in college. Thereby, investigating interrelations between parents' and students' motivational beliefs during this crucial time would yield valuable insights into the development of students' motivational beliefs and their impact on students' career paths.

Precursors of Students' Academic Aspirations

When the focus is on academic outcomes and occupational choice, students' motivational beliefs predict students' academic effort, achievement, and choices (Durik et al., 2006; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Nagengast, Trautwein, Kelava, & Lüdtke, 2013; Simpkins, Davis-Kean, & Eccles, 2006). Whereas students' value beliefs are especially important for students' actual course-taking and academic choices (e.g., Meece, Wigfield, & Eccles, 1990; Updegraff, Eccles, Barber, & O'Brien, 1996), students' ability beliefs are stronger predictors for achievement (e.g., Meece et al., 1990; Trautwein et al., 2012). Further, students' academic outcomes and career choices are also shaped by students' parents (Hill & Wang, 2015; Hyde, Else-Quest, Alibali, Knuth, & Romberg, 2006; Jodl et al., 2001; Noack, Kracke, Gniewosz, & Dietrich, 2010). Evidence suggests that both parental value beliefs and perceptions of their child's ability are associated with students' academic outcomes (Davis-Kean, 2005; Simpkins et al., 2015; Spera, 2005). According to several meta-analyses, parents' expectations, which can be defined as "the degree to which a student's parents maintained high expectations of the student's ability to achieve at high levels" (Jeynes, 2007, p. 89), show high

associations with students' achievement outcomes (Castro et al., 2015; Fan & Chen, 2001; Jeynes, 2007).

Similarly, parents' value beliefs predict not only students' value beliefs, but also students' occupational aspirations through both direct and indirect pathways (Jodl et al., 2001). For instance, Dotterer, McHale, and Crouter (2009) demonstrated that mothers' academic interest seems to buffer the decline of students' academic interest linked to the transition to junior high school. Harackiewicz, Rozek, Hulleman, and Hyde (2012) targeted parents' utility value beliefs by sending them information material about the usefulness of STEM courses for their children's future. Students whose parents received the materials took nearly one semester more STEM courses than students in the control group. Using the same dataset, Rozek et al. (2015) showed that the effect of this utility value intervention was mediated through changes in mothers' STEM utility value perceptions, thereby demonstrating the potential of parents' utility value perceptions for influencing students' academic choices.

Despite this convincing evidence of parents' impact on students' aspirations, most studies have investigated the associations of parents' and students' values on career aspirations in middle or high school and not in college (e.g., Frome & Eccles, 1998; Simpkins et al., 2012; Simpkins et al., 2015). As parents' motivational beliefs are highly associated with students' achievement (e.g., Castro et al., 2015; Frome & Eccles, 1998), investigating the unique associations between parents' motivational beliefs and students' academic outcomes over time, controlling for students' previous achievement is necessary to gain insights into the processes at play. Yet, longitudinal studies investigating both directional relations between parents' students' beliefs and their influence on students' aspirations in college controlling for students' previous achievement are missing so far.

The Present Study

In the United States, there is increasing concern regarding the constitution of the educational pipeline in STEM disciplines. Moreover, students' value beliefs in various subjects, particularly in mathematics and the sciences, declines dramatically during secondary school (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004) – yet, math and science are important prerequisites for STEM careers (National Science Board, 2007). Therefore, the present study focused on STEM motivation and achievement. To

gain insights into STEM career paths, it is necessary to understand the development of students' STEM motivation and aspirations from middle school to college and parents' impact on the development. Because college is a major step into students' career paths, investigating the prerequisites of students' motivation and career aspirations in college will yield valuable insights in the development of major transitions.

In order to examine the bidirectional relationship between parents' and children's values in STEM subjects and their associations with students' college outcomes in STEM subjects, a simultaneous assessment of parents' and children's value beliefs at each time point is necessary. Moreover, when examining parents' associations with students' academic outcomes, longitudinal data is necessary to interpret the ordering of the effects of parents' value beliefs on students' outcomes. In addition, when investigating parents' impact on students' academic outcomes, controlling for students' previous achievement is necessary to examine the processes at play. Acknowledging the developmental perspective, the present study is based on a longitudinal data set from middle school to high school graduation to the first two years of college and investigated the bidirectional relations of mothers' and students' value and ability beliefs, students' course taking and achievement, as well as career aspirations from middle school to college.

We had two major research questions: First, how are students' and parents' motivational beliefs for math and science interrelated over time? Although research suggests that parents' motivational beliefs influence students' motivational beliefs (see Lazarides et al., 2015), only a few studies have investigated to what extent students' beliefs and achievement predict their parents' beliefs. Simpkins et al. (2015) found that during early school years the direction of influence flows mainly from parents to students. Students' influences on parents might increase during middle and high school with students' achievement likely of particular importance (Simpkins et al., 2015).

Second, how do parents' and students' motivational beliefs predict students' STEM course-taking taken, achievement, and career aspirations in college? Research suggests that parents' motivational beliefs influence students' course-taking and achievement (e.g., Frome & Eccles, 1998; Jacobs & Eccles, 2000; Simpkins et al., 2015). Yet, the question of how parents' value beliefs influence students' motivation and career aspirations in college has not received much attention.

Method

Participants

The sample consisted of 301 U.S. high school students (52.5% girls) and their parents from the longitudinal Wisconsin Study of Families and Work (WSFW; for details of recruitment, see Hyde, Klein, Essex, & Clark, 1995). Women in the fifth month of pregnancy were originally recruited through physicians' offices and clinics in the Milwaukee (80% of sample) and Dane County (20%) areas of Wisconsin, and families have been followed longitudinally through the first two years in college. The average age of mothers at recruitment was 29 years (range 20 to 43); 95% of the mothers were married to the father. Mothers averaged 15.32 years of education ($SD=2.03$). Household income averaged \$51,066 (median = \$50,000) per year at the beginning of the study (1990-1991). In 1991, the median income of married couple families in the United States with the wife in the paid labor force was \$48,169 (U.S. Department of Labor, 1993).

The students attended 108 different high schools and the majority (95%) graduated, with 94% reporting plans to attend college or technical school. Ninety percent of the adolescents were European American, 1% was African American, and 8.9% were biracial or multiracial. This is representative of the Wisconsin population where students of color comprise 10% of state residents (U.S. Census Bureau, 2006). Data were collected from two cohorts of students, with one cohort graduating from high school in 2009 and the other in 2010 (see Harackiewicz et al., 2012, for further details).

Procedure

Mothers were interviewed and they filled out questionnaires repeatedly in the longitudinal study. The focus of the current article was data collected when the child was in 7th grade, 12th grade, and in college. At 7th grade, mothers filled out a questionnaire and students answered questions laptop during an in-home visit. At grade 12, parents received mailout questionnaires in the summer following their adolescent's 12th grade year. The student questionnaire was emailed a link to the survey or were sent a paper copy of the questionnaire. In addition, high school transcripts were collected from the students' schools and were coded for STEM course-taking and STEM GPA. In college, students answered questionnaires immediately after completion of the sophomore year of college.

Starting in October 2007 (10th grade), an intervention designed to increase parental knowledge regarding STEM utility value was administered to approximately half the participants (for more details, see Harackiewicz et al., 2012). The current paper is not concerned with the intervention and therefore does not include families in the experimental group participating in the intervention.

Measures

Mothers' and students' variables were assessed via separate questionnaires. All items can be found in the Appendix.

7th-grade motivation measures. Both students and mothers completed self-report surveys during students' 7th-grade year. To measure students' perceptions of the utility value of math, we used two items (e.g., "How important do you think math will be to your future?") to create a students' math value scale ($\alpha = .69$). Students' math ability beliefs were measured using four items (e.g., "How good are you at math?"; $\alpha = .88$). Mothers' perceptions of their child's ability in math was measured with four items (e.g., "How good is your child in math?") to create a mothers' math ability perception scale ($\alpha = .90$) and mothers' math value perception for the child was measured using one item ("How important is it that your child learns math?").

10th grade STEM achievement. We obtained high-school transcripts for the 301 students in the sample. Data were then extracted from the transcripts. Standardized science test scores were taken from the Wisconsin Knowledge and Concepts Exam (WKCE), which is administered to all Wisconsin students in public schools in October of 10th grade. These scores were missing for students who had moved to other states and for those who attended private schools or were home schooled.

High school GPA and courses taken. We obtained high-school transcripts for the 301 students in the sample. Transcripts were coded for STEM courses taken by counting the number of semesters of mathematics and science taken during the last two years of high school (high school STEM courses). We focused on 11th- and 12th-grade because students have the most choice about coursework during the last two years of high school. This was supported by our initial analyses which indicated very little variability in courses taken during the first two-years of high school. Transcripts were also coded for mathematics and science academic performance, which was calculated based on the standard 4-point scale (A = 4 points, B = 3 points, C = 2 points, D = 1 points). We

computed a high school STEM GPA variable by combining grades from high school STEM courses taken in 11th- and 12th-grade.

12th grade motivation measures. Both students and mothers completed surveys during the summer following the adolescent's 12th grade year. These questionnaires were completed online, unless paper copies were requested, and we obtained surveys from 264 students (88%) and 265 mothers from the sample of 301 families. To measure students' perceptions of the utility value of math and science courses, we used four items (e.g., "I think math and science will be useful in my daily life.") to create a students' STEM utility value scale ($\alpha = .92$). Students' math ability beliefs were measured with four items (e.g., "How good at math are you?", $\alpha = .91$). Mother's perceptions of the utility value of math and science courses was measured with 4 items (e.g., "In general, how useful will biology be for your teen in the future?") to create a mothers' STEM utility value scale ($\alpha = .84$).

College STEM course taking, on-going motivation, and career aspirations. In order to capture teens' ongoing motivation in STEM fields, students completed a short survey in the summer following their sophomore year of college. First, students reported on the number of math and science courses they had taken in college (*STEM courses*). Second, students responded to three questions regarding their *future STEM motivation* ("I want to take more math and science classes in the future"; $\alpha = .92$). Third, to measure students' *STEM career aspirations*, students were asked what job or career they would like to have when they turned 30. Each job was coded for the amount of mathematics and science required for that occupation using the O*Net (Occupational Information Network) Resource Center's database (U.S. Department of Labor Employment and Training Administration, 1998), which is used to quantify each occupation on a scale of 0 to 100 in terms of the knowledge required from various fields (mathematics, biology, chemistry, physics, engineering). O*Net scores are based on data from workers and occupation experts compiled by the U.S. Department of Labor. For example, for a pharmacist, mathematics = 75, biology = 79, chemistry = 85, and physics = 20. If students listed more than one occupation, the first one listed was coded. Student responses were coded by two independent research assistants ($\alpha = .79$). The average value from all five areas was used as the students' math and science career aspiration score (STEM career aspirations).

Statistical Analyses

Path Analyses. Path modeling, using Mplus version 7.1 (Muthén & Muthén, 1998-2012), was used to investigate the relationships between mother and student variables over time. All analyses used the robust maximum likelihood estimator. The variables used in the path models were mothers' math ability perceptions and mothers' perceptions of math value in 7th-grade, students' math value and students' math ability beliefs in 7th-grade, and students' 10th grade STEM achievement. The variables in high school were students' STEM courses, high school STEM GPA, as well as students' STEM utility value, students' math ability beliefs and mothers' perception of STEM utility value. The model indicators for college were STEM courses taken in college, students' future STEM motivation, and students' STEM career aspirations. In addition, a dummy code for data collection cohort, child's gender (0 = female, 1 = male), and mother's education (continuous variable) were included as covariates in all analyses.

To evaluate model fit, the following fit indices were used (Hu & Bentler, 1999): the chi-square goodness of fit, the comparative fit index (CFI), the standardized root mean square residual (SRMR), and the root mean squared error of approximation (RMSEA). Good model fit is indicated by a non-significant χ^2 -test statistic, a CFI greater than 0.95, a SRMR less than 0.06, and a RMSEA less than .08 (Hu & Bentler, 1999).

Two sets of path models were compared. In the mediated model, we examined the hypothesized bidirectional relationships between mothers and adolescents by testing a fully mediated longitudinal model. In this model, paths were specified between variables at adjacent time points, but not at non-adjacent time points. Variables at the same time point were allowed to correlate. Specifically, variables collected during middle school (mothers' math ability perceptions, mothers' perceptions of math value, students' math value, students' math ability beliefs) and students' 10th grade STEM achievement predicted variables assessed during high school (STEM courses, STEM GPA, students' STEM utility value, students' math ability beliefs and mothers' perception of math value). These high school variables then predicted college variables (STEM courses, STEM career aspirations, on-going STEM motivation). Therefore, no direct paths from variables assessed in middle school to college outcomes were estimated. In addition, the dummy variable indicating the cohort, child's gender (0 = female, 1 = male), and mother's education (continuous variable) were included as predictors for all variables. The fit of this fully mediated model was compared to the fully saturated model where all variables

at previous time points predicted all variables at future time points and correlations between variables at the same time points were allowed. Thus, a good fit of the mediated model would suggest that the effects of middle school variables on college outcomes are mediated through high school variables.

Preliminary analyses examined all two-way interactions including interactions with gender and mothers' education using procedures outlined by Aiken and West (1991). There was no systematic pattern of significant interactions and thus they are not reported here.

Missing data. Because of the longitudinal design, there was substantial missingness in the data. Following the recommendations in Graham (2009), full information maximum likelihood estimation (FIML) was used to account for missing data, which ranged from 1.3% to 39.5 % for the various variables. O*Net Codes for students' career aspirations were only obtained for some students, therefore 37.9% were missing. To validate the results, we reran the analyses by using only cases in which O*Net Codes were available, resulting in a subsample of N=187. The regression coefficients were very similar (difference of β s: Median ($\beta_{N=301} - \beta_{N=187}$) = -0.004) to the estimates observed in the complete sample. Most importantly, the effects on career aspirations did not change (difference of β s: $|0.001| \leq |\beta_{diff}| \leq |0.011|$) and remained significant. Therefore, only results using the complete sample of N=301 will be reported.

Results

We first present descriptive analyses and the test of the longitudinal mediation model. Subsequently, our first research question which dealt with the existence of bidirectional relations between students' motivational beliefs and achievement and mothers' motivational beliefs will be presented. Finally, effects of students' and mothers' motivational beliefs on students' college outcomes will be described.

Descriptive Analyses

Descriptive statistics, including means and standard deviations for all variables depending on student gender are shown in Table 1. Bivariate correlations can be found in Table 2. Values presented in Table 2 are those estimated on the full sample (N = 301) using maximum-likelihood in Mplus 7, and are the foundation of the path analyses presented next.

Table 1

Descriptive statistics for all variables by child sex.

			Female	Male	difference	p-value	Total
Control variables	Mother Education	Mean	15.41	15.24	0.17	.483	15.33
		N	154	140			295
		SD	2.15	1.89			2.03
10th grade STEM achievement		Mean	476.79	482.71	-5.91	.258	479.27
		N	95	85			182
		SD	33.61	36.48			35.15
Students' math value		Mean	6.15	5.93	0.22	.102	6.04
		N	141	128			269
		SD	0.93	1.16			1.05
7th grade	Students' math ability beliefs	Mean	4.66	4.74	-0.09	.278	4.70
		N	141	128			269
		SD	0.66	0.70			0.65
Mothers' math value perception		Mean	6.76	6.78	-0.02	.751	6.77
		N	139	129			268
		SD	0.55	0.50			0.52
Mothers' math ability perception		Mean	5.14	5.18	-0.04	.735	5.16
		N	139	129			268
		SD	1.03	1.07			1.05
STEM Courses		Mean	7.69	7.68	0.02	.958	7.69
		N	136	123			260
		SD	1.89	2.81			2.36
STEM GPA		Mean	3.02	2.70	0.32	.001	2.87
		N	136	121			258
		SD	0.72	0.81			0.78
High school utility value	Students' STEM	Mean	4.49	4.99	-0.10	0.63	4.93
		N	146	117			264
		SD	1.71	1.63			1.67
Students' math ability beliefs		Mean	4.41	4.54	-0.12	.272	4.46
		N	146	117			264
		SD	0.92	0.86			0.90
Mothers' STEM utility value		Mean	3.82	3.70	0.12	.290	3.77
		N	138	126			265
		SD	0.95	0.91			0.93
Future STEM Value		Mean	5.02	5.32	-0.30	.209	5.15
		N	126	90			216
		SD	1.81	1.62			1.73
College	STEM Courses	Mean	7.13	7.09	0.04	.951	7.11
		N	119	78			197
		SD	4.19	3.78			4.02
College Career Aspirations		Mean	28.81	32.39	5.58	.150	30.25
		N	112	75			187
		SD	13.84	18.14			15.76

Note. For some student there was no information on gender. Therefore total scores can include an additional student than gender difference tests.

Table 2

Correlations among all variables by gender (males above the diagonal and females below).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Control variables	1 Cohort	1	.13	-.06	.00	-.04	-.05	-.05	.00	-.01	-.02	-.24 **	.12	.14	-.23 *	.04
	2 Mother Education 10th grade	.02	1	.25 *	.04	.15	-.02	.09	.16	.26 **	.09	.04	.31 ***	.20	.28 *	.12
	3 STEM achievement	.04	.13	1	.08	.27 *	.21	.41 ***	.17	.55 ***	.20	.29 *	.28 *	.11	.36 *	.28
7th grade	4 Students' math value	.22 **	.16	.17	1	.31 ***	.05	.07	-.04	-.02	.20 *	.21 *	-.08	.32 **	.15	.11
	5 Students' math ability beliefs	-.01	.08	.34 **	.25 **	1	.02	.42 ***	.21 *	.19 *	.23 *	.40 ***	.05	.31 **	.10	.08
	6 Mothers' math value perception	-.02	-.10	.00	-.01	-.03	1	.35 ***	-.03	.22 *	-.03	.14	.13	-.07	-.13	.02
	7 Mothers' math ability perception	-.06	.08	.46 ***	.04	.56 ***	.13	1	.22 *	.39 ***	.27 **	.41 ***	.23 *	.25 *	.29 *	.14
High-school	8 STEM Courses	.06	.11	.38 ***	.11	.24 **	.20 *	.31 ***	1	.26 **	.38 ***	.16	.45 ***	.27 *	.38 **	.39 **
	9 STEM GPA	-.04	.30 ***	.40 ***	.04	.29 **	.04	.34 ***	.19 *	1	.28 **	.36 ***	.45 ***	.25 *	.40 **	.36 **
	10 Students' STEM utility value	.08	.08	.15	.23 **	.31 ***	.02	.35 ***	.42 ***	.18 *	1	.57 ***	.45 ***	.55 ***	.39 **	.40 **
	11 Students' math ability beliefs	.07	-.01	.20	.12	.32 ***	.07	.33 ***	.34 ***	.37 ***	.62 ***	1	.25 *	.43 ***	.32 **	.18
	12 Mothers' STEM utility value	.03	.02	.28 **	.18 *	.18 *	.08	.26 **	.41 ***	.27 **	.50 ***	.27 **	1	.39 ***	.49 ***	.47 ***
College	13 Future STEM Value	.15	.08	.19	.20 *	.25 **	-.04	.25 **	.39 ***	.21 *	.65 ***	.47 ***	.47 ***	1	.46 ***	.48 ***
	14 College STEM Courses	-.26 **	.06	.26 *	-.09	.19	.11	.29 **	.40 ***	.31 **	.38 ***	.33 ***	.46 ***	.52 ***	1	.60 ***
	15 Career Aspirations	-.04	-.13	.16	.05	.13	.06	.08	.30 **	.02	.42 ***	.27 **	.36 ***	.57 ***	.48 ***	1

Note. Gender (0 = female, 1 = male). *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. $N = 301$.

Longitudinal Mediation Model

In the mediated model, all paths from variables at adjacent time points were estimated and variables at the same time point were allowed to correlate. Therefore, effects from variables assessed in middle school on variables assessed in college were mediated through high school variables. The fully mediated model provided a good fit to the data: $\chi^2(15) = 20.58$, $p = .151$; CFI = .99; SRMR = .02; RMSEA = .04. As the χ^2 -Test indicated that the mediated model did not fit the data worse than the saturated model, the mediated model was preferred. In addition, the increase in predictive power in the fully saturated model was marginal, with an average increase in R^2 of 1.1% across all the variables in the model (see Table 3). The parameter estimates of the middle school variables predicting the five high school outcomes in the mediated model are shown in Table 4. Parameter estimates of the high school variables predicting students' college outcomes can be found in Table 5.

Bidirectional interrelations. Path coefficients from students' and mothers' middle school variables on high school indicators from the mediated model can be found in Table 4. In Figure 1, only significant paths are illustrated ($p < .05$). As presented in Figure 1, students' gender and mothers' years of education were not significantly associated with students' and mothers' motivational variables during middle school. Regarding the stability of students' and mothers' motivational beliefs, students' math values at grade 7 only marginally significantly predicted students' STEM utility values in high school ($\beta = .14$, $p = .068$). Students' math ability beliefs at grade 7 predicted students' math ability beliefs in high school ($\beta = .21$, $p = .019$). In contrast, mothers' motivational variables at grade 7 did not significantly predict mothers' STEM utility perceptions in high school.

Table 3

R-squared values for the fully mediated and saturated models.

	Mediated	Saturated	Difference
10th grade STEM achievement	.231	.235	.004
HS STEM Courses	.093	.093	.000
HS STEM GPA	.336	.341	.005
HS Students' STEM utility value	.138	.132	-.006
HS Students' math ability beliefs	.200	.198	-.002
HS Mothers' STEM utility value	.112	.111	-.001
College Future STEM Value	.432	.453	.021
College STEM Courses	.427	.470	.043
Career Aspirations	.258	.291	.033
Mean	.247	.258	.011
Fit Indices			
Chi-square	20.58(15), $p = .151$	-- ^a	
RMSEA	.035	-- ^a	
CFI	.999	-- ^a	
SRMR	.021	-- ^a	

Note. a Fit statistics are not available for the saturated model because all possible parameters were tested, including direct paths between variables and correlations between variables within the same time point.

Table 4

Standardized path coefficients of middle school (MS) variables predicting high school (HS) outcomes from fully mediated model.

Variable	10th grade STEM achievement		HS STEM utility value		HS math ability beliefs		HS mothers' STEM utility value		HS STEM courses		HS STEM GPA	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
Cohort	-.06	(.07)	.04	(.06)	-.05	(.06)	.09	(.06)	.04	(.06)	.00	(.05)
Gender (1=male)	.10	(.06)	.02	(.06)	.05	(.06)	-.08	(.06)	-.03	(.06)	-.25***	(.05)
Mothers' Education	.15**	(.05)	.02	(.06)	-.06	(.06)	.10†	(.06)	.09	(.06)	.20***	(.05)
MS students' math value	.08	(.07)	.14†	(.08)	.07	(.07)	-.01	(.08)	-.06	(.07)	-.08	(.06)
MS students' math ability beliefs	.08	(.10)	.10	(.08)	.21*	(.09)	-.02	(.07)	.10	(.08)	.05	(.07)
MS mothers' math ability perception	.36***	(.08)	.24**	(.08)	.20*	(.09)	.12	(.08)	.16*	(.08)	.16*	(.08)
MS mothers' math value perception	-.01	(.06)	-.06	(.06)	.03	(.07)	.07	(.06)	.02	(.07)	.07	(.05)
10th grade STEM achievement			.05	(.07)	.13	(.08)	.21*	(.09)	.10	(.08)	.35***	(.07)

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$.

Table 5

Standardized path coefficients predicting college STEM outcomes from fully mediated model.

Variable	College STEM Courses		STEM Career Aspirations		Future STEM Motivation	
	Mediated		Mediated		Mediated	
	Est.	(SE)	Est.	(SE)	Est.	(SE)
Cohort	-.29***	(.06)	-.05	(.07)	.09†	(.05)
Gender (1=male)	.02	(.05)	.13†	(.07)	.04	(.05)
Mother's Education	.05	(.06)	-.12†	(.06)	.04	(.05)
HS STEM Courses	.16*	(.07)	.17*	(.08)	.02	(.07)
HS STEM GPA	.15*	(.06)	.04	(.08)	.00	(.08)
HS students' STEM utility value	.12	(.09)	.23**	(.09)	.44***	(.09)
HS students' math ability beliefs	.11	(.08)	-.03	(.08)	.15*	(.08)
HS mothers' STEM utility value	.29***	(.05)	.24**	(.08)	.16*	(.06)
R ²	.427		.258		.432	

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$.

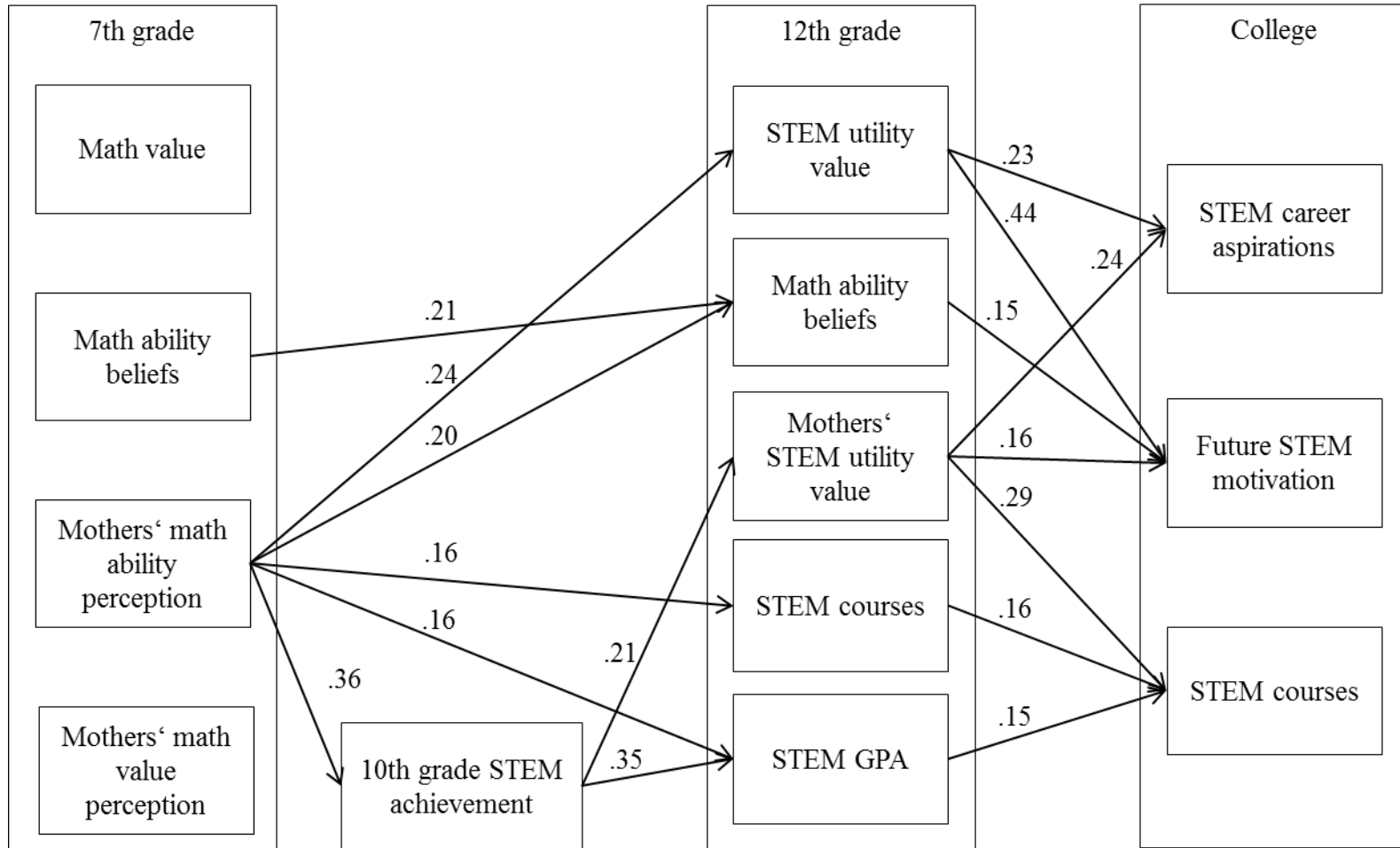


Figure 1. Fully mediated model with predictors of college STEM outcomes. Only significant paths ($p < .05$) are presented.

Looking at the relations between students' and mothers' variables, mothers' value perceptions at seventh grade had no influence on any high school variable, whereas mothers' perceptions of adolescents' abilities predicted students' ability beliefs ($\beta = .20$, $p = .034$) and utility beliefs ($\beta = .24$, $p = .005$), as well as courses taken in high school ($\beta = .16$, $p = .042$), and GPA ($\beta = .16$, $p = .039$)—over and above students' achievement during 10th grade. In contrast, students' utility and ability beliefs at grade 7 did not predict mothers' STEM utility perceptions in high school. Instead, students' achievement in grade 10 predicted mothers' STEM utility perceptions in high school ($\beta = .21$, $p = .019$). To conclude, there is convincing evidence for mothers' influence on students' from middle to high school, whereas mothers' STEM utility value was influenced by students' achievement and not students' motivational beliefs. Overall, the model accounted for 13.8% of the variance in students' utility beliefs, 20.0% of the variance in students' ability beliefs, and 11.2% of the variance in mothers' STEM utility perceptions. In addition, the model accounted for 9.3% of the variance in students' STEM courses taken during high school and 33.6% of the variance in students' STEM GPA in high school.

Effects on students' college outcomes. Path coefficients from students' and mothers' middle school variables on high school indicators from the mediated model can be found in Table 5. As presented in Figure 1, students' utility value beliefs in high school predicted students' STEM career aspirations in college ($\beta = .23$, $p = .008$) and students' future STEM motivation in college ($\beta = .44$, $p < .001$). In addition, students' ability beliefs in high school predicted students' future STEM motivation in college ($\beta = .15$, $p = .046$). Students' STEM course-taking during college was predicted by students' STEM course taking during high school ($\beta = .16$, $p = .022$) and students' STEM GPA ($\beta = .15$, $p = .014$). Additionally, mothers' utility value perceptions during high school predicted students' STEM course-taking in college ($\beta = .29$, $p < .001$)—above and beyond students' motivational beliefs, achievement, and course-taking in high school. Moreover, mothers' utility value perceptions during high school also predicted students' future STEM motivation ($\beta = .16$, $p = .010$) and students' career aspirations in college ($\beta = .17$, $p = .047$)—controlling for students' motivational beliefs, achievement, and course-taking in high school. As students' STEM GPA during high school is correlated with both students' ability beliefs during high school ($r = .25$, $p < .001$) and mothers' utility value perceptions ($r = .23$, $p < .001$), the reported effects represent unique effects of the predictors controlling for the other predictors in the model. Overall, the model accounted for 25.8%

of the variance in students' STEM career aspirations, 42.7% of the variance in students' STEM course taking, and 43.2% of the variance in students' future STEM motivation.

Discussion

This study investigated interrelations between mothers' and students' value beliefs and their associations with students' course-taking, future STEM motivation, and career aspirations in STEM subjects from middle school to college. We found that mothers' math ability perception in seventh grade predicted students' STEM utility value, STEM ability beliefs, as well as students' STEM course taking and GPA—controlling for students' motivation in grade 7 and students' STEM achievement in grade 10. In contrast, students' math values and ability beliefs did not influence mothers' math utility value over time. Instead, mothers' STEM utility values were influenced by students' achievement in STEM subjects. Therefore, our results highlight the importance of feedback loops through which students and parents influence each other (e.g., Simpkins et al., 2015): Whereas mothers' motivational beliefs influence students' motivation and academic behavior (i.e., courses taken and achievement), students' achievement influences mothers' motivational beliefs. Regarding students' outcomes in college, mothers' perceptions of utility value of STEM subjects for their children was a stronger predictor of students' courses taken in math and science in college than students' own perceptions of utility value—controlling for students' courses taken in high school and students' GPA. Similarly, mothers' perceptions of utility value at the end of twelfth grade significantly predicted students' future STEM motivation and STEM career aspirations in college. Thus, parents have a strong influence on their children and this influence does not end when their children become teenagers or even when they graduate from high school. To conclude, our results yield new insights into ways through which parents influence their children's educational pathway from middle school through high school graduation to college.

Students' STEM Motivation, Achievement, and Courses taken

How important is students' motivation for their STEM career paths compared to their achievement and courses taken? The stability of students' value and ability beliefs from middle school to high school were rather low. For students' value beliefs this is not surprising, since we assessed students' math value beliefs in 7th grade, but students'

STEM utility beliefs in 12th grade. Yet, math is an important prerequisite for STEM careers (National Science Board, 2007). From high school to college, the stability of students' STEM value was higher. Thereby, high school seems to be a suitable setting for interventions to foster students' math or science value beliefs (see also Gaspard et al., 2015; Häfner et al., 2015b).

Regarding students' college outcomes, students' STEM utility value beliefs predicted students' STEM career aspirations and future STEM motivation over and above students' STEM achievement during high school. In line with previous studies, these results support Eccles et al. (1983) Expectancy-Value theory and demonstrates the importance of value beliefs in predicting career aspirations (e.g., Updegraff et al., 1996). Students' math ability beliefs during high school only predicted students' future STEM motivation in college. First, this may be due to the fact that we measured students' math ability beliefs in high school and not specifically students' STEM ability beliefs. Second, students' math ability beliefs were related to students' high school STEM GPA. Since we investigated the unique effect of students' math ability beliefs on college outcomes controlling for GPA, math ability beliefs did not predict students' outcomes over and above GPA. Third, value beliefs have been found to be more predictive of students' career aspirations, course-taking, and future motivation than ability beliefs (Meece et al., 1990; Updegraff et al., 1996).

Parental Influences on Students' STEM Motivation, Achievement, and Courses taken

What role do parents play in students' educational pathways into STEM subjects? Mothers' math ability perception of their children at grade 7 predicted students' high school GPA, controlling for not only students' own motivational beliefs, but also students' STEM achievement in grade 10. In other words: Comparing students with the same motivational beliefs at grade 7 and the same achievement in grade 10, students' whose mothers perceived their child as higher in math ability, achieved a higher STEM GPA at the end of high school. This effect highlights the importance of parents' motivational beliefs for the development of not only students' motivation, but also students' academic outcomes. Similarly, we found that mothers' math ability perception of their children at grade 7 predicted students' high school STEM courses taken—over and above students' own motivational beliefs and students' STEM achievement in grade 10. To conclude, students' educational attainment (i.e., GPA and courses taken) is

interwoven with motivational beliefs, and parents play a crucial role all along the path. Moreover, these results support the assumptions of the parent socialization model embedded in EVT (Eccles, 2007; Jacobs & Eccles, 2000).

Regarding students' college outcomes, mothers still played a role for their children's educational future. Over and above students' high school GPA, courses taken, and motivational beliefs, mothers' utility value beliefs of STEM subjects for their children predicted all three college outcomes: students' STEM courses taken, future STEM motivation, and STEM career aspirations. Despite the fact that former research demonstrated that parents' influence on students decreases throughout adolescence (Milgram & Toubiana, 1999; Singh et al., 1995), parents still play a major role in shaping students' educational pathways. Although researchers argued that students' influences on parents might increase during adolescence (e.g., Simpkins et al., 2012), we found that the direction of influence comes mainly from parent to student—even during adolescence. In line with former research, parents' utility value beliefs were influenced by students' academic achievement (e.g., Simpkins et al., 2015). Clearly, this study demonstrates parental influences on students' educational pathways, not only in early years (Simpkins et al., 2015), but also into college.

Implications

Understanding the influences of families on students' academic development is highly relevant for practice, as schools are institutions that aim to foster academic development for students. Therefore, research investigating how students' STEM motivation and students' career aspirations develop over time is necessary to find ways to promote students' motivation in STEM subjects (e.g., Harackiewicz et al., 2012). In contrast to previous studies focusing on structural family factors that are hard to change (e.g., SES); our study investigated more proximal family characteristics, which might be more malleable to change (e.g., Rozek et al., 2015), and tried to capture the interrelations between students' and parents' motivational beliefs. In general, schools, teachers, and programs promoting student motivation need to take into account the importance of parents' motivational beliefs (see also Häfner et al., 2015a). As a next step, intervention studies could build on our work and try to foster parents' motivational beliefs. Since the stability of students' motivational beliefs over time was rather low, interventions to target parents' motivational beliefs early on might result in cascading effects on students'

motivational beliefs and ultimately students' educational outcomes (Harackiewicz et al., 2012).

Limitations and Future Research

Using a longitudinal design from middle school to college, our study provided evidence that parents' motivation plays a major role in shaping students' career paths into STEM subjects. Although data came from multiple sources (mothers' reports, students' reports, and school records), some limitations should be kept in mind when interpreting the results. First, the sample used in the present study showed above-average income and education and was mostly white. To verify external validity of this study, replicating the results with a more diverse sample in terms of parental education, income, and ethnicity will be crucial.

Second, we found support for the importance of mothers' utility values and perception of their children's ability beliefs for the development of students' motivation and achievement-related behavior. That said, future studies should investigate the processes through which parents' beliefs influence students' motivation and achievement. Simpkins et al. (2012) demonstrated that parental behaviors such as modeling, encouragement, and coactivity seem to mediate the effects of parents' motivational beliefs on students' motivational beliefs (see also, Simpkins et al., 2015). In addition, Hyde et al. (2015) were able to demonstrate, that both elaboration and personal connections mothers' made in hypothetical communications with their children, predicted students' STEM interest and utility value, as well as their STEM courses taken.

Third, although using a longitudinal data set and controlling for students' achievement at 10th grade, a cautious interpretation of results is necessary since causal interpretations cannot be made due to the possibility of third-variables explanations. Nevertheless, as students cannot be randomly assigned to parents, longitudinal nonexperimental survey studies are one of the best available options for studying the interplay of parents' and children's motivational beliefs.

Finally, we only used data from mothers. To gain more insights into the processes at play, investigating the individual importance of mothers' and fathers' motivational beliefs for the development of students' academic motivation would be a promising next step. Moreover, we did not find any systematic gender differences in the relations of parents' and students' motivational beliefs. Differentiating between parent genders might

be encouraging to investigate gender differences in the relations of parents' and students' motivational beliefs (Simpkins et al., 2015).

Conclusion

In sum, this study investigated the influence of mothers' motivational beliefs on students' academic pathways into college. Overall, we found that mothers' motivational beliefs in high school influenced students' motivation, courses taken, and career-aspirations in college directly. Furthermore, mothers' motivational beliefs in middle school influenced students' motivation, courses taken, and career-aspirations in college indirectly, through students' own motivational beliefs, courses taken, and achievement in high school. These results demonstrate the cascading effects over time through which parents influence their children's educational pathways, even during adolescence and after graduate from high school.

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Appendix

Items and Scale Information.

Scale	Item
Students' Math value 7 th grade	How important is it that you learn math? How important do you think math will be to your future?
Students' Math Ability Beliefs 7 th and 12 th grade	How good are you at math? How well do you think you will do in math next year? How successful do you think you'd be in a career that required mathematical ability? In general how hard is math for you? (recoded)
Mothers' Math Value Perception 7 th grade	How important is it that your child learns math?
Mothers' Math Ability Perception 7 th grade	How good is your child at math? How good is your child at math, compared to other kids? How much natural talent does your child have in math? How far would you like your child to go in math?
Students' STEM Utility Value 12 th grade	I think math and science will be useful in my daily life. I will use math and science in my job or career. Math and science are important for my future. It is important to understand math or science to get a good job.
Mothers' STEM Utility Value 12 th grade	In general, how useful will biology be for your teen in the future? In general, how useful will chemistry be for your teen in the future? In general, how useful will physics be for your teen in the future? In general, how useful will math be for your teen in the future?
Students' Future STEM Motivation College	Math and science are important for my future. I will use math and science in my job or career. I want to take more math and science classes in the future.

Robin Hood Effects on Motivation in
Math: Family Background Moderates
the Effects of Relevance Interventions

Häfner, I., Flunger, B., Dicke, A.-L., Gaspard, H., Brisson, B. M., Nagengast, B. & Trautwein, U. (submitted). Robin Hood Effects on Motivation in Math: Family Background Moderates the Effects of Relevance Interventions. *Developmental Psychology*.

Abstract

Using a cluster randomized field trial, the present study tested whether two relevance interventions affected students' value beliefs, self-concept, and effort in math differently depending on family background (socioeconomic status, family interest, parental utility and intrinsic value). Eighty-two classrooms were randomly assigned to either one of two intervention conditions or a control group. Data from 1522 students ($M_{age} = 14.60$) and their parents were obtained via separate questionnaires. Multilevel regression analyses with cross-level interactions were used to investigate differential intervention effects on students' motivational beliefs six weeks and five months after the intervention. Socioeconomic status, family interest, and parental utility and intrinsic values were investigated as moderators of the intervention effect. The intervention conditions were especially effective in promoting students' value beliefs for students whose parents reported lower levels of math interest and intrinsic math value five months after the intervention. No differential intervention effects were found for socioeconomic status. These results highlight the effectiveness of relevance interventions in decreasing motivational gaps between students from families with fewer and more motivational resources. Findings point to the substantial importance of motivational family resources, which have been neglected in previous research.

Keywords: utility value, expectancy-value theory, cluster randomized controlled trial, family background, socioeconomic status

Robin Hood Effects on Motivation in Math: Family Background Moderates the Effects of Relevance Interventions

Students' motivational beliefs are important predictors of academic achievement and students' achievement-related behavior (Eccles et al., 1983; Eccles & Wigfield, 2002). One factor associated with inter-individual differences in students' motivation to learn is family background (Eccles, 2005, 2007). Family background can be understood as structural characteristics of a family such as the socioeconomic status (SES) or more process related characteristics such as motivational resources within a family (Eccles, 2007; Grolnick, Friendly, & Bellas, 2009). Most previous research focused on SES with a plethora of studies demonstrating that students from families with low SES show more negative academic outcomes (e.g., Sirin, 2005). In contrast, recent studies highlighted the importance of motivational family resources, such as parents' motivational beliefs, for shaping students' academic motivation (Frenzel, Goetz, Pekrun, & Watt, 2010; Lazarides, Harackiewicz, Canning, Pesu, & Viljaranta, 2015; Simpkins, Fredricks, & Eccles, 2012). Moreover, it has been suggested that motivational family resources might even be more important for student motivation than SES (e.g., Dumont et al., 2012; Häfner et al., 2015).

Despite the increasing interest from researchers in the motivational gap between students from families with higher versus lower motivational resources, there is a lack of knowledge about potential remedies. One arguably promising avenue is the use of motivational interventions. Several recent studies indicate that interventions targeting students' relevance perceptions can successfully promote student motivation (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009). It remains unclear, however, whether these interventions are also a good means to decrease motivational gaps between students from families with more motivational resources and those from families with fewer resources. On the one hand, students with better initial conditions often profit most from these interventions (e.g., Durik, Hulleman, & Harackiewicz, in press), thereby even increasing gaps between over- and underprivileged students (Ceci & Papierno, 2005). This phenomenon is also known as the Matthew effect (Walberg & Tsai, 1983). On the other hand, some evidence suggests particularly strong ameliorative effects for students from families with fewer resources (e.g., Cohen, Garcia, Apfel, & Master, 2006; Harackiewicz et al., 2013), a phenomenon which we will call the "Robin Hood effect." Just as Robin Hood gave resources to the ones in need, relevance interventions might pass on important utility information to students in need: i.e. students

from families with fewer motivational resources. Moreover, if relevance interventions create Robin Hood effects, it remains unclear how stable these effects would be. It is possible that Robin Hood effects vanish quickly—but it is also conceivable that intervention effects for students from families with few motivational resources need some time to develop and sleeper effects (responses that may not surface for several weeks or months) occur (Kagan & Moss, 1962).

The aim of the present study was, thus, to investigate whether the effects of two relevance intervention conditions (either writing a text or evaluating interview quotations) differed depending on students' family background (both SES and motivational family resources) producing either a "Matthew effect" or a "Robin Hood effect." We used data from the Motivation in Mathematics (MoMa) study, in which two relevance interventions were implemented in a cluster randomized controlled study design with 82 German ninth grade math classrooms. Prior analyses have shown these relevance interventions to improve students' motivational beliefs in general (Brisson et al., 2015; Gaspard, Dicke, Flunger, Brisson, et al., 2015). We examined differential effects of two relevance interventions on a variety of students' motivational outcomes depending on parent-reported structural and motivational family resources. More specifically, we investigated effects six weeks and five months after the relevance interventions took place, which allowed us to differentiate between short-term effects and potential sleeper effects (Kagan & Moss, 1962).

Family Factors and Students' Academic Outcomes

In 1966, Coleman et al. (1966) concluded that the most crucial factor for students to be successful in school was family background. Although more recent research also highlighted the powerful effects of various factors at the school, classroom, and teacher level (Hattie, 2009), an overwhelming number of studies have demonstrated the importance of demographic family resources such as socioeconomic status for students' academic outcomes (see meta-analysis by Sirin, 2005). Students from families with a lower socioeconomic status have been found to show lower academic motivation and achievement (e.g., Dumont et al., 2012; Dumont, Trautwein, Nagy, & Nagengast, 2014; Sirin, 2005; Steinmayr, Dinger, & Spinath, 2012). However, most studies investigating the effects of students' family background focused on so-called structural family resources (e.g., SES), which characterize a family's economic and social position within

societal structures and are associated with students' academic outcomes (see Sirin, 2005). In addition to structural family resources, more recent research has identified motivational family resources, such as motivational beliefs within a family, which shape students' academic outcomes.

According to the Eccles et al. (1983) expectancy-value theory, students' motivational beliefs and their academic outcomes are influenced by these motivational family resources that describe more proximal process-related family aspects (Eccles, 2005, 2007; Jacobs & Eccles, 2000; Lazarides et al., 2015). This includes parents' motivational beliefs about their own values and competence beliefs as well as the more general motivational climate within the family. In more detail, EVT assumes that parents as well as students hold distinct value beliefs regarding a task and competence beliefs about the probability of mastering a task. Value beliefs can be separated into four different components: utility, attainment, intrinsic value, and cost. *Utility value* describes the perceived individual usefulness of a task, whereas *attainment value* is defined as the importance of mastering a task. *Intrinsic value* indicates the enjoyment of doing a task and *cost* is described as the negative consequences of engaging in a task (Eccles & Wigfield, 2002; Wigfield & Eccles, 1992). Students' domain-specific *competence beliefs* can be operationalized as students' *self-concepts* describing students' evaluation of their competence in a domain (Eccles et al., 1983; Eccles & Wigfield, 2002). Compared to structural family resource such as SES, motivational family resources influence students' motivational beliefs more directly and are believed to be more amenable to change. Especially parents' value beliefs and parents' interest in a subject, have been found to be associated with students' academic values and self-concept (e.g., Frenzel et al., 2010; for an overview, see Lazarides et al., 2015; Simpkins, Fredricks, & Eccles, 2015). Some studies even suggest that motivational family resources such as parents' motivational beliefs might be more important for the development of students' motivational beliefs than structural family resources (Dumont et al., 2012; Häfner et al., 2015).

Interventions Targeting Students' Relevance Beliefs

Previous research has shown that students' motivational beliefs in mathematics decrease during secondary school (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004). Because students' motivational beliefs predict students' academic effort, achievement, and choices (e.g., Nagengast, Trautwein, Kelava, & Lüdtke, 2013;

Simpkins, Davis-Kean, & Eccles, 2006; for a review, see Wigfield, Tonks, & Klauda, 2009), researchers started to develop interventions to buffer against the decrease of student motivation (see Karabenick & Urdan, 2014).

Several different types of interventions have been found to foster students' academic outcomes, relying on different theoretical backgrounds (for an overview, see Karabenick & Urdan, 2014; Yeager & Walton, 2011). One of these approaches is based on EVT and addresses subject-specific motivational beliefs such as utility value, to foster students' subject-specific motivation (for an overview, see Harackiewicz, Tibbetts, Canning, & Hyde, 2014). Compared to intrinsic and attainment value, utility value is more extrinsic in nature since the utility value of a task relates to future goals—thereby the task is not necessarily valued for its own sake (Eccles & Wigfield, 2002). Thus, utility value beliefs can be influenced in interventions by highlighting the relevance of a subject for possible future careers, occupations, and everyday life (e.g., Woolley, Rose, Orthner, Akos, & Jones-Sanpei, 2013).

Several studies demonstrated the success of interventions promoting students' utility value beliefs to enhance students' self-concept, interest, and achievement in psychology, mathematics, and science (Brisson et al., 2015; Durik & Harackiewicz, 2007; Gaspard, Dicke, Flunger, Brisson, et al., 2015; Hulleman et al., 2010; Woolley et al., 2013). Two different approaches have been used to increase students' utility value beliefs in these interventions (Canning & Harackiewicz, 2015; Durik et al., in press): students were either provided with information about the relevance of a learning task for their own life (see study 2 in Durik & Harackiewicz, 2007; Woolley et al., 2013) or were encouraged to self-generate reasons for the relevance of a task by writing an essay (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009).

Are relevance interventions also a means to reduce motivational gaps between students with distinct family backgrounds? And if so, how stable are these effects? Harackiewicz, Canning, Tibbetts, Priniski, and Hyde (2015) found a relevance (or utility value) intervention to be especially helpful for underrepresented minority students which were also first generation students, but not for students from high schools with high poverty rates. Yet, it is still unknown how relevance interventions affect students from families with different motivational resources. On the one hand, privileged students might benefit more strongly from relevance interventions, due to their initial advantage in motivational resources (see Ceci & Papierno, 2005). This advantage is typically described

as the Matthew effect (in the Bible, Matthew says that “unto every one that hath shall be given, and he shall have abundance”). On the other hand, Harackiewicz et al. (2014) recently argued that interventions targeting students’ utility value beliefs might be especially effective for students growing up in families with fewer resources (see also Harackiewicz et al., 2015). Relevance interventions might thus create a Robin Hood effect: During the intervention, students from families with fewer motivational resources might receive relevant utility information which they are not exposed to in their families due to fewer motivational resources. Students from families with fewer motivational resources could, thus, profit most from relevance interventions. However, it is unclear if this effect can be observed immediately—it might be that relevance interventions need some time to decrease motivational gaps between students from families with more motivational resources and those from families with fewer resources. According to the elaboration likelihood model of persuasion (Petty & Cacioppo, 1986), message repetition fosters objective processing in a first step and thereby can foster attitude adaption. Yet, in a second step, message repetition leads to tedium and thus results in decreased acceptance of the message. Students from families with high motivational resources might already have been exposed to relevance information about math in their families. Consequently, the relevance information might be a repetition and thus result in higher message acceptance at first, but in the longer-run might decrease message acceptance. In contrast, information about the relevance of math might be new to students from families with low motivational resources leading to a higher personal relevance and thus deeper information processing over time (Petty & Cacioppo, 1986). Accordingly, Harackiewicz et al. (2015) found the interaction effect between the utility value intervention and race and social class on final grades at the end of the semester. Therefore, follow-up designs are necessary to uncover potential sleeper effects (Kagan & Moss, 1962).

The Present Study

In the current research, we reanalyzed data from a large (82 ninth grade classes) cluster randomized controlled intervention study. Previous analyses demonstrated that two relevance interventions (text condition [self-generating a text about the usefulness of mathematics] vs. quotations condition [evaluating quotations about the usefulness of mathematics]) successfully promoted students’ value beliefs, competence beliefs, effort, and achievement (see Brisson et al., 2015; Gaspard, Dicke, Flunger, Brisson, et al., 2015)

up to five months after the intervention. The present study investigates whether the effects of these two relevance interventions on students' motivation in math were moderated by family background (parent-reported SES, family interest, parental intrinsic and utility value). Several crucial motivational variables including students' value beliefs, self-concept, and effort were assessed in order to get a comprehensive picture of the impact of the intervention conditions on students' motivation. We chose mathematics as the target subject because student motivation in mathematics declines dramatically during secondary school (Jacobs et al., 2002; Watt, 2004) and because math is an important prerequisite for STEM careers (National Science Board, 2007).

We had three major research questions. First, on a general level, we analyzed whether the effects of the relevance intervention conditions were moderated by family motivational resources. More specifically, is there empirical support for a “no differential effects” perspective, for Matthew effects (i.e., already privileged students profit most; Walberg & Tsai, 1983), or for “Robin Hood effects” (i.e., students from families with low motivational resources profit most)? The intervention conditions provided students from families with low motivational resources with relevant utility information which they may not be exposed to in their families. Therefore, we speculated that our two intervention conditions may have the power to create Robin Hood effects. Relying on results of previous studies, we assessed family motivational resources such as family interest, parents' intrinsic value, and parents' utility values.

Second, it is unclear if a brief relevance intervention, in which students receive relevant utility information at only one time point, results in immediate effects for students from families with low motivational resources or if the effects need some time to develop thereby creating sleeper effects. Students from families with fewer resources might need some time to reflect on the content of the intervention, before incorporating the new information into their motivational beliefs (e.g., Mitchell, 1993). We assumed that differential effects for students from families with low motivational resources might be stronger in the long run and therefore included a follow-up measurement to uncover potential sleeper effects (Kagan & Moss, 1962). Thus, the emergence of sleeper effects was investigated by including not only a posttest six weeks after the intervention but also a follow-up measure five months after the intervention.

Third, in comparison with the motivational family resources, what about students' socioeconomic background? Are there any interaction effects for this indicator of family

background? Results from correlational studies indicate that families' motivational resources might be even more important for students' academic outcomes than SES, as they shape students' environment more directly (e.g., Dumont et al., 2012; Häfner et al., 2015). More importantly, Harackiewicz et al. (2015) did not find any interaction effects between an utility value intervention and the level of poverty students were exposed to in high school on outcome variables. We therefore speculated that our intervention might be specifically helpful for students from families with low motivational resources and not for students from low SES families. Thereby, further insights into the importance of SES versus motivational family resources for students' academic outcomes can be derived.

Method

Sample

The data of students and their parents were collected as part of a large longitudinal intervention study "Motivation in Mathematics" (MoMa) in academic track schools in the German state of Baden-Württemberg from September 2012 to March 2013. A total of 1,978 ninth grade students with active parental consent participated in the study reflecting a high participation rate of 96%. Out of the total sample, 1,916 students (mean age at the beginning of the study = 14.62, $SD = 0.47$; 53.5% female) participated in the intervention (720 students in the text condition, 561 students in the quotations condition, and 62 students were absent during the intervention and therefore were not included in the present analyses) or were in the waiting-control group (635 students). Students were enrolled in 82 classrooms from 25 schools. Teachers and their classes were randomly assigned within each school to the waiting control group or one of two intervention conditions (text and quotations condition) resulting in 27 classes in the control condition, 30 classes in the text condition and 25 classes in the quotations condition. It was ensured that all classes taught by the same teacher were in the same experimental condition and that conditions were distributed equally within each school. For the present study, we only included students in the analyses if parent-reported data on family background was available as well. Due to the high response rate of parents from participating students (79%), the remaining sample consisted of 1,522 students (55% female, $M_{age} = 14.60$, $SD = 0.44$) in 82 classes and 25 schools and data of their parents. As a result of missing data on measures of family background, the specific sample size for the different analyses

varied from 1,459 to 1,491 students and their parents. For the parent questionnaire, we asked the parent involved the most in each student's homework to fill out the questionnaire: 56.3% of the questionnaires were filled out by students' mothers, 23.6% by mothers and fathers together, and 16.7% by fathers (0.4% were filled out by a different person). Due to data being collected from the highest educational track in Germany, parents' educational level was above the national average, with 46.6% of mothers and 47.0% of fathers holding qualifications for college education (i.e., obtained the *Abitur* certificate), but the sample comprised students with parents from a broad range of educational backgrounds. Regarding immigrant background, 10.8% of students came from families with both parents born outside Germany (predominantly in Turkey; rest mostly in east European countries).

Procedure

Data from both students and parents were collected via separate questionnaires at the pretest (T1) which took place at the beginning of the school year. Classes in the experimental conditions received the intervention approximately one week after the pretest. Both experimental groups took part in a relevance intervention which consisted of a 90-minute course unit. The first part was a psycho-educational presentation including two main topics. In the first part, research findings on the importance of students' self-concept, effort, and frame of reference for students' math achievement were presented. We included these topics because low competence beliefs might hinder the effectiveness of relevance interventions (see Durik, Shechter, Noh, Rozek, & Harackiewicz, 2014). In the second part of the presentation, examples for the usefulness of mathematics for students' future careers and their daily life were displayed. We included this information to stimulate students from families with fewer motivational resources as otherwise they might not have had enough knowledge about the possible relevance of math for their own lives.

Afterwards students worked on individual writing assignments. Each student was assigned to either a text or a quotations condition. In the text condition, the students wrote a text about the personal relevance of math for their own life, whereas in the quotations condition, students evaluated quotations of young adults about the usefulness of math. One and two weeks after the intervention, students in both intervention conditions received an intervention reinforcement exercise similar to the writing assignments. Six

weeks (T2) and five months (T3) after the intervention, students filled out questionnaires again. More details on the intervention can be found in Gaspard, Dicke, Flunger, Brisson, et al. (2015).

Instruments

Family background measures were assessed via parents at the beginning of 9th grade using the parent questionnaire. Students' academic motivation was measured via the student questionnaire at T1, T2 and T3. Items can be found in the appendix (items for students' value beliefs can be found in Gaspard et al., 2014).

Socioeconomic status (SES). Socioeconomic status was based on information about parents' occupation provided by both students and parents. Occupations were first coded using the International Standard Classification of Occupations (ISCO; ILO, 2012) and then ranked based on the International Socio-Economic Index of Occupational Status (ISEI; Ganzeboom & Treiman, 2003). The ISEI is an international standard measure indicating the status of the occupation, ranging from 16 to 90. For the analyses, we included the highest score of the occupational status of either father or mother.

Family motivational resources. The response format for all items assessing family motivational resources ranged from 1 (completely disagree) to 4 (completely agree). We assessed family math interest (e.g., "In our family we are interested in math."; $\alpha = .92$) using three items and asking for an evaluation of math interest of the whole family (adapted from Ramm et al., 2006). In contrast, parents' intrinsic math values (e.g., "I like doing math."; $\alpha = .95$) and parents' utility math values (e.g., "Math is directly applicable in everyday life."; $\alpha = .86$) both represent subjective attitudes of the parent filling out the questionnaire and were measured using four items each (Gaspard et al., 2014, adapted for parents).

Students' task values, self-concept, and effort. For all items, a 4-point point Likert-type scale ranging from 1 (completely disagree) to 4 (completely agree) was used as a response format. Students' math values were measured using the value instrument of Gaspard et al. (2014): Students' intrinsic math value was assessed using four items (e.g.; "I like doing math."; $.92 \leq \alpha \leq .93$). Students' attainment value (e.g., "Math is very important to me personally."; $.91 \leq \alpha \leq .92$), utility value (e.g., "Understanding math has many benefits in my daily life."; $.88 \leq \alpha \leq .89$), and cost (e.g.; "Math is a real burden to me."; $.93 \leq \alpha \leq .94$) were measured with 10, 12, and 11 items respectively. Students' math

self-concept (e.g., “Math just isn’t my thing.” [reverse coded]; $.92 \leq \alpha \leq .93$) was assessed using five items (Gaspard, Dicke, Flunger, Häfner, et al., 2015). Students’ effort in math (e.g., “I really work hard on homework assignments in mathematics.”; $.81 \leq \alpha \leq .87$) was measured using five items (adapted from Trautwein, Lüdtke, Roberts, Schnyder, & Niggli, 2009).

Covariates. Students’ math grades at the end of eighth grade, student gender, and test scores from a state-wide standardized, curriculum-based math achievement test that was conducted at the beginning of ninth grade were used as covariates. Additionally, students’ nonverbal cognitive abilities were measured using the Figure Analogies subscale ($\alpha = .79$) from the Cognitive Abilities Test 4 – 12 + R (Heller & Perleth, 2000).

Statistical Analyses

In our analyses, students were nested within their classrooms. To account for the hierarchical structure of the data (Raudenbush & Bryk, 2002), multilevel regression analyses using Mplus 7 (Muthén & Muthén, 1998-2012) were conducted to analyze the interaction effects of the intervention with the different indicators of students’ family background on students’ motivation.

Measurement invariance. In order to test for measurement properties across time (T1, T2, and T3) and across intervention groups, we tested for measurement invariance with separate models for each dependent variable (value components, self-concept, and effort) and increasing invariance constraints. Test of measurement properties confirmed strict measurement invariance (Widaman & Reise, 1997) across time and interventions groups and following Chen (2007) resulted in an acceptable model fit (see table S1 in the supplement for fit indices for self-concept and effort; test for measurement invariance of value beliefs can be found in Gaspard, Dicke, Flunger, Brisson, et al., 2015).

Multilevel regression analyses. To assess whether students from families with fewer resources profited more from the intervention compared to students from families with more resources, multilevel regression analyses including cross-level interactions (Raudenbush & Bryk, 2002) were calculated separately for each indicator of students’ family background and each dependent variable at post-test and follow-up, respectively. For all analyses, group mean centering was used for the indicators at the student level (Enders & Tofghi, 2007), and manifest aggregation was used for the class level predictors (Marsh et al., 2009). To estimate the effects of the intervention more precisely, all models

included the respective value indicator at the pretest as a covariate at the student level and at the class level (Raudenbush, 1997). These effects were freely estimated at both levels to account for contextual effects (Korendijk, Hox, Moerbeek, & Maas, 2011; Marsh et al., 2009). Furthermore, we included the respective indicator of family background as a predictor on both levels. As we did not find any contextual effects of the indicators of family background on any student outcome, we constrained the effects on both levels to be equal for parsimony (Korendijk et al., 2011; Marsh et al., 2009). Thereby, the overall effect of the respective indicator of family background on the depended variables was estimated. To control for the main effects of the intervention, two dummy variables indicating the two intervention conditions (respective intervention condition = 1, reference group = control group) were included as predictors at the class level. To determine whether intervention effects varied depending on students' family background, we added a non-randomly varying slope of the respective indicator of students' family background (Raudenbush & Bryk, 2002) and included two cross-level interaction effects (Quotations \times Indicator of family background, Text \times Indicator of family background).

Before running the analyses, all continuous variables were standardized to facilitate the interpretation of the results. Thus, variance at the student level is expressed in the class level coefficient. Thereby, the coefficients of the cross-level interactions indicating the effects of the intervention conditions depending on family background compared to the control condition can directly be interpreted as effect sizes (for effect sizes in multilevel models, see Marsh et al., 2009). In order to facilitate the interpretation of the interactions, we calculated simple slopes for 1 *SD* above and below the mean on the respective indicator of family background on the dependent variable (Aiken & West, 1991).

Missing data. Following the recommendations in Graham (2009), full information maximum likelihood estimation (FIML) was used to account for missing data, which ranged from 2.0% to 10.8% for the various variables. To make the assumption of missing-at-random more plausible, a nonverbal cognitive ability score, gender, previous math grade and achievement data for math at Time 1 were used as auxiliary variables by including correlations between these variables and the predictor variables as well as the residuals of the dependent variables at both levels (see Enders, 2010).

Regarding missing values on the family background interaction variables, usage of FIML resulted in non-converging models. Since the amount of missing data on family

background variables was minor (Range = 2.04% - 4.14%), we only used data from parents who had answered the respective family background measures resulting in different sample sizes for each moderator of $N = 1,491$ for SES, $N = 1,459$ for family math interest, $N = 1,474$ for family's intrinsic math value, and $N = 1,472$ for family's utility math value.

Results

Randomization Check and Descriptive Statistics

Descriptive statistics (Means, SDs, ICCs) of all variables under study are summarized in Table S2 in the Supplemental Material. As a randomization check, we tested for differences between the three experimental conditions at the pretest by calculating multilevel multi-group models for students' outcomes (utility, attainment, intrinsic value, as well as cost, self-concept, and effort) and family background (SES, family math interest, parents' intrinsic, and utility math values). We conducted several omnibus tests comparing the means of the three groups by Wald- χ^2 tests. No statistically significant differences between the conditions were found at the pretest—neither in terms of pretest scores of student outcomes (all p 's $\geq .292$), nor for family background (all p 's $\geq .071$).

Reported family motivational resources differed depending on the person filling out the questionnaire (see Table S3 in the Supplemental Material): reported family math interest was higher when fathers ($\beta = .21, p = .002$) or both parents ($\beta = .22, p = .001$) filled out the questionnaire than when mothers filled out the questionnaire. This difference was even greater for parental intrinsic math value: fathers ($\beta = .54, p < .001$) and both parents ($\beta = .33, p < .001$) reported significantly higher intrinsic math values. Similarly, fathers ($\beta = .46, p < .001$) and both parents ($\beta = .45, p < .001$) reported significantly higher utility math values than mothers.

Correlations at the pretest are presented in Table S4 in the Supplemental Material (correlation pattern at T2 and T3 were comparable). Family socioeconomic status showed positive but small associations with parents' utility ($r = .08$) and intrinsic value ($r = .18$), as well as family interest ($r = .20$), thereby supporting the theoretical differentiation between structural and process-related family resources (see also Dumont et al., 2012). Higher correlations were found between family motivational resources: Parents' utility

value beliefs were significantly correlated with intrinsic value ($r = .59$) and family interest ($r = .53$). In line with theoretical assumptions, parents' intrinsic values and family interest descriptively showed the highest correlation ($r = .74$).

Correlations between socioeconomic status and students' outcomes varied in direction and were small in magnitude ($-.13 \leq r \leq .11$). In contrast, students' motivational outcomes (with the exception of cost) were positively related to parents' utility value beliefs ($.09 \leq r \leq .20$), parents' intrinsic values ($.10 \leq r \leq .27$), and family math interest ($.11 \leq r \leq .34$). Students' cost perceptions were negatively correlated with parents' utility value beliefs ($r = -.15$), parents' intrinsic values ($r = -.22$), and family math interest ($r = -.31$). In line with previous research (e.g., Dumont et al., 2012), these results suggest that family motivational resources are more closely related to students' motivational outcomes than to SES.

Testing for Moderation by Family Motivational Variables

Our first research question dealt with the existence of differential intervention effects depending on motivational family resources controlling for students' pretest scores. With our second research question, we investigated potential sleeper effects and compared differential effects six weeks and five months after the intervention.

In order to provide a good overview of the central results without neglecting any relevant additional information, we will report the results in the following manner: (1) the central results concerning the interaction terms for all moderators (possible Matthew or Robin Hood effects) are described in Table 1. Figures 1 and 2 illustrate moderation effects of family interest. Figures S1-S2 in the Supplemental Material show these effects for the other moderators. (2) The full models (including main effects and effects of the covariates) are reported in Tables S5-S7 in the Supplemental Material. (3) For a better interpretation of significant interaction effects, conditional effects of both intervention conditions on the respective student outcome are reported in Tables S5-S7 in the Supplemental Material for subgroups of students 1 *SD* above and below the mean of the respective indicator of family background (Aiken & West, 1991).

Family Math Interest as a Moderator of the Intervention Effects. First, we asked if students from families with low family interest (FI) profited more from our intervention than students from families with a higher FI, resulting in Robin Hood effects. To this end,

we calculated separate models for each dependent variable at each time point¹. Regarding the main effects of family interest (FI) on student outcomes, students from families with higher FI reported significantly higher levels of utility ($.07 \leq \beta \leq .13$), attainment ($.09 \leq \beta \leq .13$), and intrinsic value ($.08 \leq \beta \leq .13$), as well as higher levels of self-concept ($.08 \leq \beta \leq .09$) and effort ($.07 \leq \beta \leq .08$) and fewer costs ($\beta = -.07$) at the posttest and the follow-up (see Table S5 in the Supplemental Material for details). Due to the presence of interaction effects, the effects of family interest (and other respective indicators of family background) on students' outcomes can be interpreted as the effects within the control group.

The main intervention effects out of the present models reflect the intervention effects for students with mean values on the respective indicator of family background (see Table S5 Supplemental Material for details). Analyses of the main intervention effects without including indicators of family background as independent variables can be found in Gaspard, Dicke, Flunger, Brisson, et al. (2015) and Brisson et al. (2015). Students in both intervention conditions reported statistically significant higher utility values at both time points than did students in the control group, controlling for their initial values (see Table S4). Additionally, we found significant effects of the quotations condition on students' attainment values five months after the intervention, controlling for their initial values.

An overview of the cross-level interactions between the respective moderator (here FI) and the intervention conditions on students' motivational beliefs (effects on different outcomes are presented in the rows) resulting from the multilevel models at the posttest (upper half of the table) and the follow-up (lower half of the table) can be found in Table 1. As can be seen in Table 1, the intervention effects on students' motivational beliefs were not systematically moderated by FI at the posttest (with the exception of

¹ Due to the differences in family motivational beliefs depending on the person filling out the questionnaire, we calculated additional models. Two dummy variables were included as covariates with questionnaires filled out by mothers as the reference group: one dummy variable for questionnaires filled out by fathers, one for questionnaires filled out by both parents. When trying to include these two dummy variables in our models as covariates, including correlations between the two dummy variables and the respective indicator of motivational family beliefs resulted in non-converging models in Mplus. Therefore, we ran additional models using the design-based correction of standard errors and fit statistics ("type=complex" procedure) in Mplus instead of multilevel regression analyses and reran all models reported. The results did not differ substantially from the multi-level models without controlling for the person filling out the questionnaire. Therefore, results from the multi-level models are reported.

effort)—neither Matthew effects nor Robin Hood effects occurred. At the follow-up, in contrast, we found support for our hypotheses: Several significant cross-level interaction effects between FI and both intervention conditions emerged—thereby also supporting our sleeper effect hypothesis (see Figure 1 and 2).

The effects of the intervention conditions on students' *utility values* were moderated by FI at the follow-up: As can be seen in Table 1, for students whose families report math interest 1 *SD* below the mean, the effect of the quotations condition on students' utility math values was $\beta = .13$ *SD* higher compared to the effect of the quotations conditions for students from families with mean levels of FI. Similarly, the effect of the text condition on students' utility value beliefs was $\beta = .14$ *SD* higher for students with FI 1 *SD* below the mean, compared to the effect of the text condition for students from families with mean levels of FI. In other words: Both intervention conditions resulted in compensatory effects for students with lower FI: Receiving either intervention condition, these students showed similar levels of utility value beliefs five months after the intervention compared to students from families with higher FI—thereby creating Robin Hood effects. Although we did not find significant interaction effects at the posttest on students' utility values, the interactions of FI with both intervention conditions at the posttest and the follow-up are shaped similarly (see Figure 1).

Table 1

Intervention effects depending on the respective indicators of family background on students' motivation at posttest and follow-up (N = 1,459).

Moderator		Utility		Attainment		Intrinsic		Cost		Self-concept		Effort	
		Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Posttest</i>													
Family Interest (FI)	Quotations × FI	-0.08 †	(.04)	-0.04	(.04)	-0.04	(.04)	.05	(.04)	-0.03	(.04)	-0.07	(.05)
	Text × FI	-0.01	(.05)	-0.07	(.05)	-0.05	(.04)	.03	(.03)	-0.02	(.04)	-0.10 *	(.04)
Parents' Intrinsic Values (PIV)	Quotations × PIV	-0.04	(.05)	-0.03	(.04)	-0.02	(.04)	-0.01	(.04)	-0.05	(.04)	-0.03	(.04)
	Text × PIV	-0.03	(.05)	-0.03	(.05)	-0.05	(.04)	.03	(.04)	-0.05	(.04)	-0.05	(.04)
Parents' Utility Values (PUV)	Quotations × PUV	.04	(.05)	-0.02	(.05)	.05	(.04)	.04	(.04)	-0.02	(.03)	-0.07	(.05)
	Text × PUV	-0.01	(.05)	-0.06	(.04)	-0.04	(.04)	.02	(.04)	-0.02	(.03)	-0.05	(.04)
SES	Quotations × SES	.01	(.05)	.01	(.04)	-0.03	(.03)	.01	(.04)	-0.03	(.03)	.01	(.05)
	Text × SES	.04	(.05)	-0.03	(.04)	-0.06 †	(.03)	.01	(.04)	.00	(.04)	-0.03	(.05)
<i>Follow-Up</i>													
Family Interest (FI)	Quotations × FI	-0.13 *	(.06)	-0.11 *	(.05)	-0.10 *	(.05)	.07	(.04)	-0.08 †	(.05)	-0.10	(.06)
	Text × FI	-0.14 *	(.06)	-0.15 ***	(.04)	-0.08 †	(.04)	.03	(.04)	-0.01	(.04)	-0.11 *	(.05)
Parents' Intrinsic Values (PIV)	Quotations × PIV	-0.05	(.06)	-0.04	(.05)	-0.10 *	(.04)	.02	(.04)	-0.06	(.04)	-0.05	(.05)
	Text × PIV	-0.15 **	(.05)	-0.11 *	(.04)	-0.08 †	(.04)	.01	(.05)	-0.02	(.04)	-0.10 *	(.05)
Parents' Utility Values (PUV)	Quotations × PUV	.04	(.05)	.02	(.04)	.01	(.04)	.05	(.04)	-0.06 †	(.03)	-0.01	(.04)
	Text × PUV	-0.09 †	(.05)	-0.11 *	(.05)	-0.03	(.04)	.01	(.05)	-0.04	(.04)	-0.07	(.05)
SES	Quotations × SES	-0.06	(.06)	.01	(.05)	-0.04	(.04)	.00	(.04)	.02	(.04)	-0.02	(.06)
	Text × SES	-0.08	(.05)	-0.06	(.04)	-0.04	(.04)	.00	(.04)	-0.02	(.04)	-0.04	(.04)

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. Significant effects are presented bold. Quotations × 'respective indicator of family background' = Cross-level interaction effect between respective indicator of family background and quotations condition; Text × 'respective indicator of family background' = Cross-level interaction effect between 'respective indicator of family background' and text condition.

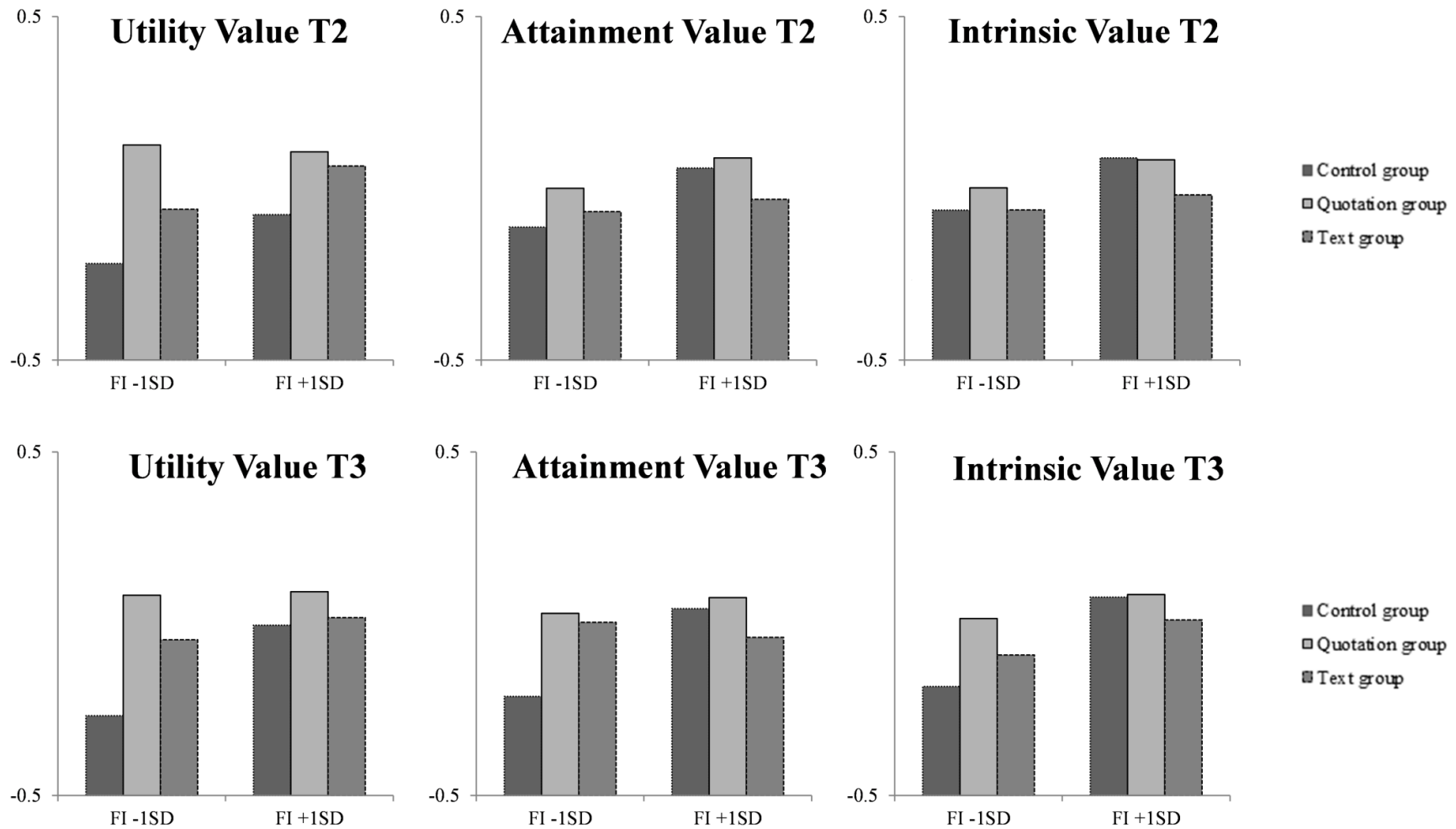


Figure 1. Adjusted means for students’ utility, attainment, and intrinsic value beliefs at posttest (upper half) and follow-up (lower half) by family interest in math (FI) and intervention group. Predicted values were generated for low (-1 SD) and high (+1 SD) family interest in math from the multilevel regression model.

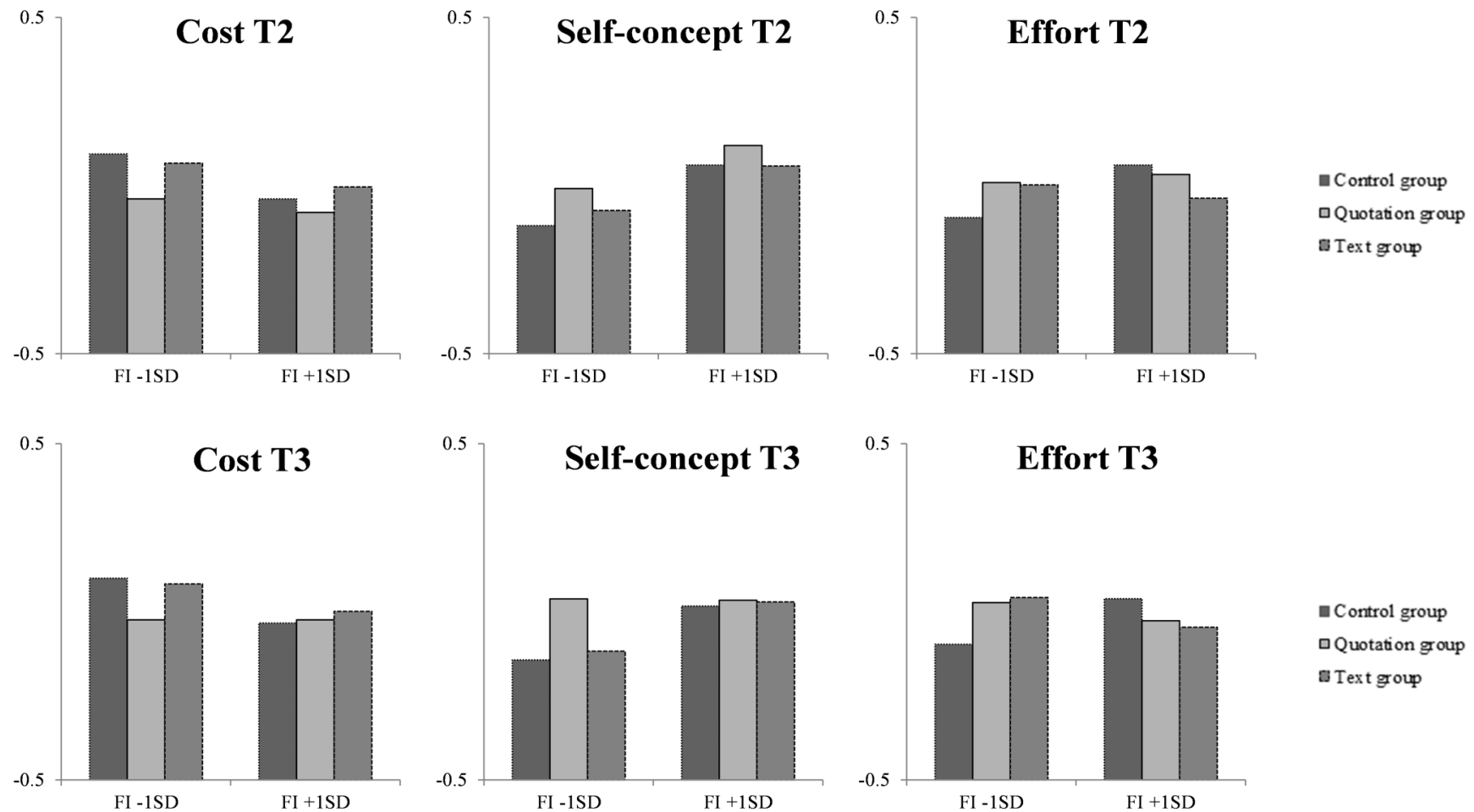


Figure 2. Adjusted means for students' cost, self-concept, and effort at posttest (upper half) and follow-up (lower half) by family interest in math (FI) and intervention group. Predicted values were generated for low (-1 SD) and high (+1 SD) family interest in math from the multilevel regression model.

Simple slope analyses indicate that students from families with FI 1 SD below the mean show an increase of $\beta = .35$ SD in utility math value when being in the quotations condition and $\beta = .30$ SD in utility math value when being in the text condition—compared to students with FI 1 SD below the mean in the control condition.

Regarding students' *attainment value*, the effects of both intervention conditions differed depending on different levels of FI at the follow-up. Both intervention conditions promoted attainment value beliefs for students from families with low FI, but not with high FI (see Figure 1). Thereby, both conditions counteracted motivational gaps between students from families with low and high FI, resulting in similarly high levels in attainment value five months after the intervention. For students' *intrinsic value*, there were significant cross-level interactions between the quotations condition and FI at the follow-up. Again, the quotations condition resulted in Robin Hood effects (see Figure 1). For students' *effort*, there were significant cross-level interactions between the text condition and FI at the posttest and the follow-up (see Figure 2). At both time points, students from families with lower FI profited more from the text condition in terms of their effort in math compared to students from families with higher FI.

Parents' Intrinsic Math Value as a Moderator of the Intervention Effects. To analyze the intervention effects according to parents' intrinsic math value (PIV), an equal set of models including cross-level interactions was calculated (see Table S6 in the Supplemental Material for details). Regarding the effects of PIV on student outcomes within the control group, students whose parents reported higher PIV showed significantly higher levels of attainment and intrinsic value, as well as higher levels of self-concept at both time points. At the follow-up, students with higher PIV additionally showed significantly higher levels of utility value.

As can be seen in Table 1, the intervention effects on students' motivational beliefs were not systematically moderated by PIV at the posttest. At the follow-up, in contrast, several significant cross-level interaction effects between PIV and both intervention conditions emerged (for illustration see Figure S1 in the Supplemental Material)—thereby, again, supporting the Robin Hood effect hypothesis and the sleeper effect hypothesis. For students' *utility value*, the effects of the text condition were moderated by PIV at the follow-up: Students from families with low PIV profited from both intervention conditions in terms of their utility value compared to the control group. Students from families with low PIV and high PIV both profited from the quotations

condition. With regards to students' *attainment values*, we also found Robin Hood effects of the text condition: Only students from families with low PIV profited from the text condition, resulting in similarly high levels in attainment value for both students from families with low and high PIV. For students' *intrinsic values*, students whose parents reported low PIV profited from the quotations condition in terms of their intrinsic values, whereas the quotations condition had no effect for students from families with high PIV. For students' *effort* in math, we also found a significant interaction between the text condition and PIV at the follow-up: The text condition was able to promote students' effort for students from families with low PIV, but not for students from families with high PIV, thereby also resulting in a Robin Hood effect.

Parents' Utility Math Value as a Moderator of the Intervention Effects. Further models including the relevant cross-level interactions were calculated to analyze the influence of parents' utility math value (PUV) on the intervention effects (see Table S7 in the Supplemental Material for details). At the posttest, there were no significant associations between PUV and student outcomes.

With regards to students' *attainment values*, we found a significant cross-level interaction between the text condition and PUV at the follow up (for illustration see Figure S2 in the Supplemental Material): Whereas the quotations condition promoted students' attainment values regardless of PUV, the text condition only promoted students' attainment beliefs if their parents reported low level of PUV, thereby creating a Robin Hood effect. For students' *utility* and *intrinsic values*, as well as for *cost*, *self-concept*, and *effort*, we did not find significant cross-level interactions at both time points.

Testing for Moderation of Effects by Socioeconomic Status

To answer our third research question, whether or not the intervention would yield Robin Hood effects depending on motivational or structural family resources, we asked if students from families with a lower SES profited more from our intervention than students from families with a higher SES, again calculating separate models for each dependent variable at each time point (see Table S8 in the Supplemental Material for details).

In contrast to family motivational beliefs, SES was not significantly related to any student outcome—neither at the posttest nor the follow-up. Regarding the cross-level interaction effects (see Table 1), we did not find significant cross-level interactions

between the intervention conditions and SES on any student outcomes at both time points; i.e. the effects of both intervention conditions on student outcomes did not differ due to SES (for illustration see Figure S3 in the Supplemental Material). To conclude, SES did not moderate the intervention effects on students' outcomes at both time points. Therefore, in line with our third hypothesis, in contrast to the effects found for family motivational beliefs, we found neither Matthew effects nor Robin Hood effects when investigating SES.

Discussion

This study investigated whether a relevance intervention in the classroom would be a promising tool to foster academic motivation for students with fewer motivational family resources: Was the intervention specifically promising for students from families with fewer resources and did it yield a “Robin Hood effect”? For four out of six indicators of student motivation (namely utility, attainment, intrinsic value, and effort), we found significant interaction effects between either one or both intervention conditions and family math interest and between at least one intervention condition and parents' intrinsic math values. Findings yielded no support for Matthew effects, but convincing support for Robin Hood effects: The relevance intervention resulted in compensatory effects for students whose parents reported lower levels of family interest and lower intrinsic math values. As expected, families' and parents' motivational resources moderated the effects of the relevance interventions in contrast to socioeconomic status. The differential effects of the intervention were found five months after the intervention, not at the posttest. Unexpectedly, parents' utility value beliefs—with one exception—did not moderate the effects of any intervention condition on students' motivational outcomes.

Family Background as a Moderator of Relevance Interventions: Support for Robin Hood Effects

Regarding family math interest as a moderator, we found several Robin Hood effects: The effects of both intervention conditions on students' utility and attainment values five months after the intervention were higher for students whose parents reported lower family interest. Students from families with lower family interest also profited more in terms of their intrinsic values when in the quotations condition and in terms of effort when in the text condition. A similar pattern occurred, when looking at parents' intrinsic

values: Comparing students with similar initial levels in each outcome, the effects of the text condition on students' utility and attainment value and effort were higher for students whose parents reported lower intrinsic math values. Regarding the quotations condition, we found one Robin Hood effect: Parents' intrinsic math values moderated the effect on students' intrinsic math values.

Interaction effects in the social sciences are often very small and due to the measurement error in manifest variables, that affects product variables particularly, often difficult to detect and biased (Busemeyer & Jones, 1983). Thereby, finding a systematic pattern of interaction effects in four of six indicators of student motivation is noteworthy. The magnitude of the interaction effects found in the present study ranged from $\beta = .10$ to $\beta = .15$ which is similar to interaction effect sizes found in other studies (e.g., Trautwein et al., 2012). As we did not control for measurement error in the predictor variables, the effect size of the interaction is probably even underestimated (Busemeyer & Jones, 1983; Dimitruk, Schermelleh-Engel, Kelava, & Moosbrugger, 2007). In addition, it is common to find lower effect sizes of interventions in natural settings compared to laboratory intervention studies (Bronfenbrenner & Morris, 2006). Although reported effect sizes might seem rather small, also seemingly small effects are meaningful in the educational setting. As can be seen in Figure 1, both intervention conditions resulted in similar levels of students' utility and attainment value beliefs for students from families with family interest $1SD$ above and below the mean – thereby compensating the motivational gaps. Moreover, simple slope analyses indicated that the text condition resulted in an increase of $.30SD$ of utility value beliefs and the quotation condition in an increase of $.35SD$ for students from families with family interest $1SD$ below mean. For students with family interest $2SD$ below the mean, the effect sizes would be even larger ($.44SD$ for the text condition and $.48SD$ for the quotation condition).

To investigate the direction and magnitude of the effects for students with distinct family backgrounds, additional simple slopes analyses were calculated following the recommendations of Aiken and West (1991). Simple slopes analyses revealed no considerable negative effect of the intervention for students with higher levels of family interest, intrinsic and utility math values. Just as Robin Hood wanted to help the less privileged by providing them with resources they did not have, we expected to foster academic motivation for students in need by giving relevant utility information to them. Students whose families hold high motivational resources (e.g. high value beliefs) were

shown to have higher levels of academic motivation themselves (Frenzel et al., 2010; Rozek, Hyde, Svoboda, Hulleman, & Harackiewicz, 2015). Put simply: We copied the resources within their families by passing on relevant utility information to students whose families do not hold these resources. Thereby students from families which did not already hold these motivational resources profited most from the intervention. At the same time, we did not find any considerable adverse effects for students from families with higher motivational resources. Yet, some would argue that students from families with high motivational resources had to attend the intervention of 90 minutes but did not profit as much as their counterparts. Nevertheless, since all students profited from the intervention in terms of their utility value beliefs—with students from families with high math interest simply profiting less—and since students' utility value beliefs predict students' academic choices (Harackiewicz et al., 2014), the 90 minutes intervention seems worthwhile. Additionally, relevance interventions might be a promising tool to establish similar initial conditions for students from families with distinct levels of family interest.

The Importance of Family Interest and Parents' Intrinsic Values

Why are families' math interests as well as parents' intrinsic values systematic moderators of the intervention effects and not parents' utility values? As we manipulated students' utility values one could assume that this would be especially promising for students whose parents do not see math as a useful subject and pass this attitude on to their children (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012). Yet, utility value is more extrinsic in nature (Eccles & Wigfield, 2002) compared to interest or intrinsic value and can thus be more easily influenced by outside interventions. In contrast, interest and intrinsic value describe affective components of motivation (Eccles & Wigfield, 2002; Hidi & Renninger, 2006), which might be more readily expressed and more easily observed compared to utility value beliefs. Moreover, interest is a construct which is closely linked to intrinsic value but can be seen as a broader construct including feeling-related and value-related valences (Schiefele, 2009) with intrinsic value as a situational component (Hidi & Renninger, 2006; Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Lazarides et al., 2015). Thus, family interest could be especially important for students' motivational outcomes as it reflects a broader motivational atmosphere within the family (e.g., Frenzel et al., 2010), which also includes siblings and both parents. If

families are interested in math, students might observe their parents enjoying math-related activities and holding a positive attitude towards math. This might encompass greater social stimulation regarding math and could be expressed more visibly in students' everyday life. Therefore, students whose families showed lower levels of interest for math might have profited most from our intervention, as they might have received new information about the relevance of math during the intervention. In contrast, the effects of the intervention did not depend on parents' utility value beliefs. Students' motivational beliefs are more strongly related to family interest and parents' intrinsic values than parents' utility values. Thereby, the intervention effects did not depend on parents' utility values: it might not be enough for parents to perceive math as a useful subject to foster students' motivation—it might be more important that the parents like it.

As our findings suggest, differentiating between motivational resources of the family and of parents sheds light on the question of which family resources matter most. Moreover, we demonstrated that a relevance intervention can effectively counteract lower family motivational resources.

Intervention Conditions and Long-term Effects

Regarding the effects of our two intervention conditions (quotations vs. text), there were more interaction effects for the text condition than for the quotations condition—especially with parents' intrinsic math values as a moderator. Therefore, the text condition promoted students' motivational beliefs if their parents reported low intrinsic math values, thereby resulting in compensatory effects. In contrast, the quotations condition promoted students' motivational beliefs mostly regardless of their parents' intrinsic values.

Family motivational resources (especially family math interest and parents' intrinsic values) did moderate the effects of the relevance intervention on students' motivation five months after the intervention. Therefore, a sleeper effect occurred: The intervention was especially successful in fostering a positive motivational development for students with lower initial motivational family resources five months after the intervention. A possible explanation of the sleeper effects found could be that students whose parents reported lower levels of math interest might have reflected about the content of the intervention, namely the usefulness of math, and—over time—realized and adopted the usefulness of math more and more. Mitchell (1993) considered stimulation

and empowerment as the key incentives for the consolidation of interest (Mitchell, 1993), which could also be relevant for the consolidation of other motivational processes. Thus, one has to get identified with a new content first, and only subsequently will it "be experienced as personally meaningful and thus empowering" (p. 426). Students from families with low math interest might have received new information from the intervention which can be considered as a factor providing stimulation. The incorporation of the value of math might therefore have taken some time.

Another possible explanation for finding sleeper effects can be derived from elaboration likelihood model of persuasion (Petty & Cacioppo, 1986). At the posttest, all students profited to the same extent. Yet, the intervention effect for students from families with low motivational resources increased even until the follow-up, in contrast to their counterparts. These students might have received new information about the relevance of math which—according to the elaboration likelihood model of persuasion (Petty & Cacioppo, 1986)—might have resulted in deeper information processing and thus longer-term attitude change. In contrast, students from families with high motivational resources might have had prior knowledge about the relevance of math resulting in a short-term attitude change which readjusted to their prior attitudes about the relevance of math over time. To conclude, finding Robin Hood effects in the long run for students from families with low motivational resources is essential to decrease motivational gaps between students from families with more versus fewer resources.

Implications

The results of our study have several implications for intervention studies and the academic context in general. With regard to intervention studies, our findings suggest that families need to be seen as an important factor moderating intervention effects. Harackiewicz et al. (2012) demonstrated that the effects of a lack of information on the utility of math can be counteracted by handing information on the utility of math to parents directly: That is, parents may act as a buffer against the decrease in students' motivation during secondary school. Our findings also indicate that parents' interest and intrinsic values are another important factor that should be taken into account in future intervention studies targeting families. Providing information that might illustrate to parents themselves how interesting a specific subject is might change the ways parents

think about a domain and, ultimately, affect the way they communicate about this issue with their children.

Interventions to counteract motivational gaps between students from families with different motivational resources are relevant to facilitate equal opportunities for students' academic development. Relevance interventions may foster academic motivation for students whose families show lower levels of interest in math and whose parents report lower levels of intrinsic math values. These compensatory effects of the relevance intervention demonstrated the opportunity to foster academic motivation for students in need within the school setting.

Limitations and Future Research

Although our study provided evidence that parents' motivation plays a major role in explaining the differential effects of classroom interventions, it has some limitations which should be kept in mind when interpreting the results. First, students from families with low motivational resources might have benefited most from our intervention as they received new information about the utility of math they did not receive from their families. However, future research is needed to investigate the processes at play: Parents' motivational beliefs are assumed to translate into parents' behavior through which students' motivational beliefs are influenced (Eccles, 2007; Simpkins et al., 2012). Students from families with low motivational beliefs might therefore encounter little social stimulation regarding math during their daily life at home: Parents' interest in a specific subject influences parents' behavior, for example conversations with their child about math. To investigate the processes at play, future research might include other methods, such as observational studies. However, such methods are rarely found in current studies investigating the importance of family background as it is hardly possible to apply these methods to large samples.

Second, we were able to demonstrate that relevance interventions can be used to promote motivational beliefs for students' from families with low motivational resources. However, it remains to be seen whether students from families with lower math interest are more prone to taking science classes after taking part in the relevance intervention or if there are further differential effects on other academic choices in the long term. Future studies should therefore investigate if Robin Hood effects from relevance interventions also influence long-term outcomes, such as students' career decisions.

Third, we were able to demonstrate the effectiveness of our relevance intervention by drawing on a particularly large sample. For comparability reasons, our sample consisted of German academic track schools and 9th grade students only. Future research needs to replicate our findings with younger students and other school types where families might hold even lower motivational resources.

Conclusion

In line with recent research investigating students' motivational development, our results highlight the importance of motivational family resources, besides socioeconomic status. The relevance intervention was especially effective in fostering value beliefs and effort for students whose parents reported lower family interest in math and lower intrinsic math values compared to their counterparts. Thereby, relevance interventions seem to be an effective tool to create Robin Hood effects by fostering motivational outcomes for students from families with fewer motivational resources while not harming their counterparts. Moreover, by investigating the moderating role of several family resources, we could show that families are complex interpersonal networks with a variety of specific characteristics that shape the environment students grow up in. Therefore it is important to account for this complexity when investigating family influences on students' academic outcomes.

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Appendix

Items and Scale Information.

Scale	Item	Origin
Family math interest	In our family we are interested in math.	Adapted from PISA study 2003 (Ramm et al., 2006)
	In our family we like to get engaged in math.	
	We can be really enthusiastic about math.	
Parental intrinsic value	Math is fun to me.	Adapted from Gaspard et al. (2014)
	I like doing math.	
	I simply like math.	
	I enjoy dealing with mathematical topics.	
Parental utility value	Understanding math has many benefits in my daily life.	Adapted from Gaspard et al. (2014)
	Math contents will help me in my life.	
	Math is directly applicable in everyday life.	
	Math is very useful to me.	
Student's mathematical self-concept	I am good at math.	Adapted from Marsh, Trautwein, Lüdtke, Köller, and Baumert (2005)
	I just do not have any talent for math. (recoded)	
	Math just isn't my thing.	
	Math comes naturally to me.	
	I always struggle with math tasks. (recoded)	
Student's effort in math	I am very industrious in math.	Adapted from Trautwein et al. (2009)
	I give my best in math.	
	I really work hard in math.	
	I work on all math assignments and homework very thoroughly.	
	I participate in math classes as best I can.	

Note. Items for students' value beliefs can be found in (Gaspard et al., 2014)

Supplement with Results for Additional Analyses

Table 1

Tests of Measurement Invariance of Self-Concept and Effort Across Time and Intervention Condition

Model	χ^2	<i>df</i>	CFI	TLI	RMSEA	SRMR
<i>Across Time</i>						
M1: Configural invariance	937.61	354	.979	.974	.033	.052
M2: Weak measurement invariance	985.48	370	.978	.974	.033	.054
M3: Strong measurement invariance	1117.88	386	.973	.970	.035	.055
M4: Strict measurement invariance	1165.72	406	.972	.970	.035	.058
<i>Across Intervention Condition</i>						
T1						
M1: Configural invariance	270.52	96	.975	.964	.061	.059
M2: Weak measurement invariance	287.66	112	.975	.969	.057	.063
M3: Strong measurement invariance	297.96	128	.975	.974	.052	.064
M4: Strict measurement invariance	300.38	148	.978	.980	.046	.065
T2						
M1: Configural invariance	239.96	96	.979	.970	.056	.052
M2: Weak measurement invariance	255.47	112	.979	.974	.052	.055
M3: Strong measurement invariance	273.12	128	.978	.977	.048	.058
M4: Strict measurement invariance	315.03	148	.975	.977	.048	.066
T3						
M1: Configural invariance	229.01	96	.982	.974	.055	.036
M2: Weak measurement invariance	242.82	112	.982	.978	.051	.040
M3: Strong measurement invariance	254.64	128	.982	.981	.047	.041
M4: Strict measurement invariance	275.47	148	.982	.984	.043	.046

Note. Tests across time: N = 1,522; Tests across intervention condition: T1: N = 1,464; T2: N = 1,448; T3: N = 1,368. Correlated residuals were allowed between identical items for analyses across time and for two negatively worded self-concept and two negatively worded effort items for all analyses. Tests of measurement invariance of value beliefs across time and intervention condition can be found in Gaspard, Dicke, Flunger, Brisson, et al. (2015).

Table 3

Descriptive statistics for motivational family beliefs depending on person filling out parent questionnaire.

Questionnaire filled out by	Family interest			Parents' intrinsic value			Parents' utility value		
	N	M	SD	N	M	SD	N	M	SD
Mother	826	2.39	0.85	838	2.61	0.96	833	2.80	0.68
Father	241	2.57	0.84	244	3.11	0.78	245	3.11	0.66
Both parents	341	2.58	0.87	340	2.91	0.85	342	3.10	0.67

Table 4

Manifest intercorrelations of Variables Measured at Time 1.

Variables	Family background				Students' academic motivation				
	1	2	3	4	5	6	7	8	9
1 Socioeconomic status									
2 Parents' utility value	.08**								
3 Parents' intrinsic value	.18***	.59***							
4 Family math interest	.20***	.53***	.74***						
5 Students' utility value	-.04	.18**	.15***	.21***					
6 Students' attainment value	-.06*	.17***	.16***	.21***	.68***				
7 Students' intrinsic value	.05†	.18***	.24***	.33***	.54***	.64***			
8 Students' costs	-.13***	-.15***	-.22***	-.31***	-.31***	-.41***	-.68***		
9 Students' self-concept	.11***	.20***	.27***	.35***	.39***	.48***	.73***	-.75***	
10 Students' effort	-.07*	.09**	.10**	.11***	.39***	.58***	.42***	-.28***	.31***

Note. Bivariate correlations at the pretest are presented. Pattern of correlations at T2 and T3 is comparable.

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

Table 5

Intervention effects depending on family math interest (FI) on students' motivation at posttest and follow-up (N = 1,459).

Variable	Utility		Attainment		Intrinsic		Cost		Self-concept		Effort	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Posttest</i>												
Student level												
Outcome T1	.66***	(.02)	.75***	(.02)	.77***	(.02)	.78***	(.02)	.82***	(.02)	.70***	(.02)
Intercept FI	.07*	(.04)	.09**	(.03)	.08*	(.03)	-.07**	(.02)	.09**	(.03)	.08**	(.03)
Class level												
Outcome T1	.82***	(.07)	.78***	(.06)	.91***	(.06)	.88***	(.07)	.84***	(.06)	.83***	(.07)
FI L2	.07*	(.04)	.09**	(.03)	.08*	(.03)	-.07**	(.02)	.09**	(.03)	.08**	(.03)
Quotations	.26***	(.06)	.07	(.05)	.03	(.06)	-.09	(.06)	.08	(.06)	.04	(.06)
Text	.15*	(.06)	-.02	(.05)	-.05	(.06)	.00	(.05)	.02	(.05)	.00	(.06)
Quotations × FI	-.08†	(.04)	-.04	(.04)	-.04	(.04)	.05	(.04)	-.03	(.04)	-.07	(.05)
Text × FI	-.01	(.05)	-.07	(.05)	-.05	(.04)	.03	(.03)	-.02	(.04)	-.10*	(.04)
Residual Variance												
Student level	.47	(.03)	.39	(.02)	.33	(.02)	.35	(.02)	.25	(.01)	.48	(.03)
Class level	.02	(.01)	.02	(.01)	.02	(.01)	.02	(.01)	.02	(.01)	.01	(.01)
<i>Follow-Up</i>												
Student level												
Outcome T1	.59***	(.03)	.67***	(.03)	.71***	(.02)	.73***	(.02)	.79***	(.02)	.61***	(.02)
Intercept FI	.13**	(.04)	.13***	(.03)	.13***	(.03)	-.07**	(.02)	.08*	(.04)	.07*	(.03)
Class level												
Outcome T1	.77***	(.07)	.78***	(.08)	.80***	(.07)	.88***	(.08)	.80***	(.06)	.78***	(.07)
FI L2	.13**	(.04)	.13***	(.03)	.13***	(.03)	-.07**	(.02)	.08*	(.04)	.07*	(.03)
Quotations	.22***	(.06)	.14*	(.06)	.10	(.07)	-.06	(.07)	.10	(.06)	.03	(.06)
Text	.16*	(.06)	.07	(.06)	.01	(.06)	.01	(.06)	.02	(.05)	.03	(.06)
Quotations × FI	-.13*	(.06)	-.11*	(.05)	-.10*	(.05)	.07	(.04)	-.08†	(.05)	-.10	(.06)
Text × FI	-.14*	(.06)	-.15***	(.04)	-.08†	(.04)	.03	(.04)	-.01	(.04)	-.11*	(.05)
Residual Variance												
Student level	.59	(.04)	.51	(.03)	.42	(.02)	.41	(.03)	.33	(.02)	.60	(.04)
Class level	.02	(.01)	.02	(.01)	.03	(.01)	.03	(.01)	.02	(.01)	.01	(.01)
Effects for subgroups ^a												
FI +1SD												
Quotations	.10		.03		.01		.01		.02		-.07	
Text	.02		-.08		-.07		.04		.01		-.09	
FI -1SD												
Quotations	.35		.24		.20		-.12		.18		.12	
Text	.30		.22		.09		-.02		.03		.14	

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. ^a Effects for subgroups in comparison to the control group. Outcome T1 = Associations between the respective student outcome at T1 and T2/T3; Intercept FI = Association of family interest and the respective student outcome at T2/T3; FI L2 = Association of family interest and the respective student outcome at T2/T3 on the class level – the effects of Intercept FI and FI L2 were constrained to be equal on both levels since no context effects were found; Quotations = Main intervention effect of quotations condition in comparison to control group; Text = Main intervention effect of text condition in comparison to control group; Quotations × FI = Cross-level interaction effect between family interest and quotations condition; Text × FI = Cross-level interaction effect between family interest and text condition.

Table 6
Intervention effects depending on parents' intrinsic value (PIV) on students' motivation at posttest and follow-up
 (N = 1,474).

Variable	Utility		Attainment		Intrinsic		Cost		Self-concept		Effort	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Posttest</i>												
Student level												
Outcome T1	.67***	(.02)	.75***	(.02)	.78***	(.02)	.77***	(.02)	.83***	(.02)	.70***	(.03)
Intercept PIV	.07†	(.04)	.07*	(.03)	.06*	(.03)	-.05†	(.03)	.08**	(.02)	.03	(.03)
Class level												
Outcome T1	.82***	(.07)	.79***	(.06)	.91***	(.06)	.89***	(.07)	.85***	(.06)	.85***	(.07)
PIV L2	.07†	(.04)	.07*	(.03)	.06*	(.03)	-.05†	(.03)	.08**	(.02)	.03	(.03)
Quotations	.28***	(.06)	.11*	(.05)	.06	(.06)	-.11†	(.06)	.10†	(.05)	.05	(.06)
Text	.15*	(.06)	-.02	(.05)	-.06	(.06)	.02	(.05)	.01	(.05)	.02	(.06)
Quotations × PIV	-.04	(.05)	-.03	(.04)	-.02	(.04)	-.01	(.04)	-.05	(.04)	-.03	(.04)
Text × PIV	-.03	(.05)	-.03	(.05)	-.05	(.04)	.03	(.04)	-.05	(.04)	-.05	(.04)
Residual Variance												
Student level	.47	(.03)	.40	(.02)	.33	(.02)	.35	(.02)	.26	(.02)	.48	(.03)
Class level	.02	(.01)	.02	(.01)	.02	(.01)	.01	(.01)	.02	(.01)	.01	(.01)
<i>Follow-Up</i>												
Student level												
Outcome T1	.58***	(.03)	.66***	(.02)	.72***	(.02)	.73***	(.02)	.80***	(.02)	.61***	(.02)
Intercept PIV	.12**	(.04)	.10***	(.03)	.13***	(.03)	-.05	(.04)	.06*	(.03)	.05†	(.03)
Class level												
Outcome T1	.78***	(.07)	.78***	(.08)	.81***	(.08)	.89***	(.08)	.82***	(.06)	.79***	(.07)
PIV L2	.12**	(.04)	.10***	(.03)	.13***	(.03)	-.05	(.04)	.06*	(.03)	.05†	(.03)
Quotations	.25***	(.06)	.17**	(.05)	.13*	(.07)	-.07	(.07)	.11†	(.06)	.05	(.06)
Text	.16*	(.06)	.07	(.06)	.00	(.06)	.03	(.07)	.00	(.05)	.04	(.06)
Quotations × PIV	-.05	(.06)	-.04	(.05)	-.10*	(.04)	.02	(.04)	-.06	(.04)	-.05	(.05)
Text × PIV	-.15**	(.05)	-.11*	(.04)	-.08†	(.04)	.01	(.05)	-.02	(.04)	-.10*	(.05)
Residual Variance												
Student level	.58	(.03)	.51	(.03)	.41	(.02)	.41	(.03)	.33	(.02)	.61	(.04)
Class level	.02	(.01)	.02	(.01)	.03	(.01)	.03	(.01)	.02	(.01)	.01	(.01)
Effects for subgroups ^a												
PIV +1SD												
Quotations	.20		.13		.03		-.05		.04		.00	
Text	.01		-.04		-.09		.03		-.02		-.06	
PIV -1SD												
Quotations	.30		.22		.23		-.09		.17		.10	
Text	.31		.17		.08		.02		.03		.13	

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. a Effects for subgroups in comparison to the control group. Outcome T1 = Associations between the respective student outcome at T1 and T2/T3; Intercept PIV = Association of parents' intrinsic values and the respective student outcome at T2/T3; PIV L2 = Association of parents' intrinsic values and the respective student outcome at T2/T3 on the class level – the effects of Intercept PIV and PIV L2 were constrained to be equal on both levels since no context effects were found; Quotations = Main intervention effect of quotations condition in comparison to control group; Text = Main intervention effect of text condition in comparison to control group; Quotations × PIV = Cross-level interaction effect between parents' intrinsic values and quotations condition; Text × PIV = Cross-level interaction effect between parents' intrinsic values and text condition.

Table 7

Intervention effects depending on parents' utility value (PUV) on students' motivation at posttest and follow-up (N = 1,472).

Variable	Utility		Attainment		Intrinsic		Cost		Self-concept		Effort	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Posttest</i>												
Student level												
Outcome T1	.66 ^{***}	(.02)	.75 ^{***}	(.02)	.79 ^{***}	(.02)	.78 ^{***}	(.02)	.84 ^{***}	(.02)	.70 ^{***}	(.02)
Intercept PUV	.04	(.04)	.06 [†]	(.03)	.01	(.03)	-.04	(.03)	.03	(.03)	.03	(.03)
Class level												
Outcome T1	.83 ^{***}	(.07)	.79 ^{***}	(.06)	.92 ^{***}	(.06)	.90 ^{***}	(.07)	.85 ^{***}	(.06)	.85 ^{***}	(.07)
PUV L2	.04	(.04)	.06 [†]	(.03)	.01	(.03)	-.04	(.03)	.03	(.03)	.03	(.03)
Quotations	.28 ^{***}	(.06)	.10 [†]	(.05)	.06	(.06)	-.10 [†]	(.06)	.10 [†]	(.05)	.05	(.06)
Text	.15 [*]	(.06)	-.02	(.05)	-.06	(.06)	.01	(.05)	.02	(.05)	.02	(.06)
Quotations × PUV	.04	(.05)	-.02	(.05)	.05	(.04)	.04	(.04)	-.02	(.03)	-.07	(.05)
Text × PUV	-.01	(.05)	-.06	(.04)	-.04	(.04)	.02	(.04)	-.02	(.03)	-.05	(.04)
Residual Variance												
Student level	.47	(.03)	.40	(.02)	.33	(.02)	.34	(.02)	.26	(.02)	.48	(.03)
Class level	.02	(.01)	.01	(.01)	.02	(.01)	.02	(.01)	.02	(.01)	.01	(.01)
<i>Follow-Up</i>												
Student level												
Outcome T1	.58 ^{***}	(.03)	.66 ^{***}	(.02)	.72 ^{***}	(.02)	.74 ^{***}	(.02)	.80 ^{***}	(.02)	.61 ^{***}	(.02)
Intercept PUV	.08 [*]	(.04)	.07 [*]	(.03)	.04	(.03)	-.04	(.03)	.06 [*]	(.03)	.01	(.03)
Class level												
Outcome T1	.79 ^{***}	(.07)	.79 ^{***}	(.08)	.83 ^{***}	(.08)	.89 ^{***}	(.08)	.82 ^{***}	(.06)	.80 ^{***}	(.07)
PUV L2	.08 [*]	(.04)	.07 [*]	(.03)	.04	(.03)	-.04	(.03)	.06 [*]	(.03)	.01	(.03)
Quotations	.24 ^{***}	(.06)	.16 ^{**}	(.05)	.13 [†]	(.07)	-.07	(.07)	.11 [†]	(.06)	.05	(.06)
Text	.16 [*]	(.06)	.06	(.06)	.00	(.06)	.02	(.07)	.01	(.05)	.04	(.06)
Quotations × PUV	.04	(.05)	.02	(.04)	.01	(.04)	.05	(.04)	-.06 [†]	(.03)	-.01	(.04)
Text × PUV	-.09 [†]	(.05)	-.11 [*]	(.05)	-.03	(.04)	.01	(.05)	-.04	(.04)	-.07	(.05)
Residual Variance												
Student level	.59	(.03)	.51	(.03)	.42	(.02)	.41	(.03)	.33	(.02)	.61	(.04)
Class level	.02	(.01)	.02	(.01)	.03	(.01)	.03	(.01)	.02	(.01)	.01	(.01)
Effects for subgroups ^a												
PUV +1SD												
Quotations	.28		.18		.14		-.02		.05		.04	
Text	.07		-.04		-.03		.03		-.03		-.03	
PUV -1SD												
Quotations	.20		.14		.12		-.13		.17		.06	
Text	.24		.17		.03		.01		.06		.11	

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. ^a Effects for subgroups in comparison to the control group. Outcome T1 = Associations between the respective student outcome at T1 and T2/T3; Intercept PUV = Association of parents' utility values and the respective student outcome at T2/T3; PUV L2 = Association of parents' utility values and the respective student outcome at T2/T3 on the class level – the effects of Intercept PUV and PUV L2 were constrained to be equal on both levels since no context effects were found; Quotations = Main intervention effect of quotations condition in comparison to control group; Text = Main intervention effect of text condition in comparison to

control group; Quotations \times PUV = Cross-level interaction effect between parents' utility values and quotations condition; Text \times PUV = Cross-level interaction effect between parents' utility values and text condition.

Table 8

Intervention effects depending on SES on students' motivation at posttest and follow-up (N = 1,491).

Variable	Utility		Attainment		Intrinsic		Cost		Self-concept		Effort	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
<i>Posttest</i>												
Student level												
Outcome T1	.67 ^{***}	(.02)	.75 ^{***}	(.02)	.78 ^{***}	(.02)	.78 ^{***}	(.02)	.84 ^{***}	(.02)	.70 ^{***}	(.02)
Intercept SES	-.03	(.03)	-.01	(.02)	.03	(.02)	-.02	(.03)	.03	(.03)	-.01	(.04)
Class level												
Outcome T1	.83 ^{***}	(.07)	.79 ^{***}	(.06)	.91 ^{***}	(.06)	.88 ^{***}	(.07)	.84 ^{***}	(.06)	.84 ^{***}	(.07)
SES L2	-.03	(.03)	-.01	(.02)	.03	(.02)	-.02	(.03)	.03	(.03)	-.01	(.04)
Quotations	.28 ^{***}	(.07)	.12 [*]	(.05)	.05	(.06)	-.11 [†]	(.06)	.11 [*]	(.05)	.07	(.06)
Text	.18 ^{**}	(.07)	.02	(.05)	-.04	(.06)	-.01	(.05)	.05	(.06)	.04	(.06)
Quotations \times SES	.01	(.05)	.01	(.04)	-.03	(.03)	.01	(.04)	-.03	(.03)	.01	(.05)
Text \times SES	.04	(.05)	-.03	(.04)	-.06 [†]	(.03)	.01	(.04)	.00	(.04)	-.03	(.05)
Residual Variance												
Student level	.47	(.03)	.40	(.02)	.33	(.02)	.36	(.02)	.26	(.02)	.49	(.03)
Class level	.03	(.01)	.02	(.01)	.02	(.01)	.02	(.01)	.03	(.01)	.01	(.01)
<i>Follow-Up</i>												
Student level												
Outcome T1	.59 ^{***}	(.03)	.66 ^{***}	(.02)	.73 ^{***}	(.02)	.73 ^{***}	(.02)	.80 ^{***}	(.02)	.61 ^{***}	(.02)
Intercept SES	.06	(.04)	.02	(.03)	.03	(.02)	.00	(.03)	.01	(.03)	-.01	(.03)
Class level												
Outcome T1	.80 ^{***}	(.07)	.82 ^{***}	(.08)	.82 ^{***}	(.08)	.89 ^{***}	(.08)	.80 ^{***}	(.06)	.78 ^{***}	(.07)
SES L2	.06	(.04)	.02	(.03)	.03	(.02)	.00	(.03)	.01	(.03)	-.01	(.03)
Quotations	.24 ^{***}	(.07)	.16 ^{**}	(.06)	.12 [†]	(.07)	-.07	(.07)	.12 [†]	(.06)	.07	(.06)
Text	.18 ^{**}	(.06)	.08	(.06)	.03	(.06)	-.01	(.07)	.05	(.05)	.06	(.06)
Quotations \times SES	-.06	(.06)	.01	(.05)	-.04	(.04)	.00	(.04)	.02	(.04)	-.02	(.06)
Text \times SES	-.08	(.05)	-.06	(.04)	-.04	(.04)	.00	(.04)	-.02	(.04)	-.04	(.04)
Residual Variance												
Student level	.59	(.03)	.52	(.03)	.43	(.02)	.42	(.03)	.34	(.02)	.61	(.03)
Class level	.02	(.01)	.02	(.01)	.03	(.01)	.03	(.01)	.02	(.01)	.01	(.01)

Note. Est. = Estimated Parameters. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$; Outcome T1 = Associations between the respective student outcome at T1 and T2/T3; Intercept SES = Association of SES and the respective student outcome at T2/T3; SES L2 = Association of SES and the respective student outcome at T2/T3 on the class level – the effects of Intercept SES and SES L2 were constrained to be equal on both levels since no context effects were found; Quotations = Main intervention effect of quotations condition in comparison to control group; Text = Main intervention effect of text condition in comparison to control group; Quotations \times SES = Cross-level interaction effect between SES and quotations condition; Text \times SES = Cross-level interaction effect between SES and text condition.

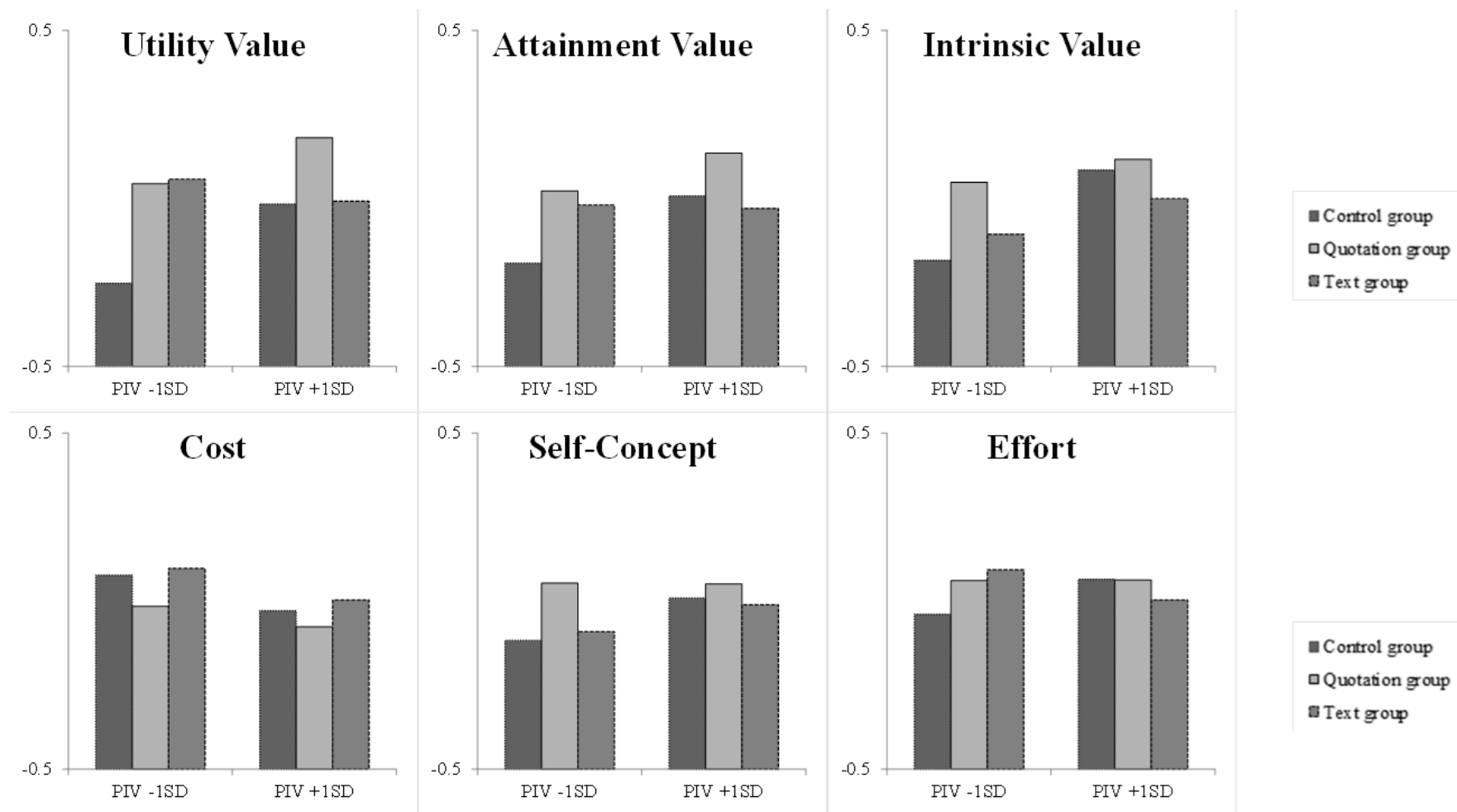


Figure 1. Adjusted means for students' value beliefs, self-concept, and effort at follow-up by parents' intrinsic math values (PIV) and intervention group. Predicted values were generated for low (-1 SD) and high (+1 SD) parents' intrinsic math values from the multilevel regression model.

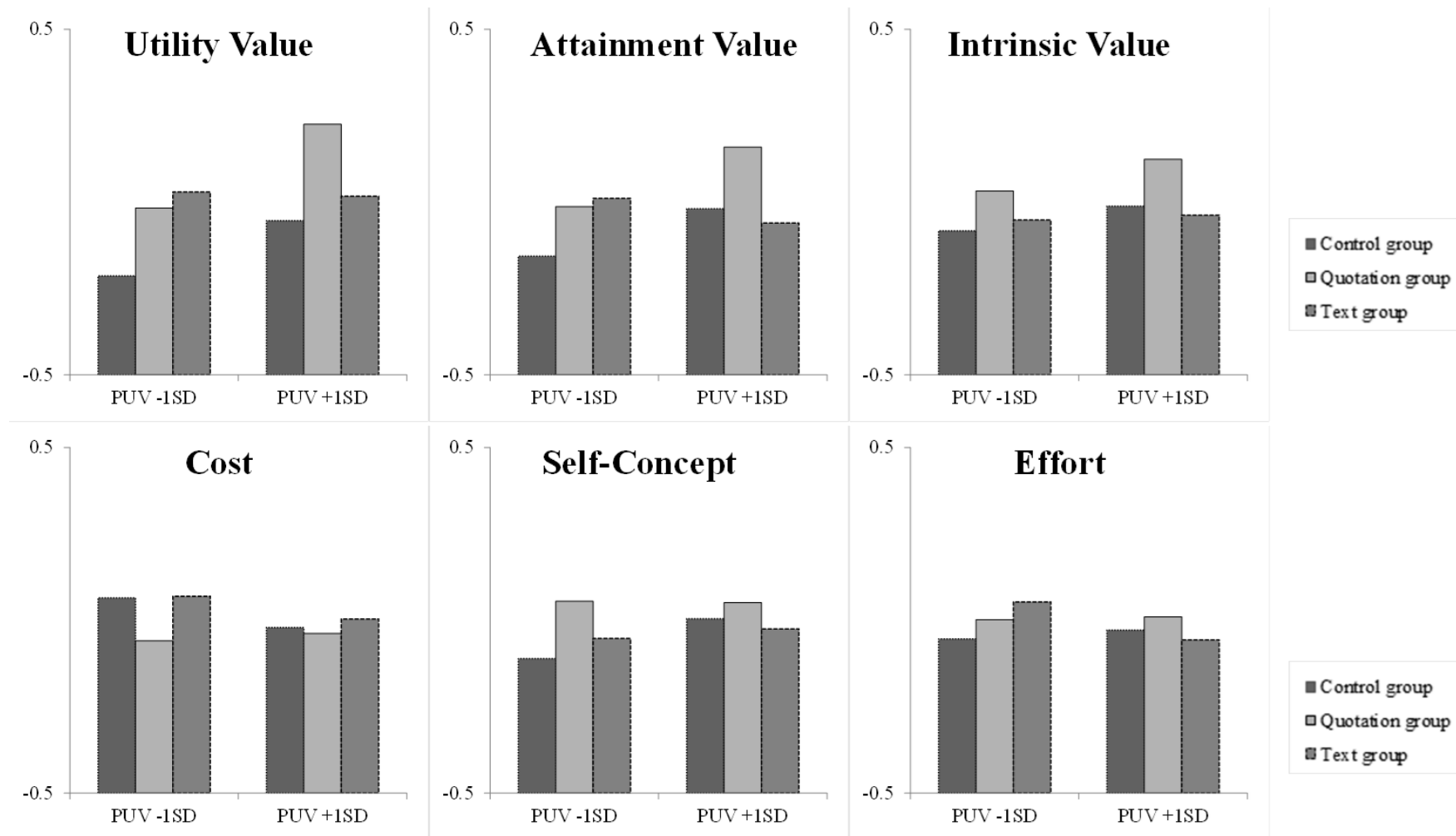


Figure 2. Adjusted means for students' value beliefs, self-concept, and effort at follow-up by parents' utility math values (PUV) and intervention group. Predicted values were generated for low (-1 SD) and high (+1 SD) parents' utility math values from the multilevel regression model.

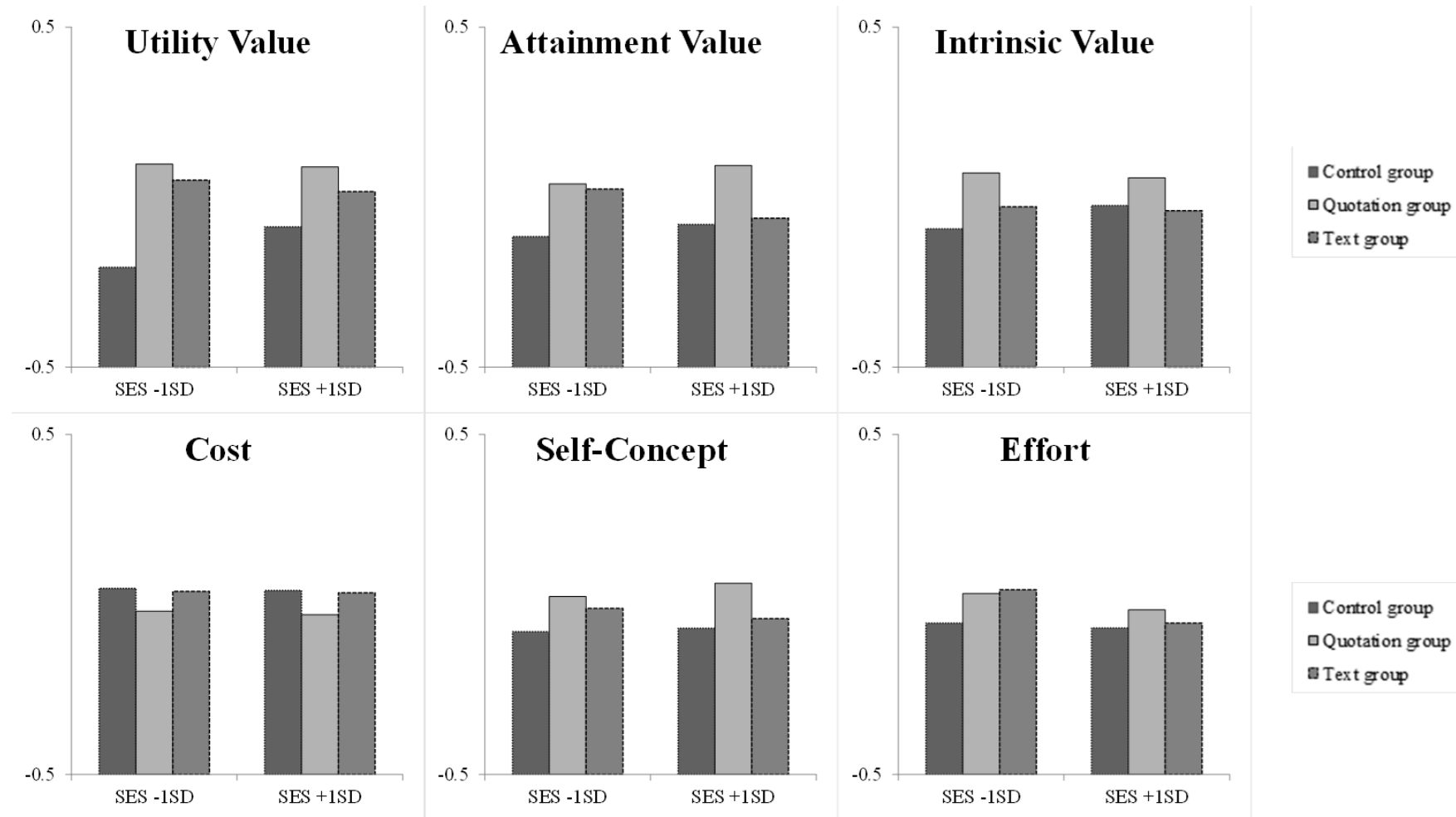


Figure 3. Adjusted means for students' value beliefs, self-concept, and effort at follow-up by socioeconomic status (SES) and intervention group. Predicted values were generated for low (-1 SD) and high (+1 SD) socioeconomic status from the multilevel regression model

General Discussion

5 General Discussion

Family background is an important predictor of students' academic outcomes (Eccles, 2007; Simpkins, Fredricks, & Eccles, 2015) and can be distinguished into structural and process-related family characteristics (Maccoby, 1992; McLoyd, 1998). Although researchers recently started to highlight the importance of process-related family characteristics for students' academic outcomes, a systematic conceptualization of family background has often been missing (Bradley & Corwyn, 2002; Lazarides, Harackiewicz, Canning, Pesu, & Viljaranta, 2015). Moreover, researchers called for person-centered approaches to investigate how specific combinations of multiple process-related family characteristics are associated with students' academic outcomes (Eccles, 2007; Simpkins et al., 2015). Therefore, the present dissertation specifically focused on process-related family characteristics and investigated how they are associated with students' academic outcomes, over and above the influence of structural family characteristics. To investigate the interplay between different process-related family characteristics, the first study applied a person-centered approach including multiple process-related family characteristics and examined their associations with students' academic outcomes, alongside with structural family characteristics. As Study 1 demonstrated the importance of motivational family characteristics for students' academic outcomes, Study 2 specifically focused on motivational family characteristics. Using a longitudinal data set with multiple measure points from middle school through college, Study 2 analyzed how motivational family characteristics predict students' motivation, achievement, career aspirations, and course-taking. Moreover, bidirectional relations between parent and student motivation were investigated to yield valuable insights in the development of academic motivation. Given the findings of Study 1 and 2, the question emerges whether interventions can counteract motivational deficits for students from families with lower motivational resources. Therefore, Study 3 examined whether value interventions can be used as a tool to decrease motivational gaps between students from families with more and less advantageous motivational characteristics. In the following section, central findings regarding associations between family characteristics and student outcomes will be discussed, and the strengths and limitations of the present dissertation will be described. In the last section, implications of the present research findings for future research and practice will be explored.

5.1. Discussion of General Findings

5.1.1. Focusing on a process-oriented framework on family background

All three empirical studies in this dissertation investigated the relative importance of process-related family characteristics in contrast to structural family characteristics, such as the socioeconomic status (SES). Whereas Study 1 included multiple family characteristics derived from literature, Study 2 and 3 focused on motivational family characteristics in particular.

A process-oriented approach to family background

Although researchers have called for a process-related approach to family characteristics previously, only a few studies have investigated process-related and structural family characteristics at the same time. Moreover, different studies used different conceptualizations of process-related family characteristics. This specifically applies to motivational family characteristics: Studies either focused on one general value construct without further differentiating between different aspects of value (Frenzel, Goetz, Pekrun, & Watt, 2010; Simpkins, Fredricks, & Eccles, 2012) or measured only one specific aspect of parents' value beliefs (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012). To overcome these inconsistencies in the operationalization of family background, the present dissertation proposed a systematic, process-oriented approach to family background relying on the parent socialization model (Eccles, 2005; Jacobs & Eccles, 2000). Supporting the assumption that process-related family characteristics might be even more important for students' academic outcomes than structural family characteristics, all three studies found higher associations between motivational family characteristics with student outcomes (Study 1: $.06 \leq r \leq .36$; Study 2: $.04 \leq r \leq .56$; Study 3: $.09 \leq r \leq .35$) than between structural family characteristics and student outcomes (Study 1: $.07 \leq r \leq .16$; Study 2: $.02 \leq r \leq .30$; Study 3: $.04 \leq r \leq .13$). More specifically, Study 1 found that different patterns of process-related family characteristics showed higher associations with students' academic motivation and achievement than SES. In Study 2, mothers' motivational beliefs predicted all student outcomes (motivational

beliefs, course-taking, achievement, and career aspirations) over and above the predictive effects of students' own motivational beliefs and achievement. However, there remained a significant effect of mothers' years of education on students' achievement. Future research is needed to investigate which processes within the family mediate this direct effect. Again supporting the importance of parents' motivational beliefs for students' motivational outcomes, Study 3 found that, controlling for students' initial value beliefs, motivational family characteristics were significantly associated with students' motivation. In contrast, there were low or even non-significant associations between SES and students' value beliefs. To conclude, the present dissertation demonstrates that process-related family characteristics, specifically motivational family characteristics, are particularly important for predicting students' academic motivation, achievement, and academic behavior, over and above what can be predicted by structural family characteristics.

A person-centered approach to family background

Families are complex systems, which are defined by the interplay of multiple variables. Therefore, it has been argued that person-centered approaches that include multiple process-related family characteristics might be more appropriate than variable-centered approaches when investigating family influences on student outcomes (Simpkins et al., 2015). However, only a few studies have investigated multiple family characteristics at the same time (Eccles, 2007) with most studies focusing on one specific family characteristics, such as parents' value beliefs (e.g., Frenzel et al., 2010; Neuenschwander, Vida, Garrett, & Eccles, 2007; Steinmayr, Dinger, & Spinath, 2012). Therefore, person-centered approaches to these topics are needed. Thus, Study 1 applied a person-centered approach to family background and found systematic cross-sectional and longitudinal associations of different patterns of process-related family characteristics with students' academic motivation and achievement. More specifically, applying a person-centered approach that incorporated multiple theoretically derived family characteristics provided new insights into the effects of parental academic involvement: Belonging to a family described by high parental academic involvement was only positively related to student motivation and achievement in math if parents were also highly interested in the subject and held high self-concepts of their math abilities.

Therefore, applying a person-centered approach helped to understand the complex nature of how process-related family characteristics predict student motivation and achievement.

In contrast to academic involvement, high motivational family characteristics (i.e., high family interest and high parental self-concept) were positively associated with students' academic motivation and achievement, regardless of the amount of parents' academic involvement (Study 1). This again suggests that it is important to assess motivational family characteristics when investigating family influences on student outcomes. Therefore, Studies 2 and 3 focused on motivational family characteristics, and their results further supported the relevance of these family characteristics. To conclude, the present dissertation highlighted the importance of considering motivational family characteristics, such as parents' motivational beliefs, when investigating parental influences on students' motivation and achievement; these have been understudies so far in research on family influences on students' academic outcomes.

A longitudinal approach to family background

When investigating family influences on student outcomes, studies need to address several issues. First of all, process-related family characteristics are influenced by the characteristics of the child. Academic involvement and parents' perceptions of child's ability are influenced by the achievement of the child: When a child struggles in a subject, parents' involvement tends to increase and they tend to be more controlling (e.g., Dumont, Trautwein, Nagy, & Nagengast, 2014). Similarly, parents' perceptions of their child's ability are highly influenced by the child's achievement (Neuenschwander et al., 2007). Controlling for students' prior achievement is thus important in order to reduce the chance that third variables influence associations between family characteristics and student outcomes. Longitudinal data allows researchers to control for students' initial values on outcome variables of interest, and thereby enables to compare students with the same initial values. Therefore, longitudinal nonexperimental studies are one of the best available options for studying associations between family characteristics and student outcomes. All three empirical studies in this dissertation profited from the use of longitudinal data sets and demonstrated the importance of process-related family characteristics for predicting students' academic outcomes, over and above the influences of structural family characteristics, students' ability levels, and students' initial values. Thus, using adequate methodologies and longitudinal datasets, the findings of all three

studies consistently demonstrated the importance of process-related family characteristics and, in particular, the importance of parents' motivational beliefs, when investigating family influences on students' academic outcomes.

Moreover, it has been argued that parental influences on student outcomes decrease when students get older (Milgram & Toubiana, 1999; Singh et al., 1995). However, although all three studies of this dissertation were based on adolescents, process-related family characteristics predicted student outcomes substantially in all three studies. In addition, Study 2 investigated bidirectional interrelations of parents' and students' motivational beliefs from middle school through college and found that mothers' value beliefs significantly predicted students' career aspirations, course-taking, and future motivation in college, after controlling for students' achievement, motivational beliefs, and academic behavior (i.e., course-taking). Thus, even during adolescence, parents are role models who shape the development of their children's academic motivation and achievement and thus their career paths.

A multidimensional approach to student outcomes

All three studies within this dissertation adopted a multidimensional approach on students' academic outcomes. Regarding student motivation, Study 1 focused on the three indicators interest, effort, and self-concept. Study 2 investigated students' value and ability beliefs, career aspirations and course-taking; and Study 3 assessed students' value beliefs in addition to effort and self-concept. In addition, Study 1 and 2 differentiated between students' motivation and achievement. Distinguishing between student outcomes is necessary to uncover differential associations between motivational family characteristics with different student outcomes. Yet, we did not find systematic differences in the associations between motivational family characteristics and the different indicators of student motivation and achievement in any of the three studies. In general, parents' motivational characteristics were highly related to students' academic motivation and achievement. As Study 2 demonstrated, mothers' perception of students' ability predicted students' utility values and ability beliefs, as well as their course-taking, and achievement. Similarly, mothers' utility value beliefs predicted students' career aspirations, their future motivation, and their career aspirations. However, motivational family characteristics showed descriptively lower associations with students' effort, than with the other indicators of student motivation (see Study 1 and 2). To conclude, if parents

hold high motivational beliefs themselves and perceive their child as high in ability, this is positively associated with a variety of important indicators of student motivation, achievement, and academic choices. Thus, high motivational beliefs of parents might have wide-ranging positive effects on students' motivation that spread on several related academic outcomes.

5.1.2. Decreasing motivational gaps between students from families with higher versus lower resources

In education and politics, a major issue involves reducing motivation and achievement gaps between students from privileged and disadvantaged families (Ceci & Papierno, 2005). However, when administering universalized interventions, which are given to all students and not just to students in need (i.e., from disadvantaged families), research shows that students with better initial conditions (i.e., students from privileged families) profit most from some interventions (Ceci & Papierno, 2005). Since students from families with lower motivational resources show lower motivation themselves (Frenzel et al., 2010; Lazarides et al., 2015), closing motivation gaps for these students is an important objective that has not been addressed in previous research. Thus, Study 3 analyzed whether a motivational intervention targeting students' relevance beliefs can be used as a tool to counteract motivational differences between students from families who have more and less advantageous motivational characteristics. Study 3 demonstrated that the value intervention was especially effective in fostering students' value beliefs and effort five months after the intervention for students from families with low motivational resources. In contrast to former interventions in which students with better initial conditions profited most, this study yielded the opposite effect: Students from families with lower motivational profited most over a period of five months. The differential effects of the intervention were found five months after the intervention, not at the posttest. Yet, counteracting motivational deficits for students from less advantageous families in the long run is essential to decrease motivational gaps between students from families with more versus fewer resources. Thus, this study contributed to existing motivation intervention research by suggesting that a 90 minute classroom intervention was able to counteract motivational gaps between students from families with more and less advantageous motivational characteristics. Study 3 also found that the value intervention was not especially beneficial at improving motivation for students from

families with low SES. In contrast, motivational gaps due to different motivational family characteristics can be reduced by value interventions.

5.1.3. Strengths and limitations of the present dissertation

Some strengths and limitations of the present dissertation need to be acknowledged when interpreting the results of the three studies conducted within this dissertation. In general, all three studies within this dissertation profited from high response rates of parents (Study 1 and 3: 79.5%; Study 2: 88.0% - 89.0%) compared to response rates in other studies (e.g., 45%; Grolnick, 2015). Another strength of this dissertation is that it contributes to existing research, by using large longitudinal data sets and analyzing the research questions using appropriate state-of-the-art statistical methodology by accounting for the multilevel structure of the data when necessary (Raudenbush & Bryk, 2002). In addition, Study 3 investigated differential effects of a motivational intervention depending on process-related family characteristics by using a strong research design (i.e., a cluster randomized field trial) including a control group.

Although all three studies yielded important findings about associations between family characteristics and students' academic outcomes, all three studies solely used questionnaire methods to assess process-related family characteristics. This might lead to parents' answers being influenced by social desirability. In contrast to the majority of studies on family characteristics, which assessed family characteristics by students (Dumont et al., 2014; Ing, 2014; Karbach, Gottschling, Spengler, Hegewald, & Spinath, 2013; Noack, Kracke, Gniewosz, & Dietrich, 2010), the use of parent questionnaires reduces the shared method variance of assessing predictors and outcome variables by the same person (e.g., the student). Regarding the common method bias and the problem of social desirability, the development of new methods to assess family characteristics would be valuable. Some studies applied observation methods to investigate the quality of parent-child interactions (e.g., Hyde, Else-Quest, Alibali, Knuth, & Romberg, 2006) which is a method less prone to social desirability and might enable a more accurate assessment of the processes at play. Yet, such methods are time-consuming and expensive and therefore are difficult to apply to large samples. Thus, both survey data and other methods such as observations can yield unique insights into the associations between family characteristics and student outcomes.

All three studies within this dissertation profited of the use of longitudinal study designs. This is an improvement from prior research, which has often used cross-sectional study designs and therefore did not control for third variables prior to the outcomes. Thus, the use of longitudinal data sets is highly recommended as they provide a more reliable interpretation of results. Yet, even in longitudinal designs, causal interpretations cannot be made due to the possibility of third-variables explanations. However, as some research questions referring to family influences on students' outcomes are difficult to translate into experiments, longitudinal nonexperimental survey studies are one of the best available options for studying associations between family characteristics and student outcomes. Moreover, investigating the effects of family characteristics on the development of students' motivation and achievement for even longer periods of time would likely provide even more valuable insights. With regards to Study 1, it is possible that the associations between patterns of family characteristics and students' academic outcomes vanish over a longer time period. Yet, it is also possible that cascading effects over time occur and, thus, family characteristics would be even more strongly associated with students' educational pathways as what has been found when looking at shorter time intervals (Simpkins et al., 2015). Concerning Study 3, we found that two relevance interventions were especially effective for students from families with low motivational resources five months after the intervention. It would be valuable to investigate if these differential intervention effects hold in the long run, possibly even influencing students' academic choices such as their course-taking and career aspirations. Evidence about the long-term effects of family characteristics would, thus, be valuable, especially when deriving implications for policy and practice.

Third, all three empirical studies intentionally focused on associations between family characteristics and student outcomes in math or STEM subjects, which constrains the generalizability of the findings. However, research suggests that the associations between parent and student motivation should not be systematically different in other subjects (Simpkins et al., 2012, 2015), and that these associations might even be stronger in leisure domains, such as instrumental music or sports (Simpkins et al., 2015). Additionally, the use of two different data sets allowed investigating associations between family characteristics and student outcomes in different age groups. However, the samples used in all three studies were rather similar (mainly white and with similar socioeconomic backgrounds). Thus, further research is needed to investigate whether the

associations between family characteristics and student outcomes differ in more diverse samples. Regarding different ethnic backgrounds, studies suggest that associations between family characteristics and student outcomes vary depending on the culture participants come from (Cheadle, 2008; Davis-Kean, 2005; McLoyd, 1998).

Lastly, we mostly used data of mothers in all three studies: Study 1 and 2 mostly relied on mothers (56.3%) and Study 3 solely used data reported by mothers. This improves upon previous studies which solely relied on student data (Dumont et al., 2014; Ing, 2014; Karbach et al., 2013; Noack et al., 2010). When previous studies have used parent data, the majority relied on data from mothers or asked both parents to fill out the parent questionnaire together (Frenzel et al., 2010; Katz, Kaplan, & Buzukashvily, 2011; Simpkins et al., 2012). It had been argued that mothers are more closely involved with students' academic lives and thereby are more important for students' academic outcomes (Dotterer, McHale, & Crouter, 2009). Yet, it is possible that the associations between different family characteristics (e.g., motivational family characteristics) and student outcomes might be influenced by parent gender (e.g., Frome & Eccles, 1998). Further evidence is needed to assess the relative importance of both mothers' and fathers' beliefs and behaviors for the development of student motivation. Moreover, an important factor facilitating value transmission between parents and students is between-parent agreement: Gniewosz and Noack (2012) found that the associations between parents' and students' value beliefs were higher when between parent agreement on value was high. Thus, it would be fruitful to assess data from both parents.

5.2. General Implications and Future Directions

The findings of the three empirical studies presented in this dissertation have implications for future research and practice. On the one hand, the findings suggest potential avenues for future research. On the other hand, relevant implications can be derived for educational policy and practice. In the following, both types of implications will be discussed.

5.2.1. Implications for future research

Implications for future research will be discussed referring to the three guiding questions of the present dissertation. First, the findings highlight the relevance of applying a process-oriented approach to family background. Yet, the findings need to be replicated and associations with other family characteristics should be investigated to ensure the validity of the five family types found in Study 1. Second, the present dissertation found that motivational family characteristics are especially important for students' academic motivation and achievement, even when students enter college. However, future studies are needed to investigate how these associations hold in other age groups. Moreover, the mechanisms through which motivational family characteristics influence student motivation need to be explored. Third, developing reliable measures to assess the quality of parental involvement would enable researchers to examine their interplay with motivational family characteristics. In addition, investigating parents' motivational beliefs for multiple subjects and their associations with students' motivation might yield new insights into the processes at play.

Exploring the conceptualization of family background

Process-related family characteristics are related to students' academic outcomes (Lazarides et al., 2015). By systematically investigating the associations of structural and process-related family characteristics, the present dissertation highlights the multidimensional assessment of family background as an important direction of future research. The application of a person-centered approach yielded new insights into the family processes at play. Yet, future research should replicate the results of Study 1 and investigate how the 5 types of families are related especially to the quality of parents' academic involvement, which has not been investigated in Study 1. Moreover,

investigating how these different patterns of family characteristics develop and which factors in the environment predict these patterns would be valuable. Investigating mechanisms through which these types of families develop might be useful not only for validating the findings of Study 1, but also for identifying mechanisms through which adaptive patterns of family characteristics develop and thus to find ways to foster the development of favorable profiles of family characteristics for students' academic outcomes.

In addition, the amount of parents' academic involvement decreases when students grow older (Singh et al., 1995). Thus, it is reasonable that different patterns of family characteristics might be found for different age-groups. Similarly, the associations between different family types and students' academic outcomes might depend on students' age as well: Students develop a higher need for autonomy during adolescence (Simmons & Blyth, 1987). It is possible that high academic involvement combined with medium levels of parent motivation is rather beneficial for students' academic outcomes when students are younger, as they need more scaffolding and structure during that time (Eccles & Midgley, 1989). However, high parental academic involvement during adolescence might be perceived as rather controlling and interfere with students' need for autonomy, therefore being negatively related to students' academic outcomes (for a similar discussion, see Jacobs & Eccles, 2000) when combined with medium parental motivation. Studies investigating profiles of multiple family characteristics and their associations with students' academic outcomes at different age-groups would thus yield more insights into the developmental aspects of family influences.

Exploring the processes of value transmission

Future research is needed to understand the mechanisms through which motivational family characteristics influence student motivation. Several researchers argued that value transmission from parent to child should be especially high when the parent-child relationship is of high quality (Eccles et al., 1993; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001). However, there is no empirical evidence for this hypothesis so far. Often ceiling effects of survey measures of parent-child relationship have been found (see Study 1), possibly due to a high influence of social desirability on parents' questionnaire answers. Applying other methods, such as observations, to assess the parent-child relationship might be fruitful to investigate the hypothesis that value

transmission should be facilitated by a positive parent-child relationship and would yield new insights into the processes through which value transmission occur. In addition, investigating related constructs such as parental autonomy support could yield new insights into value transmission: Students might be more likely to adopt parents' values if they think they have a choice and are not forced to adopt these values.

Moreover, future research is needed to examine why value interventions are especially beneficial for students from families with lower motivational resources. It is possible that students from families with less advantageous motivational characteristics might have encountered new information during the intervention which they had not received within their families. When students come from families with low interest in math, family communication might be less characterized by math-related topics. In contrast, families with high math interest might embed math-related topics and activities in their everyday life, thus, children from these families might be more familiar with the usefulness of math. Therefore, studies investigating these processes would also yield new insights into the transmission of value beliefs from parents to students.

Some research suggests that family influences on students' academic outcomes depend on student gender (Lazarides & Ittel, 2013). However, in the three studies of this dissertation and similar studies (Simpkins et al., 2015), no systematic interactions with students' gender were found. In addition to students' gender, it is unclear if family effects vary depending on parent gender. Some studies suggest that associations between process-related family characteristics and student outcomes are similar for mothers and fathers (Jodl et al., 2001), whereas other studies suggest that fathers have no or relatively little unique influence on student outcomes over mothers (Frome & Eccles, 1998). Yet, some evidence suggests that parent gender plays a role when looking at differential associations between family characteristics and student outcomes for boys and girls: McGrath and Repetti (2000) found that fathers' (but not mothers') importance of academic success was related to girls' self-concept. However, only very few studies exist examining both student and parent gender when investigating family influence on student outcomes. Therefore, future studies are needed that investigate differential associations between family characteristics and student outcomes depending on both student and parent gender.

Exploring the multidimensionality of motivational family characteristics

When exploring the interplay of multiple family characteristics, including indicators assessing the quality of parents' behavior, such as parents' need-supportive behavior, might yield new insights into the processes at play. However, finding appropriate methods to assess parents' need supportive behavior is currently an issue in research. The question emerges if need supportive behavior should be measured in general or specifically for one situation (e.g., homework involvement; Katz et al., 2011). Theoretically parents' need supportive behavior should be represented by the components autonomy support, structure, and interpersonal involvement (Grolnick, Deci, & Ryan, 1997; Grolnick, Friendly, & Bellas, 2009). Yet, some studies have used a general indicator of parents' need supportive behavior and thereby did not distinguish between different components (e.g., Katz et al., 2011). Studies assessing multiple aspects of parents' need supportive behavior focused on different aspects, which vary from study to study (Dumont et al., 2014; Grolnick, 2015; Grolnick & Slowiaczek, 1994; Karbach et al., 2013). Therefore, finding a common approach to parents' need supportive behavior and establishing profound measures, would enable researchers to investigate the interplay between the quality of parent behavior with other process-related family characteristics. A new venue to measure parents' need supportive behavior might be other methods than traditional questionnaire assessment. Vignettes, in which parents are presented with a specific situation and then asked how they would react to it, might result in more reliable data and would be suited to decrease social desirability.

Another attempt would be to apply a multidimensional approach to parents' motivational beliefs: Parents and students hold motivational beliefs for multiple subjects. So far it is unclear through which mechanisms parents' motivational beliefs influence student motivation. Exploring parents' motivational beliefs for multiple subjects and their associations with students' motivational beliefs might yield new insights into the processes through which parents motivational beliefs influence student motivation. For students, internal-external frame of reference effects (Marsh, 1986) have been found, in which a high motivation for STEM subject mostly goes in line with lower motivation for language-related subjects. The same processes might apply to parents and the different valuing of language-related versus STEM subject could then be transferred to students; thus, if parents specifically value STEM subjects and simultaneously hold low motivation

for language-related subjects, this pattern might explain the external frame of reference effects to some extent.

5.2.2. Implications for educational policy and practice

Understanding the associations between family characteristics and students' academic development is highly relevant for practice, as teachers interact not only with students but also with parents. With regards to parents' academic involvement, teachers can influence parents to get more or less involved into their children's academic lives, specifically in children's homework. Findings of Study 1 found that students only benefitted from parents' academic involvement when parents were interested in the topic they got involved in and thought they are competent. Although future research is needed to investigate the quality of academic involvement next to the quantity of academic involvement and parents' motivation, solely increasing parental academic involvement might be critical. As some intervention programs specifically focus on increasing parents' academic involvement (for an overview, see Castro et al., 2015), simultaneously taking into account the importance of parents' own motivational beliefs (e.g., Harackiewicz et al., 2012) might be a fruitful approach to foster student motivation.

Moreover, schools are institutions that aim at fostering motivation and achievement for all students. Thus, closing motivational gaps between students from families with more and fewer motivational resources is highly relevant for educational practice, as student motivation is an important precursor of students' achievement and educational choices (Durik, Vida, & Eccles, 2006; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). As the value intervention in Study 3 was conducted within the classroom and was relatively short, it could be implemented as part of a regular math curriculum. Yet, evaluating this intervention as a teacher-administered intervention would be necessary beforehand, to test if the intervention would still be effective if delivered by teachers.

Another way to decrease academic gaps between students from families with more and less motivational resources would be to target parents' motivational beliefs directly (Harackiewicz et al., 2012). The findings of Study 2 highlighted the importance of mothers' motivational beliefs for students' academic outcomes. Trying to foster parents' motivational beliefs early on might lead to cascading effects on students' own motivational beliefs and ultimately on students' academic choices over time. Therefore,

trying to foster parents' motivational beliefs, such as parents' utility value beliefs, might be a way to influence students' career orientations. As parents have the most knowledge about the interests of their children, giving them information about the relevance of different school subjects for different careers might be a relatively simple way to foster students' career aspirations that would be easy to implement on a larger scale. As the results of Study 3 suggest, such an intervention might be especially effective for students from families with low motivational beliefs. Future studies are thus needed to investigate if a parent-targeted intervention would be a more practical approach to foster academic motivation for students from families with low motivational beliefs.

To conclude, although there are still some unanswered questions, the present dissertation has shown that a process-oriented approach to family characteristics is a fruitful endeavor. Understanding the importance of family characteristics for students' academic outcomes is necessary to find ways to decrease academic gaps between students from more advantaged and more disadvantaged families.

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