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Students' Well-Being in the Late Elementary and Early Secondary School Years: Investigation of Conditional Factors Using Large-Scale Assessment Studies

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Abstract

Children and adolescents spend a large part of their time at school (cf. OECD, 2016). It is therefore important that they not only see school as a duty, but also feel comfortable there. In this regard, it is relevant to promote students' well-being in school. Students' well-being can generally be described by the positive cognitions and emotions they have about school (Hascher, 2008; Putwain et al., 2020; van Petegem et al., 2007). Importantly, it is viewed as a multifaceted construct that encompasses cognitive, affective, physical, and social aspects (Borgonovi & Pál, 2016; Hascher, 2004; Huppert & Cooper, 2014). In addition to the fact that students should feel comfortable in the place that represents a central socialization context of their early life, there are a number of other reasons why it is important to promote students' well-being in school. For example, positive cognitions and emotions towards school are associated with key school-related outcomes such as academic achievement (e.g., Bücker et al., 2018; Kaya & Erdem, 2021). Furthermore, it is important for students to develop a positive attitude towards learning in order to strengthen their lifelong learning skills (Demirel, 2009): Students who do not feel well in school are at risk of becoming alienated from learning, which can lead to long-term reluctance to engage in lifelong learning (Hagenauer & Hascher, 2010; Scharf, 2021). In addition, the school can be a resource for children experiencing adversity (Drew & Banerjee, 2019; Gilligan, 1998) and, thus, students' well-being in school can serve as an indicator of the school's protective role. However, despite students' well-being in school has gained increasing interest and the number of studies on this topic has grown accordingly in recent decades (Hascher & Hagenauer, 2020; Renshaw et al., 2015; Tobia et al., 2019) there are still many unanswered questions about this area of research. Especially evidence from longitudinal studies is missing to determine how students' well-being develops in central developmental stages and to identify upstream factors that influence it. Furthermore, data from large-scale assessment studies would help to corroborate the findings by means of large sample sizes.

Against this background, this dissertation was devoted to the study of students' well-being. To obtain robust results on the antecedents of students' well-being, mainly data from large-scale assessment studies with longitudinal designs were used to examine its relations with school-related factors believed to thwart or satisfy students' sense of self-determination (Ryan & Deci, 2000, 2020). Thereby, the multifaceted nature of students' well-being was considered in order to provide a fine-grained picture of its associations with other variables. In addition to self-determination theory (Ryan & Deci, 2000, 2020), theoretical considerations from broaden-and-build theory (Fredrickson, 2001, 2013), stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993), and theories of socialization (Grusec & Hastings, 2007; Parsons & Bales, 1955) were drawn upon to address key research desiderata and provide empirical findings on the conditional factors and the development of students' well-being. More precisely, it was examined (1) how students' academic achievement and their well-being are interrelated, (2) how students' perceptions of autonomy-supportive and autonomy-threatening behaviors of their parents and teachers are related to their well-being, and (3) how students' well-being develops in early adolescence and how factors that promote self-determination are related to this development. Thereby, the end of elementary school and the early phase of secondary school were focused as they represent central stages in a child's school career. For this purpose, three empirical studies were conducted.

Study I focused on the interplay between students' well-being and academic achievement during the early years of secondary school. Because self-determination theory (Ryan & Deci, 2000, 2020) and broaden-and-build theory (Fredrickson, 2001) provide different explanations for the association of these variables, an exploratory cross-lagged panel analysis was conducted to determine whether there is a preponderance of the effect of academic achievement on well-being or vice versa. This analysis was conducted separately for both genders and different types of schools characterizing either general or more academic programs in the German education system. Results based on a total of 4,303 students (Grades 5–9)

participating in the *National Educational Panel Study* (NEPS; Blossfeld & Roßbach, 2019) revealed positive longitudinal associations between well-being and performance in reading and mathematics. The results suggested that academic achievement in mathematics is particularly important for physical well-being, while cognitive well-being is important for later academic achievement. The study provides important new insights into the relations between students' well-being and academic achievement as it suggests that both variables influence each other, with achievement in mathematics being particularly important for students' well-being.

Study II investigated the development of students' well-being during early adolescence taking into account their increasing need for autonomy. More precisely, based on stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993), it was examined if students perceived their teachers to be less autonomy supportive over time and if this would be related to the development of their school-related well-being. Data from 3,446 students (Grades 5–9) participating in the NEPS were analyzed using latent growth curve modeling, and it was found that students' cognitive, affective, and physical school-related well-being declined over early adolescence. In addition, perceived autonomy support from teachers also declined over time, and this decline was associated with trends in students' cognitive, affective, and physical school-related well-being. In terms of the stage-environment fit theory, the results of the study may suggest that students' increasing need for autonomy is increasingly poorly met as they progress through adolescence, which also leads to lower well-being in school. Thus, the importance of autonomy supportive teacher behavior for students' well-being in the early adolescence is underscored.

Further analyses in *Study III* examined the relations between academic pressure and elementary school children's well-being. Following self-determination theory (Ryan & Deci, 2000, 2020), it was hypothesized that academic pressure – as it undermines elementary school children's sense of autonomy – would negatively affect their well-being. Furthermore, because students' parents and individuals in the school environment, such as teachers, are central agents

of socialization (e.g., Grusec & Hastings, 2007), the academic pressure they each exert on students was compared in terms of its relation with students' well-being. Thereby, it was controlled for students' gender and their academic achievement. Applying structural equation modeling on data of 342 fourth graders from Germany participating in the field test of the *Progress in International Reading Literacy Study* (PIRLS; Mullis & Martin, 2019), it was found that academic pressure was negatively related to several facets of students' well-being. In addition, pressure exerted by parents was somewhat more strongly associated with students' well-being than pressure exerted by the school environment. The study's findings suggest that academic pressure, particularly those exerted by parents, undermine elementary school children's well-being.

This dissertation extends the current literature on students' well-being by providing detailed insights into its state, its development, and its associations with other school-related factors through the use of longitudinal designs and a comprehensive operationalization of this construct. The importance of several school-related factors related to self-determination theory (Ryan & Deci, 2000, 2020) to students' well-being is underscored. More specifically, factors that address the needs for competence (academic achievement) and autonomy (teacher autonomy support) were found to be positively related to several facets of students' well-being, while factors that thwart the need for autonomy (academic pressure) were found to be negatively related to it. In addition, cognitive well-being was related to later academic achievement. These findings and the observation of negative trends in cognitive, affective, and physical well-being in adolescence point to the need for interventions that promote autonomy-supportive skills among teachers and parents and improve students' enjoyment, engagement, and resilience at school.

Zusammenfassung

Kinder und Jugendliche verbringen einen großen Teil ihrer Zeit in der Schule (vgl. OECD, 2016). Daher ist es wichtig, dass sie die Schule nicht nur als Pflicht empfinden, sondern sich dort auch wohlfühlen. Entsprechend ist es von Relevanz, das Wohlbefinden der Schülerinnen und Schüler in der Schule zu fördern. Das Wohlbefinden von Schülerinnen und Schülern lässt sich im Allgemeinen durch die positiven Kognitionen und Emotionen beschreiben, die sie mit der Schule verbinden (Hascher, 2008; Putwain et al., 2020; van Petegem et al., 2007). Weiterhin wird es als ein vielschichtiges Konstrukt angesehen, das kognitive, affektive, physische und soziale Aspekte umfasst (Borgonovi & Pál, 2016; Hascher, 2004; Huppert & Cooper, 2014). Neben der Tatsache, dass sich Schülerinnen und Schüler an dem Ort wohlfühlen sollten, der einen zentralen Sozialisationskontext ihres Lebens darstellt, gibt es eine Reihe weiterer Gründe dafür, dass es wichtig ist, das Wohlbefinden von Schülerinnen und Schülern in der Schule zu fördern. So sind beispielsweise positive Kognitionen und Emotionen gegenüber der Schule mit wichtigen anderen schulbezogenen Variablen wie der Leistung assoziiert (z. B. Bücker et al., 2018; Kaya & Erdem, 2021). Darüber hinaus ist es wichtig, dass die Schülerinnen und Schüler eine positive Einstellung zum Lernen entwickeln, damit sie im Sinne des lebenslangen Lernens erfolgreich auf Veränderungen reagieren können (Demirel, 2009): Schülerinnen und Schüler, die sich in der Schule nicht wohlfühlen, laufen Gefahr, sich vom Lernen zu entfremden, was zu einer langfristigen Abneigung gegenüber dem Lernen führen kann (Hagenauer & Hascher, 2010; Scharf, 2021). Darüber hinaus kann die Schule eine Ressource für Kinder sein, die mit Widrigkeiten konfrontiert sind (Drew & Banerjee, 2019; Gilligan, 1998), und somit kann das Wohlbefinden der Schülerinnen und Schüler in der Schule als Indikator für die Schutzfunktion der Schule dienen. Obwohl das Wohlbefinden von Schülerinnen und Schülern in der Schule in den letzten Jahrzehnten zunehmend an Interesse gewonnen hat und die Zahl der Studien zu diesem Thema entsprechend gestiegen ist (Hascher & Hagenauer, 2020; Renshaw et al., 2015; Tobia et al.,

2019), lassen sich noch einige offene Fragen innerhalb dieses Forschungsbereichs identifizieren. Insbesondere fehlt es an Erkenntnissen aus Längsschnittstudien, um zu ermitteln, wie sich das Wohlbefinden von Schülerinnen und Schülern in zentralen Entwicklungsphasen entwickelt und welche zeitlich vorausgehenden Faktoren es beeinflussen. Zudem würden Daten aus Large-Scale Assessment Studien helfen, die Befunde durch große Stichprobengrößen zu untermauern.

Vor diesem Hintergrund widmete sich diese Dissertation der Untersuchung des Wohlbefindens von Schülerinnen und Schülern. Um robuste Ergebnisse zu den Antezedenzien des Wohlbefindens zu erhalten, wurden vor allem Daten aus Large-Scale Assessment Studien mit Längsschnittdesigns verwendet, um die Zusammenhänge mit schulbezogenen Faktoren zu untersuchen, von denen angenommen wird, dass sie das Selbstbestimmungsgefühl von Schülerinnen und Schülern bedrohen oder befriedigen (Ryan & Deci, 2000, 2020). Dabei wurde die Vielschichtigkeit des Wohlbefindens von Schülerinnen und Schülern berücksichtigt, um ein differenziertes Bild der Zusammenhänge mit den anderen betrachteten Variablen zeichnen zu können. Neben der Selbstbestimmungstheorie (Ryan & Deci, 2000, 2020) wurden theoretische Überlegungen aus der Stage-Environment Fit-Theorie (Eccles & Midgley, 1989; Eccles et al., 1993), der Broaden-and-Build-Theorie (Fredrickson, 2001, 2013) und Sozialisationstheorien (Grusec & Hastings, 2007; Parsons & Bales, 1955) herangezogen, um zentrale Forschungsdesiderate zu adressieren und empirische Befunde zu den Bedingungsfaktoren und der Entwicklung des Wohlbefindens von Schülerinnen und Schülern zu liefern. Konkret wurde untersucht, (1) wie die schulischen Leistungen und das Wohlbefinden von Schülerinnen und Schülern zusammenhängen, (2) wie die Wahrnehmung autonomiefördernder und autonomiebedrohender Verhaltensweisen von Eltern und Lehrkräften mit dem Wohlbefinden von Schülerinnen und Schülern zusammenhängt und (3) wie sich das Wohlbefinden von Schülerinnen und Schülern in der frühen Adoleszenz entwickelt und wie selbstbestimmungsfördernde Faktoren mit dieser Entwicklung zusammenhängen. Dabei

standen das Ende der Grundschule und die Anfangsphase der weiterführenden Schule im Mittelpunkt, da sie zentrale Phasen in der Schullaufbahn von Kindern darstellen. Es wurden drei empirische Studien durchgeführt, um die oben genannten Fragestellungen zu beantworten.

Studie I konzentrierte sich auf das Zusammenspiel zwischen dem Wohlbefinden der Schülerinnen und Schüler und ihren schulischen Leistungen in den ersten Jahren der Sekundarstufe. Da die Selbstbestimmungstheorie (Ryan & Deci, 2000, 2020) und die Broaden-and-Build-Theorie (Fredrickson, 2001) unterschiedliche mögliche Erklärungen für den Zusammenhang dieser Variablen liefern, wurde eine explorative Cross-Lagged Panel-Analyse durchgeführt, um festzustellen, ob der Effekt der schulischen Leistung auf das Wohlbefinden überwiegt oder umgekehrt. Diese Analyse wurde getrennt für beide Geschlechter und verschiedene Schultypen durchgeführt. Die Ergebnisse auf Grundlage von insgesamt 4303 Schülerinnen und Schülern (Klassen 5-9), die an der *National Educational Panel Study* (NEPS; Blossfeld & Roßbach, 2019) teilnahmen, zeigten positive Längsschnittassoziationen zwischen Wohlbefinden und Leistung in den Bereichen Lesen und Mathematik. Die Ergebnisse deuten darauf hin, dass die schulischen Leistungen in Mathematik besonders wichtig für das körperliche Wohlbefinden sind, während das kognitive Wohlbefinden von Relevanz für die späteren schulischen Leistungen ist. Die Studie liefert wichtige neue Erkenntnisse über die Beziehung zwischen dem Wohlbefinden der Schülerinnen und Schüler und ihren schulischen Leistungen, da sie darauf hindeutet, dass sich beide Variablen gegenseitig beeinflussen, wobei sich insbesondere die Leistungen in Mathematik als bedeutsam für das Wohlbefinden der Schülerinnen und Schüler erweisen.

Studie II untersuchte die Entwicklung des Wohlbefindens von Schülerinnen und Schülern in der frühen Adoleszenz unter Berücksichtigung ihres zunehmenden Autonomiebedürfnisses. Genauer gesagt wurde auf der Grundlage der Stage-Environment Fit-Theorie (Eccles & Midgley, 1989; Eccles et al., 1993) untersucht, ob Schülerinnen und Schüler ihre Lehrkräfte im Laufe der Zeit als weniger autonomiefördernd wahrnehmen und ob dies mit

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der Entwicklung ihres schulbezogenen Wohlbefindens zusammenhängt. Die Daten von 3446 Schülerinnen und Schülern (Klassen 5-9), die an der NEPS teilnahmen, wurden mit Hilfe der Modellierung latenter Wachstumskurven analysiert, und es wurde festgestellt, dass das kognitive, affektive und körperliche schulbezogene Wohlbefinden der Schülerinnen und Schüler im Laufe der frühen Adoleszenz abnahm. Darüber hinaus nahm auch die wahrgenommene Autonomieunterstützung durch die Lehrkräfte im Laufe der Zeit ab und dieser Rückgang war mit den negativen Trends im kognitiven, affektiven und körperlichen schulbezogenen Wohlbefinden der Schülerinnen und Schüler assoziiert. Im Sinne der Stage-Environment Fit-Theorie könnten die Ergebnisse der Studie darauf hindeuten, dass das zunehmende Autonomiebedürfnis der Schülerinnen und Schüler im Laufe der Adoleszenz immer weniger erfüllt wird, was in einer gleichzeitigen Abnahme des Wohlbefindens in der Schule resultiert. Damit wird die Bedeutung von autonomieförderndem Lehrkraftverhalten für das Wohlbefinden der Schülerinnen und Schüler in der frühen Adoleszenz unterstrichen.

In *Studie III* (weitere Analysen) wurde der Zusammenhang zwischen dem wahrgenommenen schulischen Druck und dem Wohlbefinden von Grundschulkindern untersucht. In Anlehnung an die Selbstbestimmungstheorie (Ryan & Deci, 2000, 2020) wurde die Hypothese aufgestellt, dass akademischer Druck – da er das Autonomiegefühl von Grundschulkindern untergräbt – das Wohlbefinden der Kinder negativ beeinflussen würde. Da es sich bei den Eltern und den Akteuren im schulischen Umfeld (z. B. Lehrkräfte) um zentrale Sozialisationsinstanzen handelt (z. B. Grusec & Hastings, 2007), wurde der akademische Druck, den sie jeweils auf die Schülerinnen und Schüler ausüben, in Hinblick auf die jeweilige Beziehung zum Wohlbefinden der Schülerinnen und Schüler miteinander verglichen. Dabei wurde für das Geschlecht der Schülerinnen und Schüler und ihre schulischen Leistungen kontrolliert. Die Strukturgleichungsmodelle, die auf die Daten von 342 Viertklässlerinnen und Viertklässlern aus Deutschland, die am Feldtest der *Progress in International Reading Literacy Study* (PIRLS; Mullis & Martin, 2019) teilnahmen, angewendet wurden, ergaben, dass

akademischer Druck negativ mit mehreren Facetten des Wohlbefindens der Schülerinnen und Schüler zusammenhing. Darüber hinaus war der von den Eltern ausgeübte Druck etwas stärker mit dem Wohlbefinden der Schülerinnen und Schüler assoziiert als der vom schulischen Umfeld ausgeübte Druck. Die Ergebnisse der Studie deuten darauf hin, dass – insbesondere der von den Eltern ausgeübte – schulische Druck das Wohlbefinden von Grundschulkindern beeinträchtigt.

Diese Dissertation vertieft die aktuelle Forschung zum Wohlbefinden von Schülerinnen und Schülern, indem sie durch die Verwendung von Längsschnittdesigns und einer umfassenden Operationalisierung dieses Konstrukts detaillierte Einblicke in dessen Zustand, Entwicklung und seine Beziehungen zu anderen schulbezogenen Faktoren bietet. Die Bedeutung verschiedener, mit der Selbstbestimmungstheorie (Ryan & Deci, 2000, 2020) in Zusammenhang stehender, Faktoren für das Wohlbefinden der Schülerinnen und Schüler wird unterstrichen. Insbesondere wurde festgestellt, dass Faktoren, die die Bedürfnisse nach Kompetenz (schulische Leistung) und Autonomie (Autonomieunterstützung durch die Lehrkraft) befriedigen, positiv mit mehreren Facetten des Wohlbefindens der Schülerinnen und Schüler assoziiert sind, während Faktoren, die das Bedürfnis nach Autonomie bedrohen (akademischer Druck durch Eltern und Lehrkräfte), negativ damit zusammenhängen. Darüber hinaus stand das kognitive Wohlbefinden mit den späteren schulischen Leistungen in Zusammenhang. Diese Ergebnisse und die Feststellung negativer Entwicklungsverläufe kognitiven, affektiven und körperlichen Wohlbefindens im Jugendalter weisen auf die Notwendigkeit von Maßnahmen hin, die die autonomieunterstützenden Fähigkeiten bei Lehrkräften und Eltern fördern und die Freude, das Engagement und die Resilienz der Schülerinnen und Schüler in der Schule stärken.

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1. Introduction

Students' performance in various school subjects is an important and frequently used indicator to assess the effectiveness of an education system (Govorova et al., 2020; Suldo et al., 2006). Accordingly, the measurement of academic achievement represents the main focus of large-scale assessment studies like the *Programme for International Student Assessment* (PISA; OECD, 2019), the *Trends in International Mathematics and Science Study* (TIMSS; Mullis & Martin, 2017), and the *Progress in International Reading Literacy Study* (PIRLS; Mullis & Martin, 2019). Socio-emotional variables such as students' well-being have received little attention in the past, but have recently come into sharper focus (Govorova et al., 2020; Kanonire et al., 2020; Organisation for Economic Cooperation Development [OECD], 2017). A reason for this attentional shift is that in recent years a "whole child" perspective has gained prominence, emphasizing that children should develop cognitive, social, and emotional skills that equip them for the 21st century (OECD, 2015; Suldo et al., 2006). In this context, the impact of students' well-being on their health and life satisfaction later in life has been increasingly discussed (Choi, 2018; Seligman et al., 2009). Furthermore, associations between students' well-being and school-related outcomes such as academic achievement have been reported (Bücker et al., 2018). For these reasons, it is critical to gain robust empirical evidence on students' well-being so that it can be targeted and promoted.

A very sensitive period to consider in this regard is adolescence. Adolescence is characterized by individual changes, as it often coincides with the onset of puberty, which is accompanied by rapid physical, cognitive, social, and emotional development (Sawyer et al., 2012) as well as identity formation (e.g., Erikson, 1968; Klimstra et al., 2010). Because it often begins in the latter stages of elementary school and continues through secondary school, these are two particularly important phases in a child's school career. The developmental leaps that are taking place in adolescence lead to changes in children's needs, for example their need for autonomy (Zimmer-Gembeck & Collins, 2003). However, the external demands and changes

that affect students at this stage are not always tailored to their individual needs (Eccles et al., 1993; Ryan & Deci, 2000, 2020). The end of elementary school represents a crucial phase in this context as students' future school careers depend to a large extent on their performance in this phase. It is likely that they perceive pressure from parents and teachers in this course, which threatens their need for autonomy. Entering secondary school poses another challenge, as students find themselves in a completely different school environment with different interaction partners and different cognitive demands (Eccles, 2004; Eccles et al., 1993; Gillison et al., 2008). While some students benefit from these external changes, others may experience difficulties if the changes do not meet their individual needs (Gutman & Eccles, 2007). Against this background, it can be concluded that both the late elementary and early secondary school phases present particular challenges to achieving key educational goals such as students' well-being.

This dissertation is intended to contribute to the burgeoning field of research on students' well-being. More precisely, it examines which factors are associated with students' well-being and its development, focusing on the two aforementioned seminal stages of the school career. In the course of this, based on self-determination theory (Ryan & Deci, 2000, 2020), school-related factors related to the satisfaction of students' basic psychological needs are identified to examine their association with students' well-being. Furthermore, some methodological issues of the current literature are addressed. For example, even though the multifaceted-nature of students' well-being has repeatedly been pointed out (Borgonovi & Pál, 2016; Hascher, 2004; Huppert & Cooper, 2014), many of the previous studies analyzing associations with academic and behavioral outcomes focused only on single aspects of students' well-being (Heffner & Antaramian, 2016). Therefore, it is operationalized in this dissertation by means of various components comprising cognitive, affective, physical, and social aspects. Moreover, evidence concerning the development of students' well-being over time as well as its associations with other constructs comes mainly from cross-sectional studies. Hence, the

aim of this dissertation is to gain further in-depth insights from longitudinal studies. Finally, data from large-scale assessment studies is used to ensure high external validity of the findings.

This work is divided into several chapters: First, the theoretical background of the dissertation will be presented (Chapter 2). In this context, the concept of well-being in general will be introduced and two central theories will be briefly described (Chapter 2.1). Afterwards students' well-being is focused on (Chapter 2.2). Thereby, various models that have been proposed to measure it will be presented (Chapter 2.2.1) and the components of well-being on which this thesis focuses will be described in detail (Chapter 2.2.2). Next, the relevance of students' well-being in the school context and its impact on other important outcomes will be addressed (Chapter 2.2.3). Subsequently, the antecedents of students' well-being, particularly in light of self-determination theory (Ryan & Deci, 2000, 2020), will be focused (Chapter 2.2.4). The theoretical background concludes with a summary of the current state of research and resulting research desiderata (Chapter 2.3). Chapter 3 presents the individual empirical studies that make up this dissertation (see Table 1 for an overview). This is followed by a general discussion of the findings from these studies (Chapter 4). In doing so, the newly gained insights are reflected upon and placed within the theoretical background, whereby the overarching research questions formulated in Chapter 2.3 will be in focus (Chapters 4.1 and 4.2). Subsequently, overarching limitations and strengths of the studies are addressed (Chapter 4.3). Finally, implications for future research and educational practice are discussed (Chapter 4.4). Chapter 4.5 provides a general conclusion.

2. Theoretical Background

2.1 Central Theories of Well-Being

Well-being – or similar concepts like happiness – has preoccupied humanity throughout history and is sometimes considered "the highest good and ultimate motivation for human action" (Diener, 1984, p. 542). In the middle of the last century, the topic of well-being began to arouse the interest of empirical researchers. Although researchers from the social and behavioral sciences had been interested in well-being before, until then it was mainly unhappiness and pathology that were studied (Diener, 1984; Seligman & Csikszentmihalyi, 2000). The research discipline focusing on well-being and the positive psychology movement that later gained momentum (Seligman & Csikszentmihalyi, 2000) sought to respond to practices that focused on pathological traits and mental illness. Emphasis on positive cognitions and emotions, as well as health and desirable outcomes such as meaning and purpose in life or positive social relationships, is a central characteristic of the discipline of well-being (Diener et al., 2018; Ryff, 1989, 2014; Seligman & Csikszentmihalyi, 2000). Since the formation of this research discipline, many different definitions and models of well-being have been put forward (Diener, 1984; Diener et al., 2018; Ryff, 1989, 2014; Seligman, 2011), whereby a consistent definition is lacking so far. Instead, well-being is often described as a multidimensional and multifaceted construct (Borgonovi & Pál, 2016; Gysin, 2017; Hascher, 2004; Huppert & Cooper, 2014).

What many of the proposed models for measuring well-being have in common, however, is that they are grounded on the concepts of *eudaimonia* and *hedonia*, two ancient philosophical notions of the vague term of happiness. Greek philosophers like Aristotle used the term Eudaimonia to describe an optimal way to live one's life and to use potentials entirely so that life is given meaning and direction (e.g., Waterman, 1993). The hedonic perspective is associated with Aristippus of Cyrene who lived in the fourth century B.C. and founded the Cyreanic School of philosophy. This school emphasized the importance of regular experiences

of pleasure while avoiding pain for being happy (e.g., Heathwood, 2013). Since well-being has become an independent topic of empirical research, two models have gained increasing attention internationally: The model of psychological well-being (Ryff, 1989, 2014; Ryff & Keyes, 1995) is influenced by the eudaimonic view on happiness and comprises six dimensions to approach it (self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth). The most prominent model based on the hedonic view on happiness is that of subjective well-being by Diener (1984; Diener et al., 2018). It incorporates Bradburn's (1969) differentiation between positive and negative affect and additionally considers a cognitive component of well-being, namely satisfaction with life. According to this operationalization, people feel well if they experience a high level of positive affect and a low level of negative affect and report a high satisfaction with their life.

The importance of well-being was not only theoretically justified, but also empirically demonstrated. Accordingly, well-being has been shown to be associated with many positive outcomes, such as flexible and creative thinking, health and longevity, effectiveness at work, financial success, and a higher likelihood of participating in community organizations (De Neve et al., 2013; Diener et al., 2015; Huppert, 2009; Thoits & Hewitt, 2001; Veenhoven, 1988). These empirical findings underscore the importance of well-being for various domains of life.

2.2 Well-Being in the School Context

Not only can well-being be considered important to different domains of life, but it can also be specific to particular domains and contexts, and some of these are more significant to overall well-being than others. Depending on the stage of life, different domains play a more or less central role. In the early stages of life, the school is one of the most important contexts. From a research perspective, it is therefore of interest to investigate how variables in this context interact with students' well-being. First, however, it is necessary to clarify how students' well-being can be operationalized. Previous studies dealing with students' well-being show considerable differences in this regard. One reason for discrepancies in its operationalization is

the varying degree of focus on the school context (cf., Tobia et al., 2019). While many studies measure students' well-being using classical approaches – particularly that of Diener (1984) – when examining relations with other constructs (e.g., Antaramian, 2015; Bailey & Phillips, 2016; Eryilmaz, 2014; Li et al., 2015; Steinmayr et al., 2016; Suldo et al., 2009), there are also a large number of studies in which it is operationalized in a context-specific manner (e.g., Hascher & Hagenauer, 2020; Hoferichter et al., 2021; Putwain et al., 2020; Tian et al., 2013; Tobia et al., 2019; Yang et al., 2019). Researchers who advocate for a school-specific operationalization of students' well-being argue that children spend more time in school than in any other place outside home (e.g., Morinaj & Hascher, 2019; Tian et al., 2015) which makes their overall well-being highly dependent on their experiences related to this socialization context. Furthermore, it has been pointed out that well-being is domain-specific so that school-related and global assessments of students' well-being may differ (Hascher, 2004; Huebner et al., 2005; Sarason, 1997). In this regard, Haranin et al. (2007) could demonstrate significant incremental validity of adolescents' domain-based reports (e.g., family, school) beyond their general life satisfaction with respect to internalizing and externalizing problems. Another argument put forward is that focusing on school-related well-being could be informative for policymakers by exposing weaknesses in the school system itself (e.g., Kanonire et al., 2020).

Students' school-related well-being can be broadly defined in terms of the dominance of positive over negative emotions and cognitions towards school life (Hascher, 2008; Putwain et al., 2020; van Petegem et al., 2007). It is not characterized by a single phenomenon, but is a multifaceted construct that encompasses subjective feelings and cognitions related to the school context, learning, and people within the school (e.g., Hascher, 2008). Thereby students' well-being can serve as an indicator for a school environment that gives students' opportunities to optimally develop emotionally, cognitively, and socially and hence provides them a qualitatively good school life (e.g., Hascher, 2008). Several models have been proposed to operationalize students' school-related well-being. Despite the different focus, most measures

of school-specific well-being are based on models focusing on adult well-being (Diener, 1984; Diener et al., 2018; Ryff, 1989, 2014). In the following section, I will present three models focusing on school-related well-being. These models were selected because they encompass multiple aspects to capture the multifaceted nature of students' well-being, yet they differ in terms of their theoretical foundation and methodological approach.

2.2.1 Models of School-Related Well-Being

One example for a model addressing students' school-related well-being is that by Hascher (2004). It focuses on the subjective nature of well-being and includes positive, as well as negative aspects that form six components: *Joy at school*, *positive attitudes towards school,* and *scholastic self-esteem* represent positive aspects, while *worries about school*, *physical complaints about school,* and *social problems at school* represent negative aspects. Most of the components of the model make reference to those identified by Grob et al. (1991), whereby concentrating on the context of school. Furthermore, the facet "depressive mood" which is part of the model by Grob et al. (1991) is replaced by the facet "social problems at school". Comparable to the classical operationalization of subjective well-being (Diener, 1984), the model includes positive and negative affect components (joy at school, worries about school) and considers variables which represent the cognitive component (positive attitudes towards school, scholastic self-esteem). Furthermore, it comprises a physical component (physical complaints about school) and a social component (social problems at school). Hascher (2004) emphasized that the components are not simply hedonic factors of students' well-being, but rather resources to cope with the school demands. Hascher's (2004) model is well established in research on students' school-related well-being and has been used repeatedly in empirical studies on this topic (Donat et al., 2016; Hoferichter et al., 2021; Obermeier et al., 2021; Siriparp et al., 2012; Urhahne & Zhu, 2015).

For the analysis of students' well-being in PISA 2015 (Borgonovi & Pál, 2016) a framework mainly based on the work of Pollard and Lee (2003) on children's well-being was

used. The model includes five components (*Cognitive well-being*, *psychological well-being*, *physical well-being*, *social well-being*, and *material well-being*), with cognitive well-being referring to students' skills and cognitive capacities to acquire knowledge and participate successfully in society rather than their cognitive evaluation of their (school) life. These cognitive evaluations as well as affective aspects related to school are covered by the psychological component. Similar to the model presented above, physical and social components are included to comprehensively describe students' well-being. However, unlike the model by Hascher (2004), the OECD well-being framework also includes a material well-being component that encompasses the financial background of students' families. Due to its use in PISA and because it was one of the first comprehensive models of students' well-being to be used in large-scale assessment studies, several researchers have referred to this framework model (Govorova et al., 2020; Kaya & Erdem, 2021; Obermeier & Gläser-Zikuda, 2022; Tang, 2019).

A more recent and methodologically validated model that addresses students' school-related well-being comes from Kanonire et al. (2020). This model includes five different components (*satisfaction with school*, *affect toward school*, *collaboration* and *hostility* in relations with classmates, and *subjective physical well-being*) that were selected on the criteria that they are stable across different theoretical approaches and can predict various life outcomes of students such as future relationships, health, and achievement. These components reference the model of subjective well-being (Diener, 1984; Diener et al., 2018) by including cognitive (satisfaction with school) and affective (affect toward school) aspects. In addition, social (cooperation, hostility) and physical (subjective physical well-being) aspects of students' well-being are also considered here. Kanonire et al. (2020) examined this model in elementary school children and found empirical evidence for a correlated factors model and a model with a general well-being factor. Because it is a relatively new model, it has not yet been taken up by other

research. However, it is distinguished from the models described above by the methodological approach used to provide empirical evidence of the complexity of well-being.

2.2.2 Components of School-Related Well-Being

The models presented in the previous section have in common that multiple components are used to comprehensively describe students' well-being. In addition, all of these models consider cognitive, affective, physical, and social components. The following paragraphs describe these components and central indicators in detail regarding their importance and representativeness for students' well-being and provide empirical evidence of their relations to other school-related variables. The material component, which is included in the PISA model of students' well-being (Borgonovi & Pál, 2016; Pollard & Lee, 2003), is not addressed in detail in this dissertation. Although it can be an important predictor of subjective well-being (Diener et al., 2018; Howell & Howell, 2008), it is a more objective indicator, and it was intended to operationalize students' well-being more in terms of subjective indicators (Diener, 1984; Diener et al., 2018; Hascher, 2004) in this dissertation.

The cognitive component of students' well-being refers to students' subjective, cognitive evaluations and attitudes towards school life (e.g., Tian et al., 2015). An indicator of the cognitive component is students' satisfaction with school. Satisfaction with school can be described as a "subjective, cognitive appraisal of the overall positivity of school experiences" (Huebner & Gilman, 2006, p. 140). Several studies have shown positive relations with different academic outcomes. For example, positive associations between satisfaction with school and school connectedness (Zullig et al., 2011), academic self-efficacy (Huebner & McCullough, 2000), and academic achievement (Huebner & Gilman, 2006) have been reported. Furthermore, it has been shown that satisfaction with school is related to non-academic outcomes such as general life satisfaction (Ferguson et al., 2011; Huebner & Gilman, 2006; Varela et al., 2018).

The affective component of students' well-being comprises their emotions towards school. Positive emotions towards school reflect a high school-related well-being and it has

been argued that they facilitate learning, motivation, and achievement (Durlak et al., 2011; Pekrun, 2016), and promote students' school engagement (Reschly et al., 2008). Conversely, negative emotions like worries about school reflect low student well-being (Hascher, 2010; Lauermann et al., 2017). Hascher (2010) stated that such negative emotions lead to task-irrelevant cognitions that absorb attention which might further affect learning and achievement (see also Attentional Control Theory; Eysenck et al., 2007). Empirically, it has been shown that, for example, enjoyment of school is negatively related to school reluctance and truancy (Hascher & Hagenauer, 2020). In addition, positive emotions towards school, mediated by academic psychological capital and academic engagement, predicted academic achievement (e.g., Carmona-Halty et al., 2021). In contrast, worries about school were positively related to school reluctance and truancy (e.g., Hascher & Hagenauer, 2020).

The physical component of students' well-being comprises their physical constitution. It has been argued that health conditions play a crucial role for a person's reported subjective well-being (Diener et al., 2018). Consequently, students' physical condition – especially related to the context of school – represents helpful information about their well-being in school. Possible indicators of the physical component of students' well-being include their self-rated health and physical complaints related to school. Furthermore, days of absence from school can be used as additional less subjective information. Research indicates that physical complaints related to school are associated with higher levels of school reluctance and school absenteeism (Hascher & Hagenauer, 2020) while the absence of physical complaints related to school has been found to be associated with higher academic achievement (Obermeier et al., 2021). In addition, with respect to frequent absences, it has been argued that this can have long-term negative effects on academic achievement and social functioning (Allen et al., 2018).

Social well-being can be broadly defined in terms of the assessment of one's own circumstances and functioning in society (Keyes, 1998). Furthermore, social challenges and resources represent criteria to assess the quality of one's own life (Keyes, 1998). Students'

social well-being can, therefore, be understood as their social functioning and involvement in the school context. One indicator of the social component of students' well-being is their social integration into the classroom community. It has been reported that students' connectedness with their peers is associated with overall well-being (Jose et al., 2012). Furthermore, the importance of positive relationships with peers for students' academic accomplishments and school adjustment has been highlighted repeatedly (Ladd et al., 1996; Wentzel, 2017; Wentzel et al., 2004).

The aspects described in the last paragraphs have an indicative function of students' well-being and show correlations with various school variables indicative of good academic functioning. Moreover, these aspects have been used in various models to operationalize students' well-being (Borgonovi & Pál, 2016; Hascher, 2004; Kanonire et al., 2020). On this basis, students' well-being was operationalized in this dissertation using a cognitive, an affective, a physical, and a social component (see Figure 1).

Figure 1

Conceptualization of Students' Well-Being in the Present Dissertation
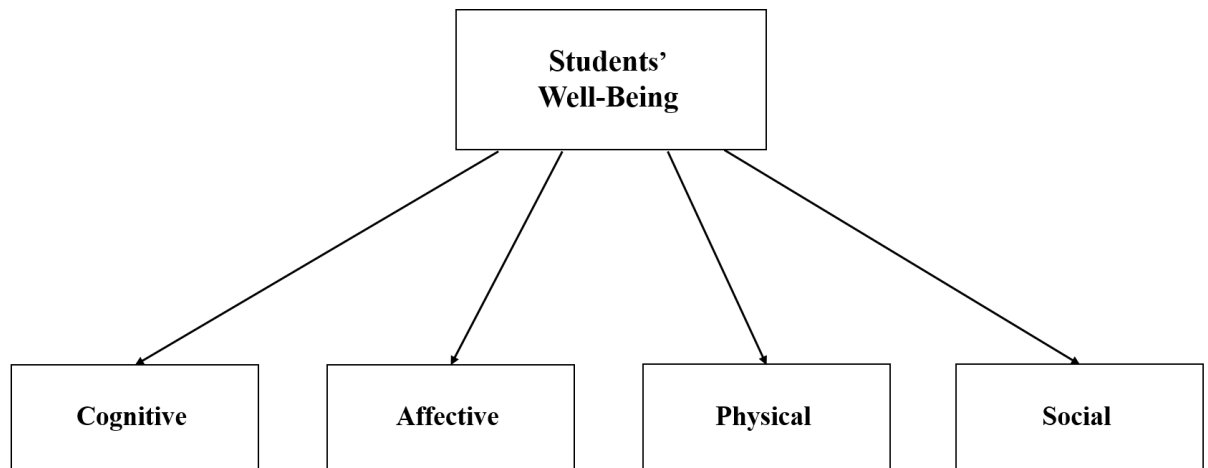
Note. The conceptualization of students' well-being in the present dissertation is based on the models by Borgonovi and Pál (2016), Hascher (2004), and Kanonire et al. (2020).

2.2.3 Relevance of Well-Being in the School Context

In addition to the acquisition of competencies in various subjects, students' well-being at school is an important measure of educational success, and there have been calls to pay more attention to it (Kanonire et al., 2020; OECD, 2017; Seligman et al., 2009). One reason for this is that students' well-being at school is an inherent goal: The school provides an important socialization context in childhood (Grusec & Hastings, 2007; Parsons & Bales, 1955) and children spend much of their time in school (cf., OECD, 2016). Consequently, it is important that they do not develop an aversion regarding this institution. Another related reason is that students' well-being at school instills a positive attitude towards learning in the long term. A central goal of educational work is to prepare children for lifelong learning and this is achieved by fostering positive cognitions and emotions towards school and learning (Demirel, 2009). Furthermore, especially for children experiencing adversity (e.g., parental divorce, abuse, neglect), the school can serve as a resource (Drew & Banerjee, 2019; Gilligan, 1998). Therefore, it is essential for schools to recognize this role and place more importance on the needs of students to promote their well-being.

Another reason that justifies a greater focus on well-being in the school context is the potential positive impact on academic and nonacademic outcomes. Seligman et al. (2009) argued that well-being at school is associated with students' general life satisfaction and that fostering students' well-being could help to reduce depression rates. Furthermore, there is evidence for positive relations between students' well-being and other important outcomes related to school. For example, McKnight et al. (2002) found a negative relation between well-being and problematic student behavior. In addition, well-being has been repeatedly reported to be related to higher levels of academic engagement (Datu & King, 2018; Forrest et al., 2013; Gutman & Vorhaus, 2012). The broaden-and-build theory (Fredrickson, 2001, 2013; Garland et al., 2010) provides a possible theoretical explanation for positive effects of well-being on academic outcomes such as academic achievement. Central to this theory is the assumption that positive emotions can expand people's momentary thought-action repertoires. Fredrickson (2001) sought to explain the function of positive emotions, assuming that they not only serve as markers for human flourishing but also produce it. Thereby, she contrasted them with the function of negative emotions such as fear and anger, which are plausible to be associated with action tendencies such as flight and attack, respectively, because these responses best helped human ancestors survive in life-threatening situations. However, although positive emotions tend to occur in situations that are not life-threatening and therefore do not require an immediate physiological response, this does not necessarily mean that positive emotions are associated with inactivity. Accordingly, instead, Fredrickson (2001) argued that they could lead to a broadening of people's thought-action repertoires. For example, she declared that joy fosters the urge to play or to be creative and that interest leads to the urge to explore and to gather information. Based on the broaden-and-build theory, it is therefore reasonable to assume that well-being has positive effects on academic outcomes as it can lead, for example, to creativity and exploration. In addition to broaden-and-build theory, there are other theories that articulate similar theoretical assumptions and support the notion that students' well-being may be

positively related to academic outcomes. For example, one assumption underlying the control-value theory of achievement emotions (Pekrun, 2000, 2006) is that achievement emotions can influence learning and performance through cognitive and motivational mechanisms. Thereby, it is differentiated between positive activating (e.g., enjoyment); positive deactivating (e.g., relaxation); negative activating (e.g., anxiety); and negative deactivating (e.g., hopelessness) emotions. These in turn are expected to influence cognitive processes underlying learning (e.g., attention, memory storage and retrieval, cognitive problem solving). Another theory that might explain an influence from well-being on other academic outcomes is Eysenck's Attentional Control Theory (Eysenck et al., 2007). This theory postulates that anxiety negatively affects the efficient functioning of the goal-directed attentional system, whereas processing through the stimulus-driven attentional system is enhanced. Negative emotions might therefore direct attention to distracting rather than task-relevant aspects, leading to poorer academic performance.

Several studies have provided empirical evidence for a positive relation between students' well-being and academic achievement. In their meta-analysis, Bücker et al. (2018) were able to show that well-being and academic achievement are positively related, albeit only to a small extent ($r = .164$, 95% CI: [0.113, 0.216]). This result was later corroborated by another meta-analysis by Kaya and Erdem (2021), who found comparably high effect sizes for different domains of students' well-being. Furthermore, Mega et al. (2014) conducted a cross-sectional study and reported that positive emotions can affect academic achievement through self-regulated learning and motivation. So far, however, longitudinal findings suggesting a direction in the relation between students' well-being and academic achievement are rare (for exceptions see Steinmayr et al., 2016; Suldo et al., 2011). Accordingly, more evidence from longitudinal studies is needed, particularly because there are also theoretical considerations that suggest that students' well-being may be influenced by academic achievement, as will become apparent in the following section on the antecedents of school-related well-being.

2.2.4 Antecedents of School-Related Well-Being

Now that the relevance of students' well-being in the school context has been outlined, the question arises as to which factors might influence it. There are various potential causes for students' well-being, ranging from individual factors to external factors, such as those within the family and school, or even in a broader context. Examples of individual factors that influence well-being are genetic determinants, gender, or age. Several empirical studies demonstrated gender differences in school-related well-being, in the way that female students show higher satisfaction with school, more positive attitudes toward school (Hascher & Hagenauer, 2011; Liu et al., 2016), and more positive emotions related to school (Palsdottir et al., 2012). In contrast, however, they also reported more physical symptoms and higher levels of anxiety (Wiklund et al., 2012). With respect to age, empirical studies have shown that older students have lower levels of well-being than younger students (e.g., Casas & González-Carrasco, 2019; González-Carrasco et al., 2017; Schütz et al., 2019). However, I will return to this point later, as this result could also be due to external circumstances that take place during the school career.

In addition to these factors inherent to the individual (e.g., age, gender), there are also factors related to the student's environment that influence his or her well-being. The self-determination theory (SDT) is a comprehensive framework for describing factors that influence intrinsic and autonomous extrinsic motivation, as well as well-being (Ryan & Deci, 2000, 2020). SDT is based on the premise that people are naturally inclined toward psychological growth and integration (e.g., learning, mastery, connection with others). It is further assumed that these human tendencies are not taken for granted, but that they require supportive conditions in order to flourish. Specifically, SDT argues that certain psychological needs have to be supported in order to promote healthy development (Ryan & Deci, 2020; Tay & Diener, 2011). Basic Psychological Need Theory is one of the six mini-theories within SDT and distinguishes the needs for autonomy, relatedness, and competence (Ryan & Deci, 2000;

Vansteenkiste et al., 2020). *Autonomy* refers to the feeling of doing things voluntarily. It is supported when interest and value are experienced and undermined when one's own actions seem to be externally controlled, for example through rewards or punishments (Ryan & Deci, 2020). *Relatedness* is characterized by warm and caring relationships with others. This need is satisfied by the experience of feeling connected to others and being meaningful to them (Ryan & Deci, 2020; Vansteenkiste et al., 2020). *Competence* describes a sense of mastery and the feeling to be effective. This need is satisfied when the environment provides optimal challenges, positive feedback, and opportunities for advancement so that one's own strengths and capabilities become apparent (Ryan & Deci, 2020). It is assumed that the satisfaction of these needs leads to greater motivation and well-being, while thwarting any of them produces the opposite (Abidin et al., 2021; Ryan & Deci, 2000, 2020; Stang-Rabrig et al., 2022; Tay & Diener, 2011). Based on this theoretical perspective, it seems reasonable to assume that students' well-being at school is dependent on the extent to which their basic psychological needs are met.

Students' sense of self-determination can be reinforced especially by the behavior of parents and teachers, but also by their own perceptions and individual experiences. Students' need for autonomy can be met, for example, if parents and teachers offer students different options among which they can choose, support them in decision making, and show them that their views are respected and considered (e.g., Adie et al., 2008). Several studies could show that such autonomy-supportive behavior is positively related to adolescents' well-being (Chirkov & Ryan, 2001; Diseth & Samdal, 2014; Ferguson et al., 2011; Lekes et al., 2010). In contrast, students' perception that they are the origin of their own behavior can be undermined if they feel heteronomous (Deci & Ryan, 2013). An important factor in this context is the extent to which students feel pressured by parents and teachers to perform well. Previous research found evidence for negative associations between academic pressure and students' well-being (Choi et al., 2019; Deb et al., 2015; Liu & Lu, 2012; Torsheim & Wold, 2001). For the

satisfaction of students' need for relatedness, their relationships with people around them are important. In addition to relationships with classmates, the quality of the teacher–student relationship is of particular importance in this context. Several studies have reported that the quality of the teacher–student relationship is positively related to students' well-being (Baker, 2006; Lin et al., 2021; Poulou, 2020; Zhou et al., 2022). Autonomy-supportive behavior by teachers can also play an important role here, as it conveys an appreciation of the other person and thus gives students a sense of closeness (Ryan & Solky, 1996). Students' need for competence can be met in the school context when they experience a sense of mastery. This can, for example, happen when they perform well in a test situation or when they are given feedback by teachers either verbal or in terms of grades. Such individual experiences and external feedback can also increase students' self-concept in certain academic domains (Burnett, 2003; Marsh et al., 2018). As has already been mentioned in the previous section, research has repeatedly confirmed a positive relation between academic achievement and students' well-being (see for example meta-analyses by Bücker et al., 2018; Kaya & Erdem, 2021), whereby longitudinal findings on the relation are rare (for exceptions see Steinmayr et al., 2016; Suldo et al., 2011).

Addressing students' needs is of particular importance as students enter adolescence. For example, the cognitive, physical, social, and emotional developmental leaps that occur during adolescence lead to an increased need for autonomy (Zimmer-Gembeck & Collins, 2003). However, according to stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993), students' environments, including schools, do not always adequately address these dynamic changes. For example, teachers often do not provide sufficient opportunities for students to participate in decision making (Eccles et al., 1993). Moreover, the quality of the teacher–student relationship declines at this stage, while relationships outside the family are actually becoming more important (Nelson et al., 2016; Valdebenito et al., 2022). As described above, previous studies suggest that students' well-being declines during adolescence (e.g.,

Casas & González-Carrasco, 2019; González-Carrasco et al., 2017; Liu et al., 2016; Schütz et al., 2019; Tian et al., 2013; Tobia et al., 2019). However, the evidence comes from either cross-sectional studies, studies that do not focus on school-related aspects of well-being, or longitudinal studies that cover only a relatively short period of time. In addition, based on the theoretical considerations outlined above, it seems reasonable to simultaneously consider aspects related to students' needs to examine whether the decline in their well-being is due to meeting or not meeting those needs.

2.3 Research Conclusion and Central Research Questions

There is widespread agreement on the importance of students' well-being in school (Hascher, 2004; Kanonire et al., 2020; OECD, 2017; Seligman et al., 2009), which is partly due to its relevance and positive consequences (see Chapter 2.2.3). However, even though the number of studies on students' well-being has grown steadily over the past years (Hascher & Hagenauer, 2020; Renshaw et al., 2015; Tobia et al., 2019), the current state of research provides an incomplete picture of its relations with other constructs. For example, previous studies suggest positive relations between factors satisfying students' needs and their well-being, but further research is needed to provide a more detailed picture of these associations. An important limitation of many previous studies is that relations between students' well-being and potential influencing factors were examined by means of cross-sectional studies. As cross-sectionally designed studies do not provide information about causality in most cases, there is a need for longitudinal studies even if causal inferences are limited in such studies as well. Longitudinal designs could especially be helpful to shed light on the relation between academic achievement and students' well-being. Many studies have shown that students' well-being and academic achievement are positively related to each other (Crede et al., 2015; Gumora & Arsenio, 2002; Pietarinen et al., 2014; Steinmayr et al., 2019), but only few of them investigated the longitudinal association (e.g., Steinmayr et al., 2016). Moreover, studies examining the longitudinal relation between students' well-being and academic achievement during early

adolescence appear to be particularly rare. An exception is the study by Suldo et al. (2011). In their study, the longitudinal relations between well-being and academic achievement were analyzed at two measurement points, one year apart, whereby well-being was not collected at the second measurement point. However, while in terms of broaden-and-build theory (Fredrickson, 2001) it would be reasonable to expect an effect of students' well-being on academic achievement, in terms of SDT (Ryan & Deci, 2000, 2020) an effect of academic achievement on well-being might be possible, too. Studies measuring both constructs on multiple measurement points could provide information about the effects of students' well-being and their academic achievement on each other while controlling for the stability of both constructs. In addition, longitudinal studies could be useful in examining how students' well-being develops over time. While cross-sectional studies have repeatedly shown that older students report lower well-being than younger students (overall-well-being: Casas & González-Carrasco, 2019; González-Carrasco et al., 2017; Schütz et al., 2019; school-related well-being: Liu et al., 2016; Tian et al., 2013; Tobia et al., 2019), few studies have examined longitudinal trends in early adolescence (overall well-being: Shek & Liang, 2018; school-related well-being: Hagenauer & Hascher, 2010). Moreover, research on factors related to this development are rare. In this context, it would be informative in terms of the stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993) to examine how school-related factors that address students' basic psychological needs develop over time and how these trends relate to the development of students' well-being. Another limiting element of previous research on factors related to students' well-being is that the number of studies focusing on the elementary school-context is relatively small compared to studies focusing on the secondary school-context. In Germany and some other countries, tracking takes place very early in a child's school career, and therefore there is a lot of pressure on children to qualify for higher school tracks. However, the effects of pressure on the well-being of elementary school children have rarely been studied

(for an exception see Choi et al., 2019), and until now, academic pressure from parents and individuals within the school have not been contrasted in this regard.

Besides the above-mentioned limitations concerning content and study design, the current literature has two further methodological shortcomings. First, most previous studies focused only on single aspects of well-being when analyzing relations with academic and behavioral outcomes of students (Heffner & Antaramian, 2016). However, considering multiple aspects is important to provide a more fine-grained picture of relations between well-being and other constructs (Hascher, 2008; Kern et al., 2015; Long et al., 2012). Different aspects of well-being may be related to other outcomes to varying degrees, and thus using only selected aspects or overall measures of well-being could potentially obscure valuable information (Huppert & So, 2013; Kern et al., 2015). Second, more evidence from large-scale assessment studies is needed, as studies with small sample sizes do not provide sufficient external validity.

Against this background, this dissertation aimed to provide new insights into conditional factors of students' well-being during the phase before and after the transition from elementary to secondary school. This dynamic phase is of particular importance for students' well-being, as it coincides with the onset of puberty and is therefore accompanied by cognitive, emotional, physical, and social changes that lead to a shift in students' needs (Akos & Galassi, 2004; Eccles et al., 1993; Sawyer et al., 2012). Based on theoretical considerations of SDT (Ryan & Deci, 2000, 2020), broaden-and-build theory (Fredrickson, 2001), and stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993) a theoretical framework model was derived to form the basis for this dissertation (see Figure 2). The above-mentioned methodological issues of the current literature were addressed by operationalizing students' well-being in a multifaceted manner and using data from large-scale assessment studies in all papers. Furthermore, two of the three articles included in this dissertation used data from a longitudinal study.

Figure 2

Theoretical Framework of This Dissertation
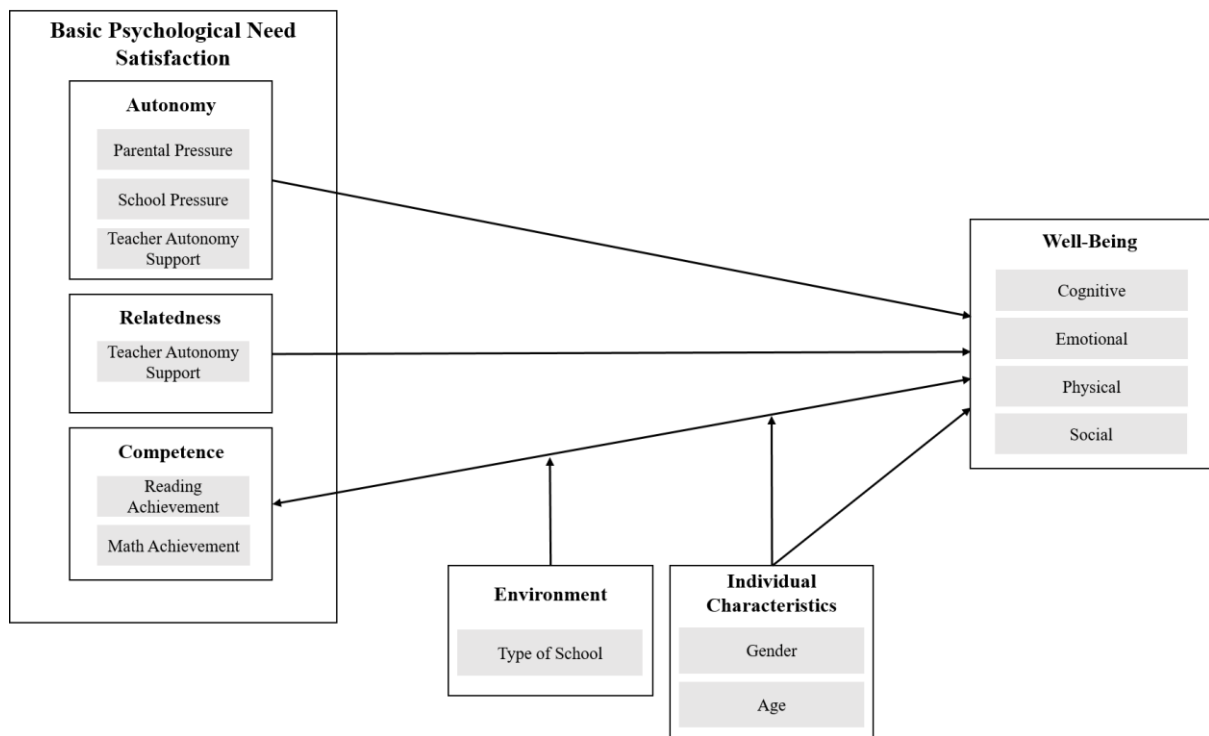
Note. The variable teacher autonomy support was not only understood as a factor that satisfies the basic psychological need for autonomy, but also that for relatedness. This was based on the theoretical assumption that a higher degree of teacher autonomy support also strengthens the quality of the teacher–student relationship (cf. Ryan & Solky, 1996).

The research questions addressed in this dissertation revolve around the antecedents of school-related well-being and its development over time. More precisely, it is investigated how school-specific indicators related to the SDT (Ryan & Deci, 2000, 2020) impact students' well-being (see Figure 2). Furthermore, based on the broaden-and-build theory (Fredrickson, 2001), potential influences of students' well-being on academic achievement are investigated. Thereby, the following overarching research questions were formulated:

1. How are students' academic achievement and their cognitive, affective, physical, and social well-being interrelated in elementary and secondary school? (Study I and further analyses in Study III)

2. How are students' perceptions of autonomy-supportive and autonomy-threatening behaviors of their parents and teachers related to different components of their well-being? (Study II and further analyses in Study III)

3. How do different components of students' well-being develop in early adolescence and how are factors that promote self-determination related to this development? (Study I and Study II)

Table 1 provides detailed information on each of the studies that address these overarching research questions and comprise the cumulative dissertation.

Table 1

Published Studies Forming the Cumulative Dissertation, and Further Analyses

Study	Authors	Title	Journal
Cumulus			
I	**Kleinkorres, R.**, Stang, J., & McElvany, N. (2020)	A Longitudinal Analysis of Reciprocal Relations Between Students' Well-Being and Academic Achievement	Journal of Educational Research Online
II	**Kleinkorres, R.**, Stang-Rabrig, J., & McElvany, N. (2023)	The Longitudinal Development of Students' Well-Being in Adolescence: The Role of Perceived Teacher Autonomy Support	Journal of Research on Adolescence
Further Analyses			
III	**Kleinkorres, R.**, Stang-Rabrig, J., & McElvany, N. (2023),	Comparing Parental and School Pressure in Terms of Their Relations With Students' Well-Being (Submitted Version)	Learning and Individual Differences

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3. Contributions of the Cumulative Dissertation

3.1 Study I: A Longitudinal Analysis of Reciprocal Relations Between Students' Well-Being and Academic Achievement

Kleinkorres, R., Stang, J., & McElvany, N. (2020). A Longitudinal Analysis of Reciprocal Relations Between Students' Well-Being and Academic Achievement. *Journal for Educational Research Online, 12*(2), 114–165. https://doi.org/10.25656/01:20975

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Abstract English

Besides acquisition of academic competencies, well-being is an important educational goal and it has been shown that both outcomes are mutually dependent. However, until now, most studies used cross-sectional designs so that the direction of the relation is not yet fully understood. In the present study we used longitudinal data from students attending grades 5 to 9 who participated in the National Educational Panel Study (NEPS). We analyzed reciprocal relations between different facets of well-being (i.e., physical, cognitive, emotional) and academic achievement. Furthermore, we examined differences between gender and type of school in these reciprocal relations. Results revealed mainly positive reciprocal relations between academic achievement and different indicators of well-being. However, multi-group models did not show differences between gender and type of school. Implications for future research and educational practice are discussed.

Abstract Deutsch

Neben dem Kompetenzerwerb stellt Wohlbefinden ein wichtiges Bildungsziel dar und es konnte gezeigt werden, dass beide Variablen voneinander abhängen. Bis jetzt liegen allerdings im Wesentlichen Befunde aus Querschnittsstudien vor, sodass die Richtung des Zusammenhangs noch nicht vollständig geklärt ist. In der vorliegenden Studie wurden längsschnittliche Daten von Schülerinnen und Schülern der 5. bis zur 9. Klasse genutzt, die an der nationalen Bildungspanelstudie (NEPS) teilgenommen hatten. Untersucht wurden reziproke Zusammenhänge zwischen verschiedenen Facetten von Wohlbefinden (körperlich, kognitiv, emotional) und schulischer Leistung. Weiterhin wurden in Bezug auf diese reziproken Zusammenhänge Unterschiede zwischen Geschlechtern und Schulformen analysiert. Die Ergebnisse zeigten vor allem positive wechselseitige Beziehungen zwischen schulischer Leistung und verschiedenen Indikatoren des Wohlbefindens. Mehrgruppenmodelle ergaben jedoch keine Hinweise auf Unterschiede zwischen Geschlechtern oder Schulformen. Implikationen für Forschung und Bildungspraxis werden diskutiert.

Schlagworte: Cross-Lagged-Panel Analyse; Geschlecht; Leistung; Schulform; Wohlbefinden von Schülerinnen und Schülern

1. A Longitudinal Analysis of Reciprocal Relations Between Students' Well-Being and Academic Achievement

The Organisation for Economic Co-operation and Development (OECD, 2017) stated that students should feel well at school so that they are motivated to learn and perform well. This demand reflects the importance of students' well-being for student achievement and stresses that there is a relation between well-being and achievement. The importance of student's well-being is also emphasized by being understood as an important educational goal, beside acquisition of academic competencies (van Petegem, Aelterman, Rossel, & Creemers, 2006). Furthermore, these two educational outcomes reflect central indicators of students' positive functioning and are most likely mutually dependent (e.g., Bücker, Nuraydin, Simonsmeier, Schneider, & Luhmann, 2018; Suldo, Riley, & Shaffner, 2006). Seligman, Ernst, Gillham, Reivich, and Linkins (2009) emphasized the importance of school for well-being due to the relation between learning, emotions, and well-being. According to the worldwide prevalence rate for schoolchildren's depression, Seligman and colleagues (2009, p. 293) even advocate to teach "skills for happiness" at school so that students can handle demanding situations better, feel and learn well.

Although acquisition of academic competencies and well-being are both important educational goals, not much is known on their relation and mutual impact on their development. On grounds of the importance of well-being for learning, more research on student well-being was done in the last years. However, studies were mainly cross-sectional and often focused rather on single aspects of students' well-being instead of considering multiple facets of this complex construct (cf., Heffner & Antaramian, 2016). Furthermore, the results of these studies are heterogeneous, whereby a current meta-analysis reported a small to medium-sized positive relation between well-being and academic achievement (Bücker et al., 2018). Nevertheless, the question of the direction between these constructs is still unanswered. Theoretically, the direction can be postulated from academic achievement to well-being as well as vice versa (see

e.g., broaden-and-build-theory, Fredrickson, 2001; self-determination-theory, Ryan & Deci, 2000). A third option could be that there is no causal relation between both constructs, although they are associated with each other. Moreover, the direction might vary for different groups of students: For example, boys and girls differ in their evaluation of school and satisfaction with life (e.g., Hascher & Hagenauer, 2011; Palsdottir, Asgeirsdottir, & Sigfisdottir, 2012). Furthermore, type of school is an important factor for academic achievement and for well-being (Chang, McBride-Chang, Stewart, & Au, 2003). Differences between these groups of students could have an impact on the relation between well-being and academic achievement.

Altogether, there is still a need for further research in order to shed light on the direction in the relation between academic achievement and well-being and to identify important influencing factors and moderators, especially in a long-term perspective.

2. Theoretical background

2.1 Students' Well-Being

Whereas well-being has formerly been defined by means of objective measures like wealth or the fact that a person is married (cf., Wilson, 1967), nowadays research often concentrates on subjective well-being (SWB). SWB is a multi-dimensional and broad construct (Seligman, 2011). However, a clear and widely accepted definition is still missing. Taken as a whole, SWB is referred to as how a person feels and thinks about his or her life in general, as well as concerning a certain domain (Diener, 1984; Diener, Suh, Lucas, & Smith, 1999).

There are several theoretical approaches of SWB. One of the most used approaches is the hedonic one (Eid & Larsen, 2008; Ryan & Deci, 2001). The hedonic approach distinguishes cognitive and affective components (Diener, 1984; Diener et al., 1999). The cognitive component comprises cognitive evaluations in the form of global and domain-specific satisfaction (Diener, Inglehart, & Tay, 2013). Global life satisfaction includes all life-evaluative attitudes and beliefs, whereas the domain-specific can be directed and refers to a particular area such as school (Schimmack, 2008). Concerning the affective component Bradburn (1969)

already differentiated between positive and negative affect (e.g., joy vs. learned helplessness). Even though it has initially been stated that both components are independent from each other (Bradburn, 1969) the relation between positive and negative affect has been debated controversially (e.g., Diener et al., 1999; Diener & Emmons, 1984; Russel & Carrol, 1999). Furthermore, there are two other important aspects which are of relevance for SWB (WHO, 2014): physical and social well-being. The physical component of SWB comprises measures like absent days as well as subjective evaluations of one's health (Richter & Hurrelmann, 2009). Social well-being encompasses the evaluation of, for example, social relationships.

For a long time, students' SWB was not in focus of psychological research (Hascher, 2008). However, recently there has been more research on students' SWB. In general, representative empirical studies in European countries such as Czech Republic, Germany or Switzerland showed that students feel well in school, are satisfied with school and do not indicate physical complaints on a high level (e.g., Hascher, 2007; Urhahne & Zhu, 2015). However, students also reported school-related worries, especially concerning grading and achievement (Hascher, 2007). Furthermore, it has been shown that SWB decreases with age (e.g., Casas & González-Carrasco, 2019; Rohlfs, 2011), whereby for most countries the decline starts around age of 10 (Casas & González-Carrasco, 2019). Thus, the examination of the relation between SWB and academic achievement seems to be of special importance in the group of adolescents.

2.2 Students' SWB and its relation to academic achievement

Students' SWB and academic achievement are important indicators of their positive psychological functioning (e.g., Suldo et al., 2006). The direction of the relation between SWB and academic achievement can be explained from both sides: Academic achievement could cause SWB as well as SWB could influence academic achievement. The first mechanism is explainable for example by means of the self-determination theory (SDT; Ryan & Deci, 2000). The SDT assumes that certain psychological needs (autonomy, competence, and relatedness)

are of importance for personality growth, social development, intrinsic motivation, and also for SWB. According to this, students' academic achievement as a reflection of the fulfillment of the psychological need of competence may influence students' SWB. The second possible path direction from SWB to academic achievement might be explainable for example by the broaden-and-build theory of positive affect (Fredrickson, 2001). This theory claims that the experience of positive affect as an important component of SWB broadens people's momentary thought-action repertoires. This enables a person to think more flexible and, therefore, might lead to higher achievement. Beneficial for the relation between positive affect and achievement might be that positive affect is also associated with mastery goals (Linnenbrink & Pintrich, 2002). Additionally, negative affect is negatively related to academic achievement (Gumora & Arsenio, 2002). Apart from these two theoretical approaches that could explain a causal relation it is also possible that the constructs are associated in a non-causal manner.

While some studies did not find a significant correlation between these two outcomes (Huebner, 1991; Huebner & Adlerman, 1993), numerous studies have given evidence for an interrelation between SWB and academic achievement (Bird & Markle, 2012; Bücker et al., 2018; Crede, Wirthwein, McElvany, & Steinmayr, 2015; Pietarinen, Soini, & Pyhältö, 2014; Suldo, Shaffer, & Riley, 2008). A meta-analysis from Bücker et al. (2018) revealed that there is a medium-sized positive relation between the two constructs[1]. Additionally, there is evidence that higher achievement leads to lower levels of psychopathology (Suldo & Shaffer, 2008). However, most of the studies were cross-sectional. Only few studies analyzed the causal relation between SWB and academic achievement. For example, Steinmayr, Crede, McElvany, and Wirthwein (2016) found that students' great point average in grade 11 predicted changes in life satisfaction in grade 12 positively. Because the evidence from longitudinal data is rare

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[1] SWB was operationalized in the meta-analysis according to Diener's (1984) definition.

and only certain age groups have been considered, the causal direction of the relation between students' SWB and academic achievement is not yet fully understood.

Beside the interplay between SWB in general and academic achievement, academic achievement is also associated with a positive health behavior and perception of one's own health (Eide, Showalter, & Goldhaber, 2010; Lavy & Sand, 2012; Sigfúsdóttir, Kristjánsson, & Allegrante, 2007; Véronneaue & Dishion, 2012; Zajacova, Lynch, & Espenshade, 2005). Furthermore, studies which mainly focused on adolescents found a positive correlation between life satisfaction and academic achievement (e.g., Heffner & Antaramian, 2016; Proctor et al., 2010). Concerning school, it was reported that life satisfaction is positively related to school grades (Gilman & Huebner, 2006; Verkuyten & Thijs, 2002). Moreover, students' perception of school satisfaction predicted positively students' perception of their academic achievement (e.g., Samdal, Wold, & Bronis, 1999). Concerning negative aspects of students' SWB, studies showed a negative relation to academic achievement. Studies have shown that *learned helplessness*[2] is negatively related to academic achievement: In particular, learned helplessness in the third grade predicted achievement test scores in grade 5 negatively (Fincham, Hokoda, & Sanders, 1989).

2.3 Gender and type of school as possible influencing factors on the relation between students´ SWB and academic achievement

One factor, which might explain differences in the relation between SWB and academic achievement, is gender. There are some studies, which found sex differences in certain areas of SWB: In contrast to boys, girls stated more often physical issues and experience of stress; whereas boys reported a less positive attitude towards school (Hascher & Hagenauer, 2011; Palsdottir et al., 2012). Corresponding to this, it has been found repeatedly that girls in contrast to boys are in general more satisfied with school (Czerwenka et al., 1990; Haecker & Werres,

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[2] The concept of *learned helplessness* (cf., Seligman, 1972) describes the subjective conviction that one has lost the ability to change one's own life situation, because of repeated negative experiences.

1983; Hascher & Winkler-Ebner, 2010). However, it seems that girls are more prone to learned helplessness compared to boys, especially in the domain of mathematics (Dweck, 1986; Farmer & Vispoel, 1990). Concerning other important facets of SWB, like social problems or self-esteem, no differences between boys and girls were discovered (Hascher & Hagenauer, 2011). In the overall picture, some differences become apparent between sexes concerning SWB whereby there are more facets in which girls have lower values than facets in which boys have lower values. So far, however, there is an ambiguous results pattern concerning gender differences in SWB (Gysin, 2017, p. 107). Given that girls tend to have better grades than boys (e.g., Berger, Alcalay, Torretti, & Milicic, 2011), it seems possible that there are gender-specific differences regarding the relation between SWB and academic achievement in that way that in girls these constructs are not as high and positively associated as in boys. A possible explanation could be that girls compensate lower well-being with a higher readiness to perform well in school. In other domains this phenomenon has been referred to by a higher "conformity of girls towards school requirements" (e.g., Sparfeldt, Buch, Schwarz, Jachmann, & Rost, 2009). Up to now, the evidence for a moderating effect of gender is sparse and inconclusive: Herman, Lambert, Reinke, and Ialongo (2008) found a moderating effect of gender in a mediation model from academic competence in the first grade over perceived control in grade six on depression in seventh grade. In contrast, there is also evidence that gender does not influence the path coefficients between academic achievement and SWB. For example, a current meta-analysis found no moderating effect of gender on the relation between SWB and academic achievement (Bücker et al., 2018).

Another factor, which might lead to differences in the relation between SWB and academic achievement, is type of school. One study found differences in SWB between students attending different types of school (Fend, Knörzer, Nagl, Specht, & Väth-Szusdziara, 1976). Additionally, Chang et al. (2003) assume that type of school is an important factor for well-being on the one hand, but also for achievement on the other hand. A relation between school

type and well-being might be explainable by differential learning environments. Students from different school types differ in achievement as well as in other student characteristics like motivation. For instance, motivational characteristics of high school students (Gymnasium) were significantly more distinct than of students of other school types. These differences may be a result of student compositional effects, different curricula or also different teacher preparation programs (e.g., Baumert, Maaz, Stanat, & Watermann, 2009; Diedrich et al. 2019). The evidence for a moderating effect of type of school on the relation between SWB and academic achievement is still scarce. Opdenakker and van Damme (2000) found differential relations between achievement motivation and well-being dependent on school characteristics like an orderly learning environment. Assuming that the learning environments differ between schools (Baumert et al., 2009) a moderating effect of type of school on the relation between SWB and academic achievement could also be plausible. However, Bücker et al. (2018) did not find an impact on the relation between student SWB and academic achievement through type of school.

3. Research questions

Due to the vital importance of SWB for students and its relation to academic achievement, we investigated the question of reciprocal relations between these constructs. Previous studies mainly used cross-sectional data and focused on only few aspects of SWB. Therefore, the direction of the relation between students' SWB and academic achievement is not yet fully understood. Because theoretical arguments support mutual effects in both directions, we pursued an explorative approach in the present study. Furthermore, several facets of SWB were taken into account and the critical age period of secondary school was focused. Additionally, we examined factors that might influence the mutual effects like gender and type of school because research on these moderating variables is sparse. The following research questions were analyzed:

1. Do reciprocal relations exist between academic achievement and a) physical well-being,

   b) cognitive well-being, and c) emotional well-being?

2. Do the reciprocal patterns differ between a) gender and b) type of school?

4. Method

4.1 Participants

Longitudinal data analysis with three points of measurement (t_1=grade 5, t_2=grade 7, t_3=grade 9) was based on data of the starting cohort 3 of the National Educational Panel Study (NEPS; Blossfeld, Roßbach, & Maurice, 2011). The original NEPS sample consisted of 4,335 students on t_1, 6,012 students on t_2 and 5,779 students on t_3 who attended one of the traditional academic tracks of the German secondary school system ("Hauptschule", "Realschule", "Gymnasium")[3]. We concentrated on students who attended the same school over the time intervals of interest ($N_{1\text{-}3}$ = 2,993, $N_{2\text{-}3}$ = 4,303) and excluded individuals who skipped or repeated classes between the corresponding intervals. The latter step led to an exclusion of 89 of the individuals who participated from t_1 on and 118 of the individuals who participated on t_2 and t_3. Finally, individuals with untypically high age were excluded from data: This concerned two of the individuals who participated from t_1 on and five of the individuals who participated on t_2 and t_3, respectively[4]. Our final sample comprised 2,902 students (49.7% female)[5] who participated constantly within the interval from t_1 and t_3 and 4,180 students (49.5% female) who participated constantly within the interval from t_2 to t_3. On the first point of measurement, in grade 5, students were on average 10.75 years old (SD = 0.48). On the second point of

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3 The sample size was increased in the NEPS between grades 6 and 7. Therefore, the number of students who participated on t_2 and t_3 was higher than those who participated on t_1.
4 The age of these individuals differed by more than four standard deviations from sample mean age.
5 In most waves there were missing values concerning sex of the students. We replaced missing values on this dichotomous variable with the median indication of sex over all other waves.

measurement, in grade 7, students were on average 12.77 years old ($SD = 0.50$)[6]. Sample characteristics for the different types of school are displayed in Table 1.

Table 1

Sample Characteristics for Different Types of School

	t_1			t_2-t_3		
	Hauptschule	Realschule	Gymnasium	Hauptschule	Realschule	Gymnasium
N	363	789	1750	583	1176	2431
% female	43.0	48.3	51.7	44.1	45.6	52.6
M_{age} (SD_{age})	11.10 (0.59)	10.85 (0.47)	10.63 (0.40)	13.12 (0.62)	12.88 (0.50)	12.63 (0.41)

4.2 Instruments

4.2.1 Academic Achievement

For the measurement of reading competence (RC) as well as mathematical competence (MC) we used tests from the NEPS (Blossfeld et al., 2011). The reading comprehension test examined students' RC in grades 5, 7, and 9. The test consisted of a total of 25 tasks which differed in difficulty. The weighted likelihood estimates (WLE) revealed good reliabilities for all points of measurement (t_1: WLE reliability = .77; t_2: WLE reliability = .79; t_3: WLE reliability = .79; cf., Gehrer, Zimmermann, Artelt, & Weinert, 2012). MC was examined in grades 5, 7, and 9 and consisted of 25 tasks, as well. Again, reliabilities were good for all points of measurement (t_1: WLE reliability = .78; t_2: WLE reliability = .72; t_3: WLE reliability = .81; cf., Neumann et al., 2013). In our analyses, the corrected weighted likelihood estimates (for a detailed description see Scharl, Fischer, Gnambs, & Rohm, 2017) of these competence tests were used as global test scores.

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6 Due to different numbers of individuals who participated within the interval from t_1-t_3 and t_2-t_3, respectively, the mean age differed between these subsamples.

4.2.2 SWB

Questionnaires were administered in the classroom in order to obtain data of students. Because data for academic achievement was available for grades 5, 7, and 9, we focused on constructs of SWB that had been measured longitudinally in at least two of these grades. In order to measure physical well-being we used two indicators: students' self-estimated health and number of days of absence from school. Self-estimated health served as subjective indicator for general physical well-being and was measured by a single item ("How would you describe your health status in general?") on a 5-point scale (1=*very poor*, 2=*poor*, 3=*fair*, 4=*good*, 5=*very good*)[7]. Days of absence from school served as objective indicator for school-related physical well-being. Students responded on the item by indicating a single number from 0 to 99.

For the measurement of cognitive well-being we used the *satisfaction scale* that was included in the questionnaire of the NEPS. The scale comprised six items that ask respondents about their satisfaction concerning different life-domains (overall, wealth, health, family, friends, and school). Students responded to each item on an 11-point scale ranging from 0 (=*completely dissatisfied*) to 10 (=*completely satisfied*). We separated the scale into the variable satisfaction with school which was assessed with one item ("How satisfied are you with your school situation?") and the variable satisfaction with life which comprised the remaining five items (e.g., "How satisfied are you, currently, with your life as a whole?") in order to oppose these two domains of SWB to each other. Measurement invariance testing showed that at least configural invariance could be assumed for the variable satisfaction with life over points of measurement (see Appendix D, Tables D3 and D4).

To measure emotional well-being, we used the helplessness scale. The instrument that is used in NEPS is based on a scale by Jerusalem and Schwarzer (1993) who derived items to measure the construct of learned helplessness (cf., Seligman, 1972). The scale originally

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7 In order to simplify interpretation of scores and relations with other variables, we reversed the self-estimated health scale. It was originally ranked as follows: 1=*very good*, 2=*good*, 3=*fair*, 4=*poor*, 5=*very poor*.

comprised five items that measure school-related helplessness in general. In the NEPS, the scale was duplicated to measure school-related helplessness for the subjects "German" and "Mathematics" (In the following we will refer to these scales by using the terms "helplessness German" and "helplessness Math"). Participants responded to the items (e.g., "No matter how much I try in German, my grades won´t get better") on a 4-point scale ranging from 1 (=*completely disagree*) to 4 (=*completely agree*). Measurement invariance testing revealed that configural invariance was only given if items 4 and 5 of the subscale helplessness German, as well as items 1 and 2 of the subscale helplessness Math were excluded in a two-factor model (see Appendix D, Tables D1 and D2). Therefore, we ran our analyses with two latent factors measured by 3 items each.

4.2.3 Moderating variables: Gender and type of school

For the examination of our second research question, we included gender (female vs. male) and type of school in our analysis. The latter was a three-staged factor differentiated into the traditional academic tracks of the German secondary school system: The lowest track ("Hauptschule"), the intermediate track ("Realschule"), and the highest track ("Gymnasium").

4.3 Data analysis

All analyses were conducted in *R* (Version 3.6.3; R Core Team, 2020). Descriptive statistics were calculated for all variables. Furthermore, differences between sexes, school types and measurement occasions were analyzed by means of ANOVAs and *t*-tests. We computed partial eta-squared and *d*-values for dependent *t*-tests (see Morris & Deshon, 2002) to quantify the effect sizes of the different test-statistics. Post-hoc tests were corrected with the Bonferroni-Holm method.

Prior to the examination of our research questions, we tested measurement invariance for those variables that were measured by multiple-item scales (see section 4.2). We followed the suggestions of other authors, which described four main steps: configural, metric, scalar, and residual invariance (e.g., Putnick & Bornstein, 2016; Widaman & Reise, 1997). Indicator-

specific covariances were included within measurement invariance analyses over points of measurement.

In order to answer our first research question three different longitudinal cross-lagged panel models were specified. In each model we investigated the reciprocal relations between academic achievement and one facet of SWB. While the relations from academic achievement with physical and emotional well-being, respectively, were calculated over two points of measurement, in the model investigating the relation between academic achievement and cognitive well-being three points of measurement were considered. Therefore, we were able to include random intercepts in the latter model to separate the within-person development from stable between-person differences (see Hamaker, Kuiper, & Grasman, 2015). To take into account that constructs only measured by a single item (i.e., days of absence, self-estimated health, satisfaction with school) were not measured perfectly reliable, we modeled each of the respective variables as single indicators of a latent variable and specified a value of 0.85 for the reliability (e.g., Jöreskog & Sörbom, 1982; Petrescu, 2013). The global test scores of MC and RC were handled in the same way, whereby fallibility was taken into account by using the reliabilities of the single measurement occasions (see section 4.1). All latent variables that were included in a single model were allowed to correlate on each of the different occasions. However, in the random intercepts cross-lagged panel model we constrained covariances between the factors capturing the individuals' stable scores over all waves (random intercepts) and exogenous within-person factors to zero. For the investigation of our second research question, multi-group models with gender and type of school, respectively, were established to examine the moderating function of these variables. For each of the moderating variables, a model with free estimation of regression parameters for all factor levels was compared to a model that restricted the regression parameters for all factor levels to be equal.

For testing measurement invariance and all analyses, the package "lavaan" (Rosseel, 2012) was used. The parameters of the models were calculated by means of maximum

likelihood estimation with robust standard errors and scaled test statistic that is asymptotically equal to the Yuan-Bentler test statistic (cf., Rosseel, 2012). To evaluate model fit, we used robust estimators of the different fit measures (see Brosseau-Liard, Savalei, & Li, 2012). Because the χ^2-difference-test is vulnerable in case of large samples, we used ΔCFI for the comparison of nested models instead. We followed the suggestions by Cheung and Rensvold (2002) to prefer the restricted model if ΔCFI is equal to or greater than -.01. The hierarchical structure of the data was taken into account. For this purpose the identification number of the students' schools (Blossfeld & Roßbach, 2019) was considered as cluster variable in our analyses to compute robust standard errors of the parameters estimated in the structural equation models. Finally, missing data was handled within the structural equation models through full information maximum likelihood method.

5. Results

5.1 Descriptive results

In Table A1 (see Appendix A) means and standard deviations of the variables we used in our analyses are summarized. As can be seen in the Table, means of satisfaction with life decreased over time ($F(2,4412) = 185.78$, $p < .001$, $\eta_p^2 = .08$), whereby scores differed significantly between classes 5 and 7 ($t(2487) = 13.99$, $p < .001$, $d = -0.28$) and between classes 7 and 9 ($t(2485) = 7.72$, $p < .001$, $d = -0.16$). Means of satisfaction with school also decreased over time ($F(2,4752) = 226.29$, $p < .001$, $\eta_p^2 = .09$). Scores differed significantly between classes 5 and 7 ($t(2556) = 17.82$, $p < .001$, $d = -0.36$) and between classes 7 and 9 ($t(2556) = 3.57$, $p < .001$, $d = -0.06$). The same statistics are displayed in Appendix A separately for gender (Table A2) and type of school (Table A3). Satisfaction with life did not differ between gender ($F(1,2205) = 0.52$, $p = .47$, $\eta_p^2 = .00$), whereas girls showed on average a higher satisfaction with school ($F(1,2375) = 14.37$, $p < .001$, $\eta_p^2 = .01$). A further trend became apparent insofar that boys compared to girls reported a higher helplessness in school subject "German" ($F(1,3334) = 96.19$, $p < .001$, $\eta_p^2 = .03$), whereby girls reported a higher helplessness

in school subject "Math" than boys ($F(1,3313) = 73.20$, $p < .001$, $\eta_p^2 = .02$). Descriptive results

for type of school showed that scores in *days of absence* ($F(2,2937) = 13.79$, $p < .001$, $\eta_p^2 = .01$),

helplessness German ($F(2,3333) = 39.31$, $p < .001$, $\eta_p^2 = .02$)*,* and *helplessness Math*

($F(2,3312) = 30.73$, $p < .001$, $\eta_p^2 = .02$) differed significantly between students attending

different types of school. Table A3 shows that scores on these measures were highest in students

attending "Hauptschule" and lowest in students attending "Gymnasium". Results reversed for

the variables *satisfaction with school* ($F(2,2374) = 28.11$, $p < .001$, $\eta_p^2 = .02$) and *satisfaction

with life* ($F(2,2204) = 15.45$, $p < .001$, $\eta_p^2 = .01$), meaning that these scores were highest in

students attending "Gymnasium" and lowest in students attending "Hauptschule". In general, it

has to be noted that the means of most of the measures were not close to the center of the scale.

Correlations between all variables of interest except for type of school can be seen in

Appendix B (Table B1). The table contains mostly statistically significant relations that

followed theory-based expectations. It has to be noted, however, that the relations of

competence measures with self-estimated health and with satisfaction with life were smaller

and reached a less high level of significance compared to relations between other variables.

5.2 Reciprocal relations between SWB and academic achievement

5.2.1 Reciprocal relations between physical well-being and academic achievement

The results for our first research question can be seen in Figure 1. The path from MC

on t_2 on days of absence from school on t_3 was significant ($\beta = -.10$, $p = .001$), whereas the

contrary path from days of absence on t_2 on MC on t_3 was not. The restriction of the

corresponding cross-lagged regression parameters (from days of absence on mathematical

competence and vice versa) to being equal was not detrimental to model fit ($\Delta CFI = -.001$)[8].

Hence, we assumed that the longitudinal association from MC on t_2 on days of absence from

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8 Comparison by means of the χ^2-difference test revealed a significant difference ($\Delta\chi^2(1) = 13.69$, $p < .001$).

school on t_3 was not stronger than vice versa. We did not find reciprocal relations between days

of absence from school and RC.

The analysis of reciprocal relations between self-estimated health and competence

measures revealed a positive longitudinal association between MC on t_2 and self-estimated

health on t_3 ($\beta = .08$, $p = .020$), but not vice versa. Restricting the corresponding regression

parameters to being equal was not detrimental to model fit (ΔCFI = .000). Conversely, the

relation between RC and self-estimated health was reciprocal: The paths from RC on t_2 on self-

estimated health on t_3 ($\beta = -.10$, $p = .001$), as well as vice versa ($\beta = -.04$, $p = .032$) were both

significantly negative. But again, there was no evidence that the regression parameters differed

in strength (ΔCFI = .000).

Figure 1

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and

Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9
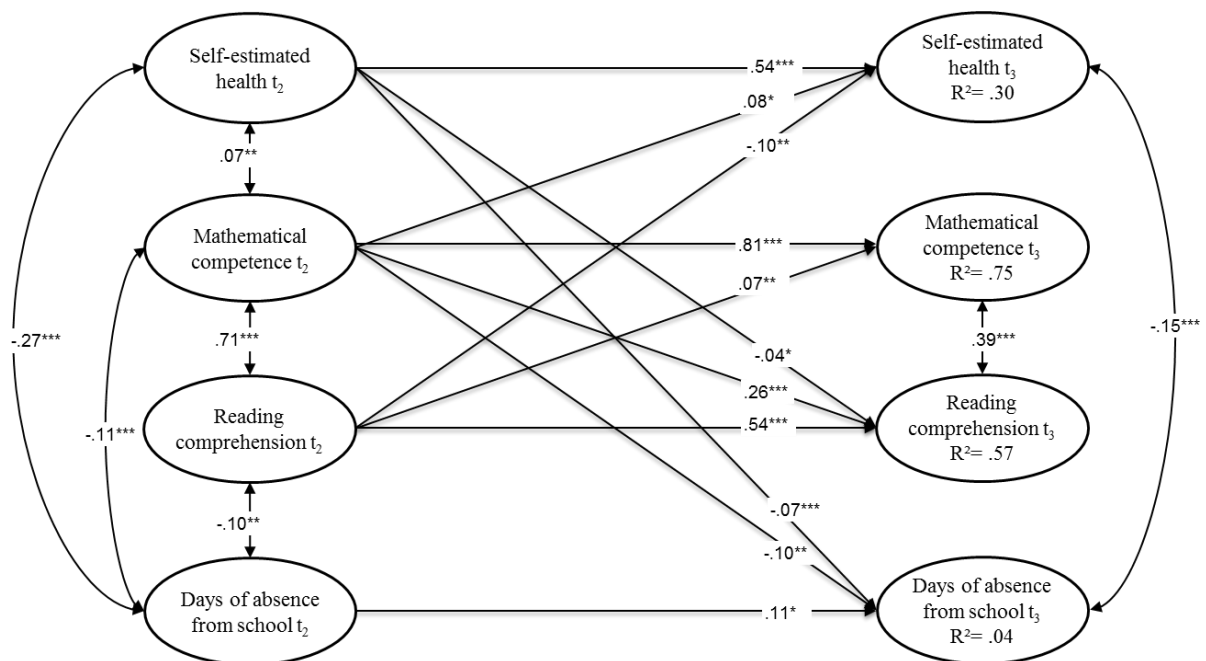
Notes. N = 4,159. Fit measures are not reported because the model is saturated. All latent

variables are measured by single indicators which have not been included in the figure. Only

statistically significant paths are shown. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

5.2.2 Reciprocal relations between cognitive well-being and academic achievement

Figure 2 displays reciprocal relations between cognitive well-being and academic achievement: While there was no reciprocal relation between satisfaction with life and MC between t_1 and t_2, the path from satisfaction with life on t_2 on MC on t_3 got significant ($\beta = -.14$, $p = .005$). However, a comparison with the corresponding path from MC on t_2 on satisfaction with life on t_3 did not reveal a significant difference in strength ($\Delta CFI = .000$). Higher satisfaction with life on t_1 was associated with higher RC on t_2 ($\beta = .15$, $p < .001$) whereas the corresponding path between t_2 and t_3 was significantly negative ($\beta = -.21$, $p = .013$). In both cases, however, the restriction of paths from satisfaction with life on RC and vice versa to being equal was not detrimental to model fit ($\Delta CFI_{1,2} = .000$; $\Delta CFI_{2,3} = .000$). Concerning satisfaction with school we identified a unidirectional association of satisfaction with school on t_2 on MC on t_3 ($\beta = .12$, $p = .004$). Restriction of cross-lagged path from satisfaction with school on t_2 on MC on t_3 and vice versa to being equal was not detrimental to model fit ($\Delta CFI = .000$). We obtained similar results for the reciprocal relation between satisfaction with school and RC: Higher satisfaction with school on t_2 was associated with higher scores in RC on t_3 ($\beta = .23$, $p = .002$). This association was, however, not stronger than from RC on t_2 on satisfaction with school on t_3 ($\Delta CFI = .000$).

Figure 2

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
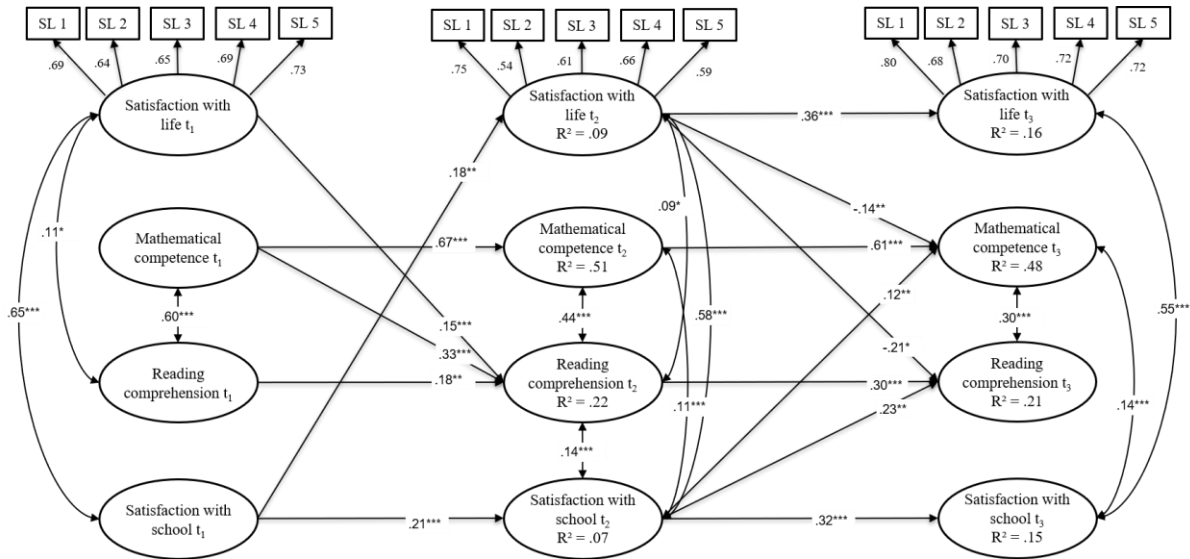
Notes. $N = 2899$. $\chi^2(187) = 479.51$, AIC $= 232205.43$, BIC $= 233023.61$, CFI $= .989$, TLI $= 0.979$, RMSEA $= .028$, SRMR $= .025$. Variables "Mathematical competence", "Reading comprehension" and "Satisfaction with school" are measured by single indicators which have not been included in the figure. Latent variables that model random intercepts have not been included in the figure for clarity purposes. Only statistically significant paths are shown. Significance codes: $* p < .05$, $** p < .01$, $*** p < .001$.

5.2.3 Reciprocal relations between emotional well-being and academic achievement

Figure 3 displays the pattern of reciprocal relations between emotional well-being and academic achievement. We observed a negative reciprocal relation between helplessness Math and MC: Higher helplessness Math on t_2 was associated with lower MC on t_3 ($\beta = -.05$, $p = .002$) and vice versa ($\beta = -.17$, $p < .001$). However, the longitudinal relation between helplessness Math and RC was unidirectional, whereby higher scores in RC on t_2 were associated with higher helplessness Math on t_3 ($\beta = .08$, $p = .008$). Helplessness German showed reciprocal relations with both competence measures: Higher helplessness German on t_2 was associated with higher scores in MC on t_3 ($\beta = .04$, $p = .030$) and the path from MC on t_2 on helplessness German on

t_3 was significantly positive as well (β = .09, p = .006). Moreover, helplessness German on t_2 was negatively associated with RC on t_3 (β = -.10, p < .001) and vice versa (β = -.12, p < .001). When the opposite regression parameters from a competence measure on a measure of emotional well-being and vice versa were compared to each other we did not find differences in the strength of paths for any of the reciprocal relations (all ΔCFIs = .000)[9].

Figure 3

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School Subjects "German" and "Mathematics", Respectively) and Academic Achievement from Grade 7 to Grade 9

Notes. N = 4159. χ^2(80) = 354.51, AIC = 130731.60, BIC = 131187.58, CFI = .989, TLI = 0.983, RMSEA = .031, SRMR = .022. Variables "Mathematical competence" and "Reading

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9 The χ^2-difference test revealed that the associations from RC on t_2 on helplessness German on t_3 and vice versa differed significantly from each other ($\Delta\chi^2$(1) = 7.14, p < .01).

comprehension" are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

5.3 Effects of moderating variables on the reciprocal relations between SWB and academic achievement

Model comparisons examining potential moderating effects of gender and type of school on the reciprocal relations between well-being (physical, cognitive, emotional) and academic achievement are displayed in Table 2. As can be seen, ΔCFI values suggested that the restriction of regression parameters to being equal between sexes and types of school, respectively, was not detrimental to model fit in any of the models. This implies that the moderating variables did not have an effect on the reciprocal relations between SWB and academic achievement. Nevertheless, in the following some descriptive differences in the patterns of reciprocal relations between academic achievement and different facets of SWB are described.

5.3.1 Moderating effects on the reciprocal relations between physical well-being and academic achievement

Reciprocal relations between physical well-being and academic achievement are displayed in Figures E1 and E2 (see Appendix E) for boys and girls, respectively. As can be seen, significant associations between MC on t_2 and self-estimated health ($\beta = .12$, $p = .024$) and days of absence ($\beta = -.16$, $p < .001$), respectively, on t_3 could only be observed for female students. However, the restriction of the corresponding paths to being equal for both sexes, did reveal a significant difference neither for the association between MC and self-estimated health (ΔCFI = -.001)[10] nor for the association between MC and days of absence (ΔCFI = .000).

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10 The χ^2-difference test revealed a significant difference ($\Delta\chi^2(1) = 14.67$, $p < .001$).

Patterns of reciprocal relations between SWB and academic achievement for different types of schools can be obtained from figures F1, F2, and F3 (see Appendix F). They show only small differences in the pattern of reciprocal relations: The most prominent differences were that MC on t_2 was not associated with days of absence on t_3 for students attending "Realschule" and that days of absence on t_2 were negatively associated with MC on t_3 only in students attending "Gymnasium". The restriction of the corresponding paths to being equal for all types of school did not affect model fit (all ΔCFIs = -.001)[11].

5.3.2 Moderating effects on the reciprocal relations between cognitive well-being and academic achievement

Concerning gender, the comparison of the patterns of reciprocal relations (see Figures G1 and G2; Appendix G) did not reveal any striking differences between female and male students. With a view on figures H1, H2, and H3 (see Appendix H) it becomes apparent that there were also no noteworthy differences in the pattern of reciprocal relations between cognitive well-being and academic achievement dependent on different types of schools.

5.3.3 Moderating effects on the reciprocal relations between emotional well-being and academic achievement

The patterns of reciprocal relations between emotional well-being and academic achievement separately for male and female students are displayed in Figures I1 and I2 (see Appendix I). We did not obtain significant paths from helplessness Math on t_2 on MC on t_3 and from RC on t_2 on helplessness German on t_3 for female students. However, the restriction of the corresponding paths to being equal for both sexes was not detrimental to model fit (all ΔCFIs = .000).

Figures J1, J2, and J3 (see Appendix J) show the reciprocal relations between emotional well-being and academic achievement separately for different types of school. It can be seen

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11 The χ^2-difference test revealed a significant difference between types of school concerning the association between days of absence on t_2 and MC on t_3 ($\Delta\chi^2(2) = 21.03$, $p < .001$).

that the pattern of reciprocal associations of students attending "Hauptschule" did show nearly no significant paths. The restriction of single paths to being equal for all types of school, however, was not detrimental to model fit in any of the cases (all ΔCFIs = .000).

Table 2

Model Comparisons Examining the Potential Moderating Effects of Gender and Type of School on the Reciprocal Relations Between Well-Being (Physical, Cognitive, Emotional) and Academic Achievement

Facet	Moderator		χ^2(df)	$\Delta\chi^2$(df)	p	AIC	BIC	*CFI*	*ΔCFI*
Physical well-being	Gender	Unrestricted M	0 (0)			95083.31	95640.61	1.000	
		Restricted M	62.68 (16)	62.68 (16)	< .001	95117.16	95573.14	.994	-.006
	Type of school	Unrestricted M	0 (0)			93228.11	94064.06	1.000	
		Restricted M	57.21 (32)	57.21 (32)	< .01	93235.81	93869.11	.994	-.006
Cognitive well-being	Gender	Unrestricted M	706.75 (374)			231535.25	233171.61	.984	
		Restricted M	767.15 (406)	60.40 (32)	< .01	231540.39	232985.65	.983	-.001
	Type of school	Unrestricted M	913.82 (561)			229162.78	231617.33	.981	
		Restricted M	1014.70 (625)	100.16 (64)	< .01	229139.58	231211.91	.980	-.001
Emotional well-being	Gender	Unrestricted M	451.97 (160)			130008.33	130920.29	.988	
		Restricted M	474.64 (176)	23.85 (16)	.093	130004.92	130815.54	.988	.000
	Type of school	Unrestricted M	492.83 (240)			128021.95	129389.89	.989	
		Restricted M	552.10 (272)	59.81 (32)	< .01	128032.00	129197.27	.987	-.002

Note. M = Model.

6. Discussion

Due to the importance of students' SWB and academic achievement for educational success, this study investigated reciprocal relations between several facets of SWB and academic achievement in adolescents. Additionally, it was analyzed whether these reciprocal relations differ for gender and for type of school.

6.1 Reciprocal relations between SWB and academic achievement

In accordance with previous research (Bird & Markle, 2012; Bücker et al., 2018; Crede, et al., 2015; Pietarinen et al., 2014; Suldo et al., 2008), we found mainly positive relations

between indicators of students' SWB and academic achievement. Regarding physical well-being, results revealed that MC played a crucial role for SWB even though the effect sizes were relatively small: MC in grade 7 was significantly associated with both indicators of physical well-being in grade 9, whereas we did not find associations between measures of physical well-being in grade 7 and MC in grade 9. A possible explanation could be that higher MC constitutes the fulfillment of the psychological need of competence (see Ryan & Deci, 2000) which in turn has a positive impact on the physical well-being of students. However, we also found that RC and self-estimated health had a negative longitudinal relation that was of reciprocal nature. This is a surprising finding, even though these relations were very small and we did not find significant bivariate correlations between both measures. The examination of reciprocal relations between cognitive well-being and academic achievement revealed that satisfaction with life in grade 5 was positively associated with changes in RC in grade 7 while paths from satisfaction with life in grade 7 on MC and RC in grade 9 indicated a negative longitudinal relation. Whereas the former result coincides with prior research that reports positive longitudinal associations between satisfaction with life and school grades (e.g., Ng, Huebner, & Hills, 2015), the latter result seems to be in conflict to these earlier findings. Additionally, higher satisfaction with school in grade 7 was associated with higher scores in MC and RC in grade 9. Finally, we found mainly negative reciprocal relations between the negative facet of emotional well-being (i.e., helplessness) and academic achievement. Cross-lagged paths between helplessness Math and MC, as well as between helplessness German and RC were negative which fits to theory as well as prior research (e.g., Fincham et al., 1989). Furthermore, we observed a positive reciprocal relation between helplessness German and MC and a positive association between RC in grade 7 and helplessness Math in grade 9. This result can be interpreted analogously to earlier findings that found negative associations from verbal and math achievement on self-concept in the respective other domain (Möller, Pohlmann, Köller, & Marsh, 2009). The underlying internal/external frame of reference model which states that

students evaluate their achievement in a given subject not only in relation to the achievement of others but in relation to their own achievement in other subjects, as well (e.g., Möller et al., 2009), could also be an explanation for the positive effects we found between academic achievement in one subject and helplessness in another subject.

Overall, we found evidence that there are reciprocal relations between SWB and academic achievement, whereby it was dependent on the considered facet of well-being if more paths from measures of competence on measures of SWB were statistically significant or vice versa. It has to be noted, however, that we did not find differences in the strength of reciprocal paths. With regard to the direction of the relation, the results do not provide an explicit answer. Therefore, our results neither support only the SDT (Ryan & Deci, 2000) nor only the broaden-and-build theory (Fredrickson, 2001).

6.2 Effects of moderating variables on the reciprocal relations between SWB and academic achievement

In general, there was no evidence for moderating effects of the variables gender and type of school. As mentioned earlier, findings in relation to moderating effects of these variables on the relation between SWB and academic achievement are sparse and heterogenous: Single studies suggest moderating effects of gender (Herman et al., 2008) and type of school (Opdenakker & van Damme, 2000). In contrast, our results support earlier findings that did report neither moderating effects of gender nor of type of school on the relation between SWB and academic achievement (cf., Bücker et al., 2018). However, it has to be considered that we used ΔCFI in our analyses to examine moderating effects of the variables gender and type of school. This measure is relatively conservative in comparison with $\Delta\chi^2$.

6.3 Strengths and Limitations

A clear strength of the present study is the approach to analyze reciprocal relations between academic achievement and SWB. For this purpose, in our analyses, we used longitudinal data with two or even three measurement time points. In the research field of

students' well-being, the usage of longitudinal data is an important extension to the mainly cross-sectional studies which have been conducted in the past. Another quality of our study is the large sample size which promises a high external validity of our results.

A further strength of the present investigation is that the multidimensionality of SWB was met by including several facets of the construct and taking into account at least one important factor for each of these. The consideration of more than one or two SWB constructs helped to get a fine grained picture on the different relations between SWB and academic achievement. Additionally, the study offers important insights for two different domains of academic achievement which are both of high importance because mathematics and reading are two main key competencies. Last but not least, we analyzed differential effects for gender and school types.

Nevertheless, it is important to be aware of some limitations when interpreting the results of the present study. First, even though we used longitudinal data to investigate the reciprocal relations between academic achievement and well-being, we could only use data of two different points of measurement in two of our models. In these models we could, therefore, not distinguish stable variability between persons from within person variance (Hamaker et al., 2015) which may lead to spurious results. Furthermore, the minimum interval between two points of measurement was two years in each model. Because of this relatively large time lag, short term effects might not be detected and longitudinal associations should be interpreted with caution.

Second, even though we included several aspects of SWB, the operationalization of SWB was not completely satisfying: One of the reasons was that some constructs had been surveyed rarely and not parallel with other important constructs in the NEPS. For example, indicators for the domain-specific social component of SWB (e.g., social inclusion in class) had only been measured in grades 6–8, whereas indicators for academic achievement like RC and MC had been measured in grades 5, 7, and 9. Therefore, a longitudinal analysis including this

facet was not possible. Another problem concerning operationalization of SWB was that some constructs were measured with single items. Even though we corrected for reliability by modeling them as single indicators of latent variables, single items are prone to contain random and nonrandom errors (Bollen, 1989, p. 151). Moreover, constructs measured by multiple indicators did partly show low levels of measurement invariance. Especially, the satisfaction scale did rarely reach levels higher than metric invariance. Concerning the results of the present study it should be considered that latent mean differences can only be interpreted reliably when high levels of measurement invariance are given (e.g., Putnick & Bornstein, 2016).

Furthermore, we considered the nesting of students in different schools but we were neither able to account for variability between German states nor to consider the nesting of students in classes. This may have affected the estimation of standard errors. Another factor that could have had an impact on the results is that the sample sizes of the different types of school differed a lot.

Finally, we did not consider possible controls and third variables. On the one hand we did not include controls for pre-existing differences in achievement like socioeconomic status and ethnic heritage (e.g., Dicke et al., 2018). On the other hand we did not include variables that may mediate the relation between SWB and academic achievement. Following the SDT (Ryan & Deci, 2000), one mechanism explaining the relation from academic achievement on SWB could be that a good performance in school causes a higher self-concept and that this in turn could enhance well-being. Furthermore, effects from SWB on academic achievement could be explained by a mediation model, too: positive emotions could lead to an increase in interest and creativity which in turn could improve performance in school (e.g., Fredrickson, 2001).

6.4 Implications for future research and educational practice

The present study revealed new insights concerning the relation between SWB and academic achievement. However, further research is needed to support the presented findings. As has been mentioned above, the construct of SWB was not operationalized satisfyingly. To

be able to draw conclusions which are more content-related, future studies should consider a greater number of facets of SWB to satisfy the complexity of the construct and should analyze students' SWB by means of well-validated instruments. Furthermore, it would be desirable to investigate the reciprocal relation between SWB and academic achievement on basis of at least three points of measurement and shorter time lags between each of them. This would enable researchers to distinguish stable variability between persons from within person variance (Hamaker et al., 2015).

Moreover, future studies should examine effects of additional variables. In this regard, variables like socioeconomic status and ethnic heritage should be included to control for pre-existing differences in achievement. The role of variables like self-concept, interest and divergent thinking that possibly mediate the relation between SWB and academic achievement should be investigated, as well. Because we found evidence that – especially – higher scores in MC were associated with higher scores of several aspects of SWB on a later time, it would be interesting to investigate a possible mediation through self-concept in mathematics on this relation. Furthermore, recent findings suggest that the association between positive emotions and academic achievement might be mediated through motivation (Mega et al., 2014). Therefore, it would be interesting to investigate if these results apply on other facets of well-being as well. Another desideratum in this context might be to investigate influences of variables on higher hierarchical levels on students' SWB or academic achievement. For example, the role of compositional effects of classes or the big-fish-little-pond-effect (Marsh & Parker, 1984), which explains differences in academic self-concepts could be related to SWB of students. Big-fish-little-pond-effects are a result of academic achievement groupage which is very prominent in Germany (Köller, 2004). Additionally, teachers' SWB should also be investigated more deeply, because teachers' SWB might have an influence on quality of teacher-student relationships, which, in turn, could influence the emotional-motivational characteristics of students. In order to study such research questions that require consideration

of variables on the class (or the school) level, multi-level models should be specified to determine, for example, cross-level effects.

After a replication of the results, also implications for educational practice are possible. Due to the importance of students' SWB (e.g., satisfaction with school) for academic achievement, it would be thinkable to emphasize its relevance in training programs for teachers or to involve it in university curricula of teacher students. Furthermore, the influence of mathematical competence on SWB has to be investigated more deeply to derive implications for educational practice: If, for example, self-concept would mediate the relation between mathematical competence and well-being, intervention programs might be developed in order to strengthen mathematical self-concept of students, which also may have positive influences on their SWB.

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Appendix

Appendix A

Means, standard deviations and skewness for the variables used in the analyses of the present study

Table A.1

Means, Standard Deviations and Skewness for the Variables used in the Analyses of the Present Study

Variable	Grade 5[a]		Grade 7		Grade 9	
	M (*SD*)	*Skewness*	*M* (*SD*)	*Skewness*	*M* (*SD*)	*Skewness*
DA	-		1.44 (4.09)	10.79	1.36 (2.52)	3.95
SH	-		4.25 (0.78)	-0.94	4.14 (0.80)	-0.77
SL	8.89 (1.51)	-3.14	8.39 (1.43)[a]	-1.62 [a]	8.13 (1.66) [a]	-1.73 [a]
SS	8.06 (2.25)	-1.59	7.10 (2.31) [a]	-1.00 [a]	6.94 (2.26) [a]	-0.97 [a]
HG	-		1.77 (0.69)	0.87	1.80 (0.69)	0.68
HM	-		1.68 (0.71)	0.96	1.74 (0.75)	0.85
MC	0.24 (1.14)	0.00	0.89 (1.22)	-0.01	0.15 (1.20)	0.20
RC	0.24 (1.23)	0.17	0.84 (1.37)	0.20	0.10 (1.13)	0.20

Note. n = 4,180. DA = Days of absence from school, SH = Self-estimated health, SL = Satisfaction with life, SS = Satisfaction with school, HG = Helplessness German, HM = Helplessness Math, MC = Mathematical competence, RC = Reading competence. Values for MC and RC are WLEs. [a] *n* = 2,902 students.

Table A.2

Means, standard deviations and skewness for the variables used in the analyses of the present study separately for both sexes

| | Male [a] | | | | | | Female [b] | | | | | |
| | Grade 5 [c] | | Grade 7 | | Grade 9 | | Grade 5 [d] | | Grade 7 | | Grade 9 | |
Variable	*M (SD)*	*Skewness*	*M (SD)*	*Skewness*	*M (SD)*	*Skreness*	*M (SD)*	*Skewness*	*M (SD)*	*Skewness*	*M (SD)*	*Skewness*
DA	-		1.63 (4.96)	10.57	1.33 (2.70)	4.51	-		1.24 (2.94)	6.59	1.39 (2.34)	3.05
SH	-		4.26 (0.78)	-1.02	4.22 (0.79)	-0.90	-		4.25 (0.77)	-0.87	4.06 (0.79)	-0.67
SL	8.83 (1.54)	-3.08	8.37 (1.48)	-1.85 [c]	8.19 (1.73)	-1.87 [c]	8.94 (1.48)	-3.21	8.41 (1.39)[d]	-1.33 [d]	8.08 (1.58)[d]	-1.56 [d]
SS	7.90 (2.36)	-1.46	6.95 (2.38)[c]	-0.94 [c]	6.88 (2.33)[c]	-0.92 [c]	8.22 (2.12)	-1.73	7.25 (2.23)[d]	-1.06 [d]	7.01 (2.19)[d]	-1.03 [d]
HG	-		1.86 (0.72)	0.71	1.90 (0.73)	0.56	-		1.68 (0.65)	1.04	1.70 (0.64)	0.77
HM	-		1.60 (0.69)	1.07	1.64 (0.72)	1.00	-		1.75 (0.71)	0.87	1.84 (0.77)	0.71
MC	0.37 (1.14)	1.21	1.06 (1.27)	-0.02	0.29 (1.25)	0.16	0.11 (1.12)	-0.02	0.73 (1.14)	-0.10	0.00 (1.12)	0.17
RC	0.17 (1.27)	0.16	0.69 (1.39)	0.23	0.01 (1.17)	0.26	0.32 (1.19)	0.21	0.98 (1.32)	0.21	0.21 (1.06)	0.20

Note. DA = Days of absence from school, SH = Self-estimated health, SL = Satisfaction with life, SS = Satisfaction with school, HG = Helplessness German, HM = Helplessness Math, MC = Mathematical competence, RC = Reading competence. Values for MC and RC are weighted likelihood estimates. [a] $n = 2,109$, [b] $n = 2,071$, [c] $n = 1,461$, [d] $n = 1,441$.

Table A.3

Means and Standard Deviations for the Variables used in the Analyses of the Present Study Separately for Different Types of School

	Hauptschule [a]						Realschule [b]						Gymnasium [c]					
	Grade 5 [d]		Grade 7		Grade 9		Grade 5 [e]		Grade 7		Grade 9		Grade 5 [f]		Grade 7		Grade 9	
Variable	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK	M (SD)	SK
DA	-		2.93 (8.67)	6.31	1.84 (3.21)	3.77	-		1.58 (3.86)	6.64	1.53 (2.92)	4.42	-		1.01 (2.33)	5.14	1.21 (2.23)	3.51
SH	-		4.25 (0.85)	-1.03	4.11 (0.80)	-0.46	-		4.22 (0.77)	-0.85	4.08 (0.80)	-0.78	-		4.29 (0.77)	-1.01	4.17 (0.79)	-0.83
SL	8.48 (1.89)	-2.31	8.23 (1.68)[d]	-1.21[d]	8.15 (1.84)[d]	-1.64[d]	8.63 (1.91)	-2.72	8.34 (1.42)[e]	-1.42	8.03 (1.75)[e]	-1.55	9.08 (1.15)	-3.24	8.44 (1.38)[f]	-1.80[f]	8.17 (1.57)[f]	-1.84[f]
SS	7.33 (2.84)	-1.02	6.76 (2.64)[d]	-0.79[d]	7.02 (2.38)[d]	-0.91[d]	7.68 (2.54)	-1.29	6.82 (2.44)[e]	-0.90	6.78 (2.28)[e]	-0.90	8.37 (1.91)	-1.80	7.29 (2.16)[f]	-1.06[f]	7.00 (2.22)[f]	-1.03[f]
HG	-		2.03 (0.81)	0.46	1.89 (0.76)	0.66	-		1.85 (0.73)	0.73	1.83 (0.69)	0.62	-		1.65 (0.64)	1.05	1.73 (0.68)	0.85
HM	-		1.96 (0.84)	0.53	1.89 (0.84)	0.73	-		1.78 (0.75)	0.79	1.71 (0.72)	0.81	-		1.58 (0.66)	1.17	1.69 (0.73)	0.91
MC	-1.17 (0.91)	0.19	-0.64 (0.97)	0.09	-1.09 (0.91)	0.44	-0.21 (0.84)	-0.00	0.41 (0.97)	0.19	-0.34 (0.93)	0.29	0.73 (0.96)	0.29	1.42 (1.02)	0.17	0.67 (1.06)	0.19
RC	-1.11 (0.98)	0.51	-0.62 (1.10)	0.14	-1.04 (0.83)	0.32	-0.15 (1.04)	0.37	0.30 (1.12)	0.36	-0.26 (0.90)	0.38	0.69 (1.08)	0.37	1.30 (1.23)	0.26	0.55 (1.03)	0.18

Note. $n = 4,180$. DA = Days of absence from school, SH = Self-estimated health, SL = Satisfaction with life, SS = Satisfaction with school, HG = Helplessness German, HM = Helplessness Math, MC = Mathematical competence, RC = Reading competence, SK = Skewness. Values for MC and RC are weighted likelihood estimates. [a] $n = 583$, [b] $n = 1,176$, [c] $n = 2,431$, [d] $n = 363$, [e] $n = 789$, [f] $n = 1,750$.

Appendix B

Correlations between all relevant constructs used in the present study

Table B.1

Correlations Between all Variables Included in the Present Study

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. DA t_2																				
2. DA t_3	.13***																			
3. SH t_2	-.22***	-.08***																		
4. SH t_3	-.11***	-.15***	.40***																	
5. SL t_1	-.07***	-.03	.16***	.13***																
6. SL t_2	-.11**	-.08**	.45***	.26***	.30***															
7. SL t_3	-.07**	-.11***	.27***	.43***	.20***	.40***														
8. SS t_1	-.06**	-.06**	.13***	.11***	.57***	.25***	.15***													
9. SS t_2	-.11***	-.09***	.27***	.17***	.19***	.50***	.27***	.29***												
10. SS t_3	-.08***	-.12***	.19***	.25***	.11***	.25***	.52***	.16***	.38***											
11. HG t_2	.06**	.09***	-.13***	-.09***	-.15***	-.27***	-.13***	-.21***	-.36***	-.21***										
12. HG t_3	.04	.06**	-.08***	-.06**	-.08***	-.14***	-.12***	-.16***	-.22***	-.26***	.37***									
13. HM t_2	.10***	.08***	-.12***	-.08***	-.13***	-.21***	-.15***	-.17***	-.32***	-.22***	.34***	.13***								
14. HM t_3	.05*	.12***	-.09***	-.11***	-.04	-.13***	-.16***	-.09***	-.21***	-.30***	.08***	.16***	.38***							
15. MC t_1	-.12***	-.12***	.02	-.00	.06**	.00	-.00	.11***	.14***	.10***	-.13***	-.08***	-.25***	-.21***						
16. MC t_2	-.10***	-.11***	.05***	.03	.07***	.03	.02	.11***	.13***	.14***	-.17***	-.06***	-.28***	-.22***	.73***					
17. MC t_3	-.10***	-.13***	.05**	.02	.06**	.01	-.00	.10***	.14***	.16***	-.15***	-.07***	-.28***	-.27***	.70***	.73***				
18. RC t_1	-.10***	-.07***	-.00	-.05*	.07***	-.01	-.05*	.11***	.13***	.07***	-.23***	-.17***	-.16***	-.07***	.62***	.56***	.55***			
19. RC t_2	-.09***	-.09***	.03	-.02	.11***	.06**	.02	.11***	.19***	.14***	-.27***	-.16***	-.19***	-.11***	.54***	.61***	.57***	.61***		
20. RC t_3	-.07***	-.08***	.01	-.02	.06**	.01	-.02	.12***	.17***	.12***	-.25***	-.21***	-.20***	-.14***	.53***	.53***	.60***	.61***	.63***	
21. Gender	-.04**	.01	-.01	-.10***	.04	.01**	-.03	.07***	.07***	.03	-.13***	-.15***	.10***	.13***	-.12***	-.14***	-.12***	.06***	.10***	.10***

Notes. DA = Days of absence from school, SH = Self-estimated health, SL = Satisfaction with life, SS = Satisfaction with school, HG = Helplessness German, HM = Helplessness Math, MC = Mathematical competence, RC = Reading competence, t_1 = measurement in grade 5, t_2 = measurement in grade 7, t_3 = measurement in grade 9. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$

Appendix C

In the following you can see the intraclass correlation coefficients (ICC) for the variables we used in our analyses. Sample sizes differed depending on the number of measurement time points used in the respective analysis. Therefore, ICC's are displayed once for variables included in the analysis over three points of measurement (see Table C1) and once for the variables included in the analyses over two points if measurement (see Table C2). As can be seen from the tables the ICC values of the variables mathematical competence and reading comprehension are very high. This is not a surprising finding because the cluster variable contains schools from different types of school and those should vary highly on academic achievement.

Table C.1

ICC Values of Variables Included in the Analysis Over t_1 to t_3

	t_1	t_2	t_3
Satisfaction with life	.04	.05	.03
Satisfaction with school	.06	.03	.03
Mathematical competence	.41	.41	.38
Reading comprehension	.31	.31	.33

Table C.2

ICC Values of Variables Included in the Analysis Over t_2 to t_3

	t_2	t_3
Days of absence from school	.03	.02
Self-estimated health	.03	.02
Helplessness German	.07	.03
Helplessness Math	.06	.05
Mathematical competence	.41	.38
Reading comprehension	.32	.33

Appendix D

Measurement invariance of the helplessness scale had to be tested between different points of measurement, as well as between sexes and types of school. Therefore, we started by testing measurement invariance between different occasions. More precisely, we first checked measurement invariance between points of measurement considering all individuals and afterwards by focusing on different groups of gender and type of school (see Table D1). Subsequently, we tested measurement invariance between different sexes and types of school for single points of measurement (see Table D2). Configural invariance over points of measurement was achieved through excluding items 4 ("When my teacher calls me surprisingly in German I cannot answer even the simplest questions") and 5 ("No matter if I try to do my homework in German, I always make many mistakes") of the subscale helplessness German and 1 ("No matter how much I try in Math, my grades won´t get better") and 2 ("It's not worth practicing mathematics for a class test, I will be bad again") of the subscale helplessness Math. Tables D1 and D2 show that – according to ΔCFI – metric invariance could be assumed for the helplessness scale.

Table D.1

Examination of Measurement Invariance of the Helplessness Scale over Points of

Measurement

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	Comparison	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
Overall:										
1. configural	216.66	42	<.001	.989/0.982	.039/.025					
2. metric	237.89	46	<.001	.987/0.982	.039/.027	2 vs. 1	.002	21.23	4	<.001
3. scalar	295.90	52	<.001	.984/0.980	.041/.028	3 vs. 2	.003	62.63	6	<.001
4. residual	302.44	58	<.001	.983/0.981	.040/.028	4 vs. 2	.004	64.23	12	<.001
Gender = male[a]:										
1. configural	114.68	42	<.001	.990/0.984	.036/.025					
2. metric	129.82	46	<.001	.989/0.984	.037/.028	2 vs. 1	.001	15.04	4	<.01
3. scalar	160.80	52	<.001	.985/0.981	.040/.029	3 vs. 2	.004	33.87	6	<.001
4. residual	162.31	58	<.001	.985/0.983	.038/.028	4 vs. 2	.004	32.68	12	<.01
Gender = female[b]:										
1. configural	147.27	42	<.001	.987/0.979	.042/.027					
2. metric	155.09	46	<.001	.986/0.980	.041/.029	2 vs. 1	.001	8.02	4	.091
3. scalar	187.60	52	<.001	.983/0.978	.042/.031	3 vs. 2	.003	34.08	6	<.001
4. residual	193.56	58	<.001	.982/0.979	.041/.032	4 vs. 2	.004	38.75	12	<.001
Type of school = „Hauptschule"[c]:										
1. configural	85.71	42	<.001	.978/0.966	.056/.039					
2. metric	92.93	46	<.001	.977/0.967	.055/.041	2 vs. 1	.001	7.05	4	.134
3. scalar	108.87	52	<.001	.973/0.965	.057/.047	3 vs. 2	.004	16.52	6	<.05
4. residual	118.15	58	<.001	.969/0.965	.057/.046	4 vs. 2	.008	25.09	12	<.05
Type of school = „Realschule"[d]:										
1. configural	105.21	42	<.001	.985/0.977	.044/.029					
2. metric	111.60	46	<.001	.985/0.978	.043/.030	2 vs. 1	.000	6.59	4	.159
3. scalar	127.40	52	<.001	.983/0.978	.043/.030	3 vs. 2	.002	16.01	6	<.05
4. residual	144.96	58	<.001	.979/0.976	.045/.031	4 vs. 2	.006	32.83	12	<.01
Type of school = „Gymnasium"[e]:										
1. configural	134.45	42	<.001	.990/0.984	.036/.025					
2. metric	156.61	46	<.001	.988/0.982	.038/.029	2 vs. 1	.002	21.76	4	<.001
3. scalar	258.28	52	<.001	.978/0.972	.048/.038	3 vs. 2	.010	113.14	6	<.001
4. residual	263.65	58	<.001	.976/0.973	.047/.039	4 vs. 2	.012	97.69	12	<.001

Notes. $N = 4,180$. χ^2 = Chi-Square, df = degrees of freedom. CFI= Comparative Fit Index. TLI = Tucker-Lewis index. RMSEA = Root mean square error of approximation. SRMR = Standardized root mean square residual. $p(\Delta\chi^2)$-values are calculated based on the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 1999).
[a] $n = 2,109$, [b] $n = 2,071$, [c] $n = 583$, [d] $n = 1,166$, [e] $n = 2,431$,

Table D.2

Examination of Measurement Invariance of the Helplessness Scale over Gender and Types of

School on Single Occasions

Modell	χ^2	*df*	*p*	CFI/TLI	RMSEA/ SRMR	Comparison	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
Over gender on t_2:										
1. configural	121.01	16	<.001	.985/0.971	.070/.030					
2. metric	134.76	20	<.001	.984/0.976	.064/.032	2 vs. 1	.001	8.19	4	.085
3. scalar	277.86	26	<.001	.967/0.962	.081/.059	3 vs. 2	.017	171.49	6	<.001
4. residual	286.95	32	<.001	.963/0.965	.077/.060	4 vs. 2	.021	147.21	12	<.001
Over gender on t_3:										
1. configural	68.59	16	<.001	.993/0.987	.048/.023					
2. metric	76.04	20	<.001	.993/0.989	.044/.026	2 vs. 1	.000	7.48	4	.112
3. scalar	224.53	26	<.001	.975/0.971	.071/.064	3 vs. 2	.018	172.34	6	<.001
4. residual	229.79	32	<.001	.972/0.974	.068/.065	4 vs. 2	.021	143.07	12	<.001
Over types of school on t_2:										
1. configural	111.16	24	<.001	.987/0.976	.063/.029					
2. metric	127.45	32	<.001	.986/0.981	.056/.031	2 vs. 1	.001	13.46	8	.097
3. scalar	289.95	44	<.001	.968/0.967	.074/.074	3 vs. 2	.018	200.59	12	<.001
4. residual	383.42	56	<.001	.952/0.962	.080/.077	4 vs. 2	.034	251.47	24	<.001
Over types of school on t_3:										
1. configural	73.26	24	<.001	.993/0.988	.047/.023					
2. metric	87.51	32	<.001	.993/0.990	.043/.027	2 vs. 1	.000	13.59	8	.093
3. scalar	161.57	44	<.001	.986/0.985	.051/.040	3 vs. 2	.007	82.95	12	<.001
4. residual	175.97	56	<.001	.983/0.986	.049/.044	4 vs. 2	.010	78.45	24	<.001

Notes. $N = 4{,}180$. χ^2 = Chi-Square, *df* = degrees of freedom. CFI= Comparative Fit Index. TLI = Tucker-Lewis index. RMSEA = Root mean square error of approximation. SRMR = Standardized root mean square residual. $p(\Delta\chi^2)$-values are calculated based on the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 1999).

Similar to the procedure described above, measurement invariance of the satisfaction scale had to be tested between different points of measurement, as well as between sexes and types of school. Therefore, we started by testing measurement invariance between different occasions. More precisely, we first checked measurement invariance between points of measurement considering all individuals and afterwards by focusing on different groups of gender and type of school (see Table D3). Subsequently, we tested measurement invariance between different sexes and types of school for single points of measurement (see Table D4). Because we were interested in differences between general life satisfaction and satisfaction with school, we excluded one item ("How satisfied are you with your school situation?") and calculated measurement invariance for the remaining 5 items. As can be seen from Tables D3 and D4 – according to ΔCFI – at least configural invariance was given for the satisfaction scale. Furthermore, metric invariance was given for most measurement invariance analyses, as well. Only the measurement invariance analyses of female students over points of measurement and students attending "Hauptschule" over points of measurement represented an exception of this.

Table D.3

Examination of Measurement Invariance of the Satisfaction Scale over Points of

Measurement

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	Comparison	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
Overall:										
1. configural	151.58	72	<.001	.991/0.986	.028/.026					
2. metric	204.21	80	<.001	.985/0.980	.033/.039	2 vs. 1	.006	47.27	8	<.001
3. scalar	484.99	90	<.001	.953/0.946	.055/.068	3 vs. 2	.032	355.20	10	<.001
4. residual	602.09	100	<.001	.936/0.933	.061/.073	4 vs. 2	.049	339.37	20	<.001
Gender = male[a]:										
1. configural	89.07	72	<.001	.996/0.994	.018/.028					
2. metric	98.89	80	<.001	.996/0.994	.018/.033	2 vs. 1	.000	9.82	8	.278
3. scalar	216.67	90	<.001	.971/0.967	.044/.056	3 vs. 2	.025	152.49	10	<.001
4. residual	288.24	100	<.001	.954/0.952	.052/.061	4 vs. 2	.042	164.12	20	<.001
Gender = female[b]:										
1. configural	132.99	72	<.001	.986/0.980	.034/.031					
2. metric	205.88	80	<.001	.970/0.961	.047/.055	2 vs. 1	.016	60.74	8	<.001
3. scalar	401.39	90	<.001	.928/0.916	.069/.088	3 vs. 2	.042	231.15	10	<.001
4. residual	511.66	100	<.001	.895/0.890	.079/.096	4 vs. 2	.075	252.25	20	<.001
Type of school = „Hauptschule"[c]:										
1. configural	80.16	72	<.001	.992/0.989	.024/.049					
2. metric	100.66	80	<.001	.981/0.975	.037/.065	2 vs. 1	.011	20.61	8	<.01
3. scalar	125.96	90	<.001	.968/0.962	.045/.065	3 vs. 2	.013	27.87	10	<.01
4. residual	170.53	100	<.001	.931/0.928	.063/.076	4 vs. 2	.050	61.86	20	<.001
Type of school = „Realschule"[d]:										
1. configural	96.38	72	<.001	.991/0.986	.028/.032					
2. metric	125.22	80	<.001	.982/0.977	.037/.049	2 vs. 1	.009	27.36	8	<.001
3. scalar	187.96	90	<.001	.963/0.957	.051/.061	3 vs. 2	.019	78.09	10	<.001
4. residual	252.07	100	<.001	.937/0.934	.063/.069	4 vs. 2	.045	112.81	20	<.001
Type of school = „Gymnasium"[e]:										
1. configural	123.11	72	<.001	.990/0.985	.028/.031					
2. metric	153.34	80	<.001	.985/0.980	.033/.042	2 vs. 1	.005	26.04	8	<.01
3. scalar	452.76	90	<.001	.925/0.913	.068/.097	3 vs. 2	.060	356.85	10	<.001
4. residual	569.01	100	<.001	.895/0.890	.076/.105	4 vs. 2	.090	343.28	20	<.001

Notes. $N = 2,902$. χ^2 = Chi-Square, df = degrees of freedom. CFI= Comparative Fit Index. TLI = Tucker-Lewis index. RMSEA = Root mean square error of approximation. SRMR = Standardized root mean square residual. $p(\Delta\chi^2)$-values are calculated based on the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 1999).
[a] $n = 2,109$, [b] $n = 2,071$, [c] $n = 583$, [d] $n = 1,166$, [e] $n = 2,431$,

Table D.4

Examination of Measurement Invariance of the Satisfaction Scale over Gender and Types of

School on Single Occasions

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	Comparison	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
Over gender on t_1:										
1. configural	30.05	10	<.001	.991/0.982	.056/.018					
2. metric	34.71	14	<.001	.991/0.987	.048/.025	2 vs. 1	.000	4.16	4	.385
3. scalar	46.33	19	<.001	.989/0.989	.044/.030	3 vs. 2	.002	11.07	5	.050
4. residual	66.78	24	<.001	.978/0.982	.055/.043	4 vs. 2	.013	31.07	10	<.001
Over gender on t_2:										
1. configural	22.47	10	<.001	.993/0.986	.041/.016					
2. metric	41.56	14	<.001	.985/0.979	.051/.037	2 vs. 1	.008	19.55	4	<.001
3. scalar	72.77	19	<.001	.974/0.973	.058/.042	3 vs. 2	.011	41.53	5	<.001
4. residual	79.09	24	<.001	.971/0.976	.054/.049	4 vs. 2	.014	38.04	10	<.001
Over gender on t_3:										
1. configural	22.19	10	<.001	.995/0.990	.045/.014					
2. metric	28.77	14	<.001	.994/0.992	.041/.024	2 vs. 1	.001	6.19	4	.186
3. scalar	68.45	19	<.001	.984/0.983	.059/.035	3 vs. 2	.010	62.28	5	<.001
4. residual	84.50	24	<.001	.979/0.982	.061/.040	4 vs. 2	.015	59.79	10	<.001
Over types of school on t_1:										
1. configural	31.32	15	<.001	.993/0.985	.048/.015					
2. metric	53.21	23	<.001	.987/0.983	.051/.035	2 vs. 1	.006	22.34	8	<.01
3. scalar	113.52	33	<.001	.971/0.974	.064/.065	3 vs. 2	.016	89.17	10	<.001
4. residual	278.24	43	<.001	.842/0.890	.131/.098	4 vs. 2	.145	298.12	20	<.001
Over types of school on t_2:										
1. configural	26.50	15	<.001	.994/0.988	.039/.017					
2. metric	34.44	23	<.001	.994/0.992	.031/.025	2 vs. 1	.000	7.88	8	.445
3. scalar	54.27	33	<.001	.990/0.991	.033/.032	3 vs. 2	.004	22.62	10	<.05
4. residual	117.66	43	<.001	.963/0.974	.056/.046	4 vs. 2	.031	87.79	20	<.001
Over types of school on t_3:										
1. configural	25.08	15	<.001	.996/0.992	.040/.014					
2. metric	33.02	23	<.001	.997/0.995	.031/.022	2 vs. 1	-.001	6.84	8	.554
3. scalar	55.92	33	<.001	.993/0.994	.036/.030	3 vs. 2	.004	28.18	10	<.01
4. residual	80.01	43	<.001	.988/0.991	.042/.039	4 vs. 2	.109	47.90	20	<.001

Notes. $N = 2,902$. χ^2 = Chi-Square, df = degrees of freedom. CFI= Comparative Fit Index. TLI = Tucker-Lewis index. RMSEA = Root mean square error of approximation. SRMR = Standardized root mean square residual. $p(\Delta\chi^2)$-values are calculated based on the Satorra-Bentler scaled chi-square difference test (Satorra & Bentler, 1999).

Appendix E

Structural equation models for the examination of moderating effects by gender on the reciprocal relation between physical well-being and academic achievement

Figure E.1

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9
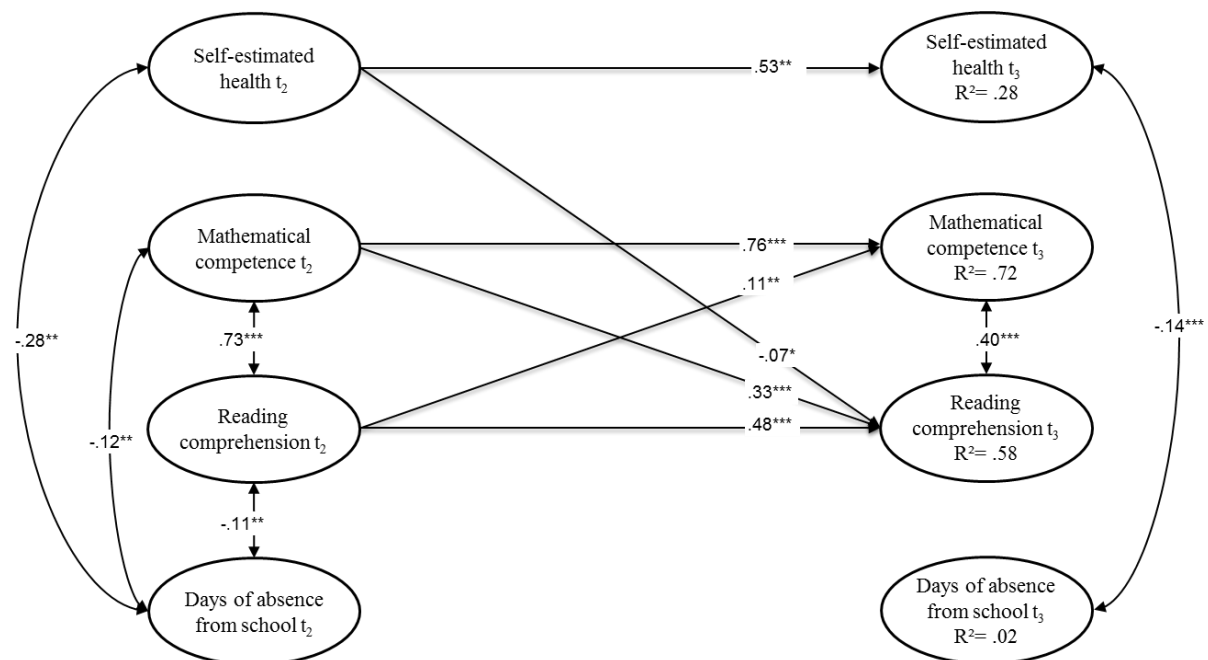
Notes. Sex = male. $N = 2100$. Fit measures are not reported because the model is saturated. All latent variables are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure E.2

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and

Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9
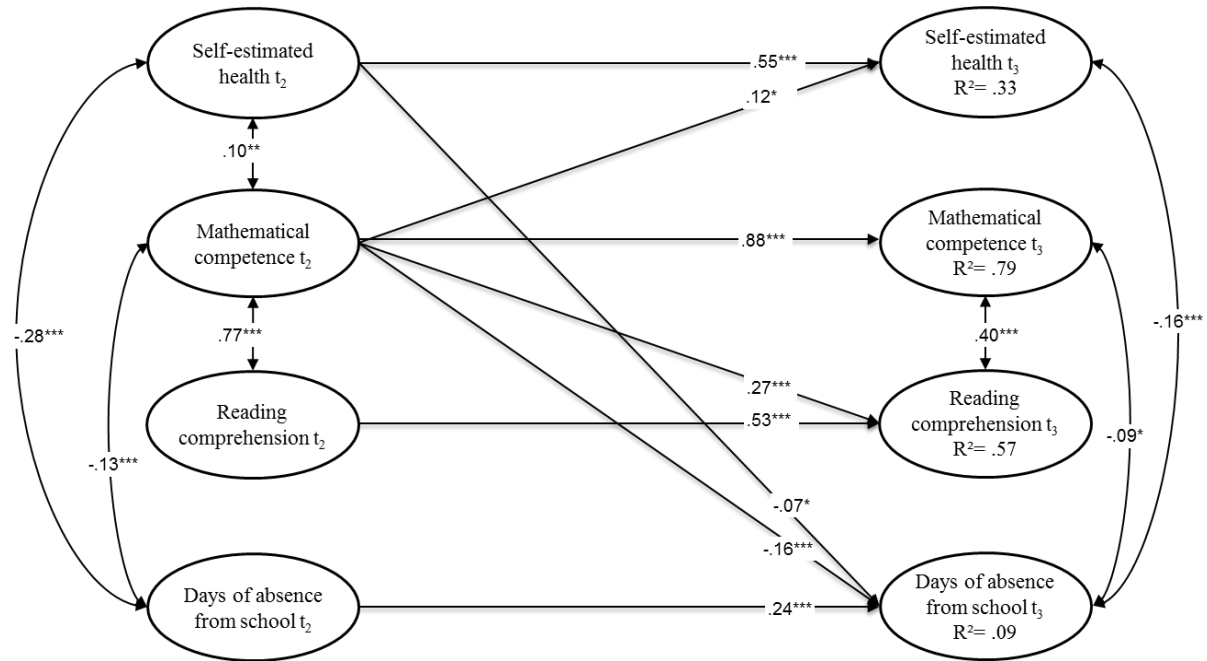
Notes. Sex = female. *N* = 2059. Fit measures are not reported because the model is saturated.

All latent variables are measured by single indicators which have not been included in the

figure. Only statistically significant paths are shown.

Significance codes: * *p* < .05, ** *p* < .01, *** *p* < .001.

Appendix F

Structural equation models for the examination of moderating effects by type of school on the reciprocal relation between physical well-being and academic achievement

Figure F.1

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9

Notes. Type of School = "Hauptschule" (lowest track of German secondary school system).

$N = 577$. Fit measures are not reported because the model is saturated. All latent variables are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure F.2

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and

Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9
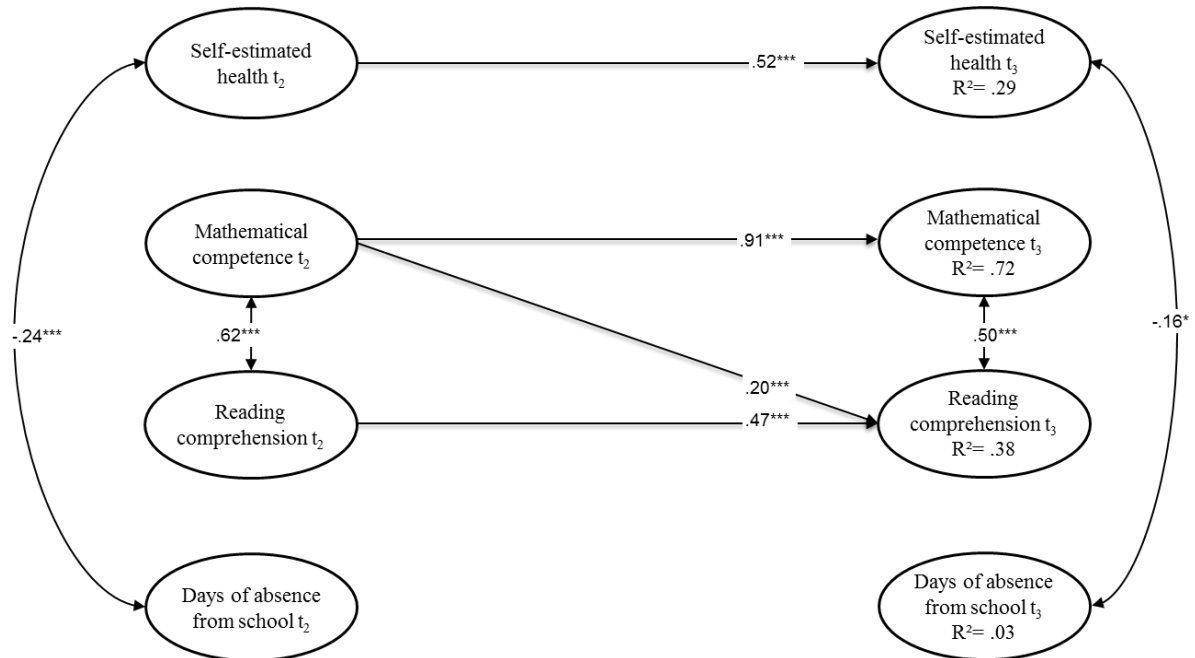
Notes. Type of School = "Realschule" (intermediate track of German secondary school

system). $N = 1162$. Fit measures are not reported because the model is saturated. All latent

variables are measured by single indicators which have not been included in the figure. Only

statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure F.3

Reciprocal Relations Between Physical Well-Being (Measured by Self-Estimated Health and Days of Absence from School) and Academic Achievement from Grade 7 to Grade 9
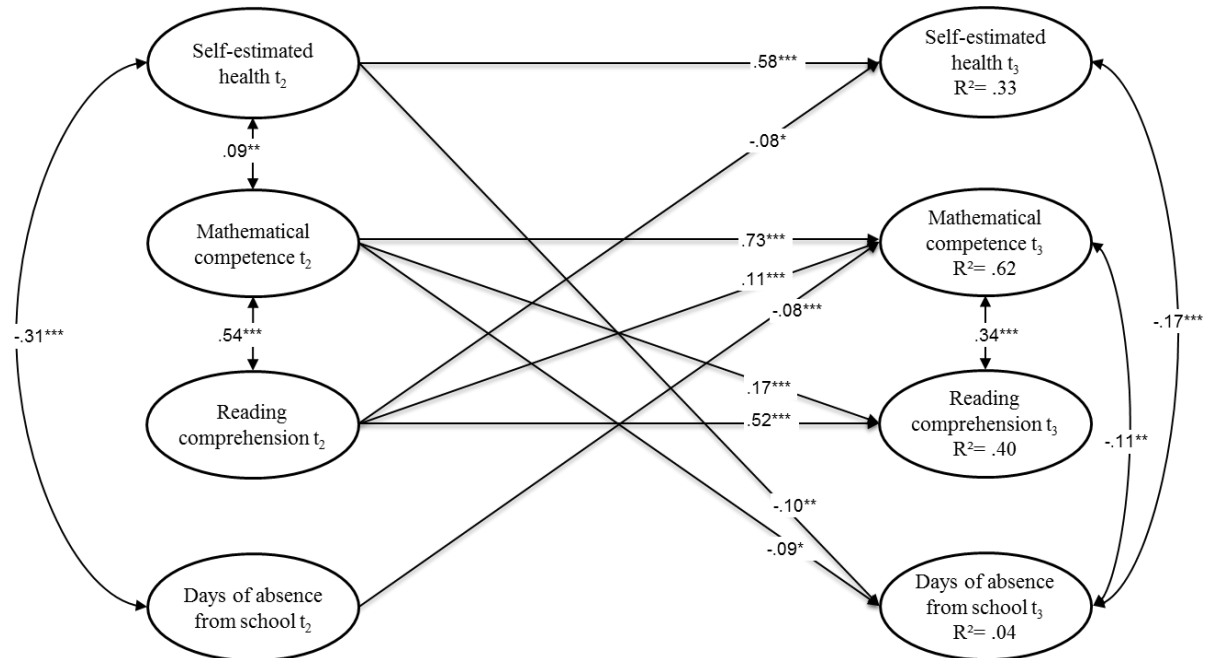
Notes. Type of School = "Gymnasium" (highest track of German secondary school system). $N = 2420$. Fit measures are not reported because the model is saturated. All latent variables are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix G

Structural equation models for the examination of moderating effects by gender on the

reciprocal relation between cognitive well-being and academic achievement

Figure G.1

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction

and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
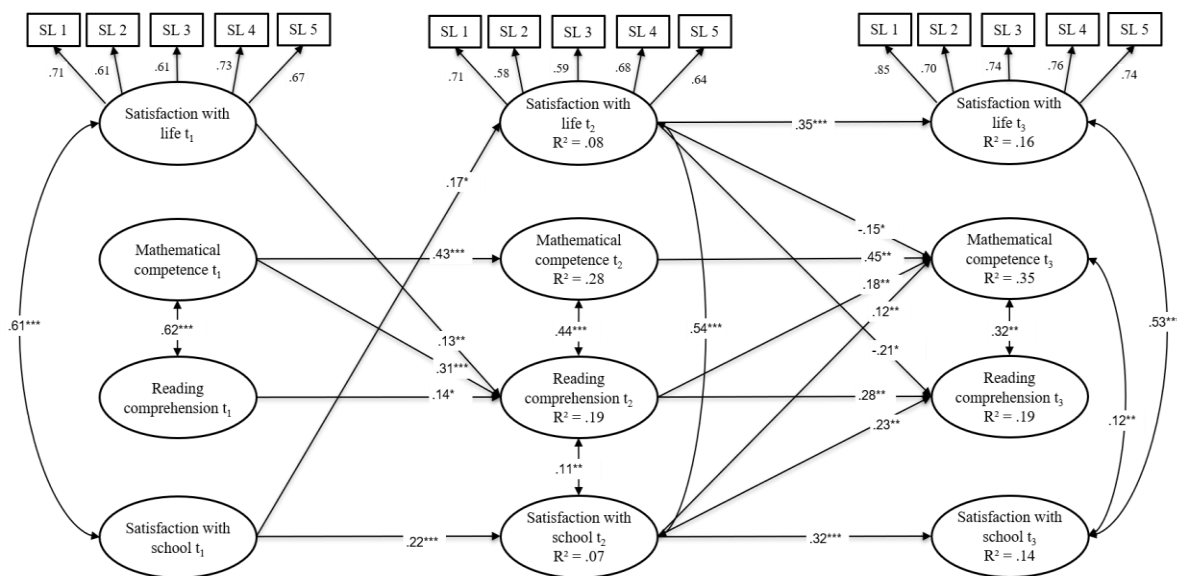
Notes. Sex = male. N = 1458. $\chi^2(187)$ = 279.73, AIC = 117852.80, BIC = 118576.82,

CFI = .991, TLI = 0.987, RMSEA = .022 SRMR = .024. Variables "Mathematical

competence", "Reading comprehension" and "Satisfaction with school" are measured by

single indicators which have not been included in the figure. Latent variables that model

random intercepts have not been included in the figure for clarity purposes. Only statistically

significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure G.2

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
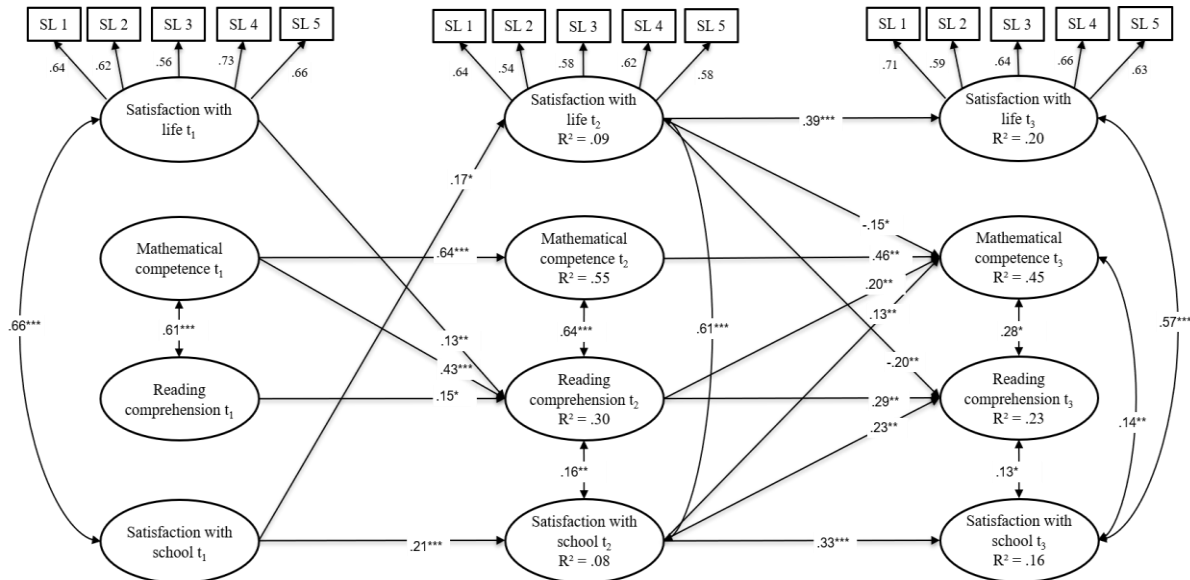
Notes. Sex = female. N = 1441. $\chi^2(187)$ = 429.22, AIC = 113682.45, BIC = 114404.87, CFI = .977, TLI = 0.967, RMSEA = .035 SRMR = .035. Variables "Mathematical competence", "Reading comprehension" and "Satisfaction with school" are measured by single indicators which have not been included in the figure. Latent variables that model random intercepts have not been included in the figure for clarity purposes. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix H

Structural equation models for the examination of moderating effects by type of school

on the reciprocal relation between cognitive well-being and academic achievement

Figure H.1

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction

and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
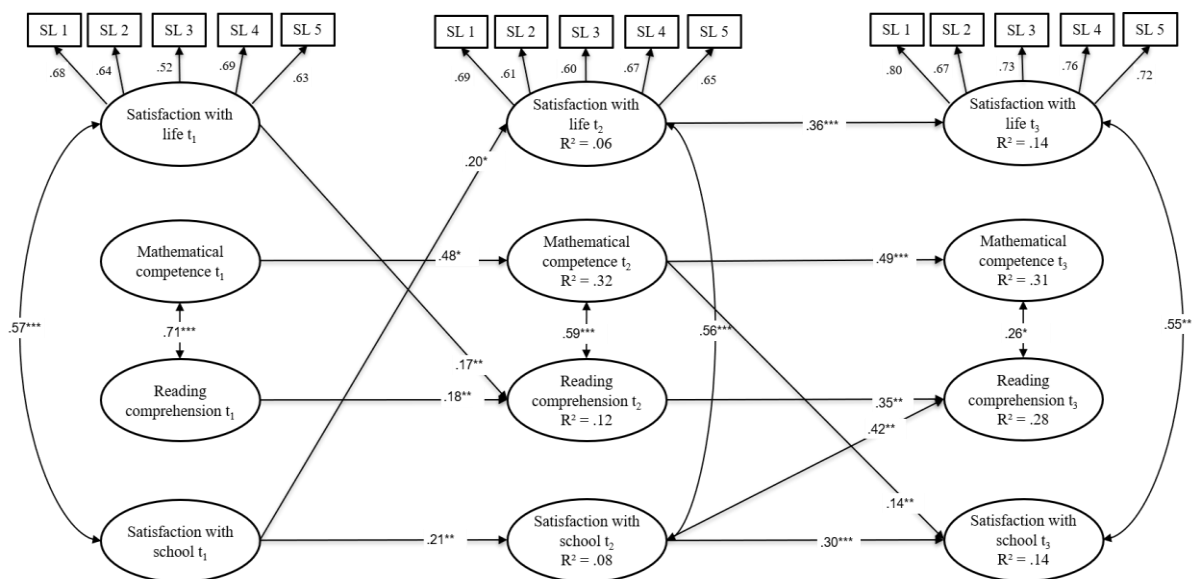
Notes. Type of school = "Hauptschule" (lowest track of German secondary school system).

$N = 363$. $\chi^2(187) = 235.65$, AIC = 29320.07, BIC = 29853.60, CFI = .981, TLI = 0.971,

RMSEA = .029 SRMR = .038. Variables "Mathematical competence", "Reading

comprehension" and "Satisfaction with school" are measured by single indicators which have

not been included in the figure. Latent variables that model random intercepts have not been

included in the figure for clarity purposes. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure H.2

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction

and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
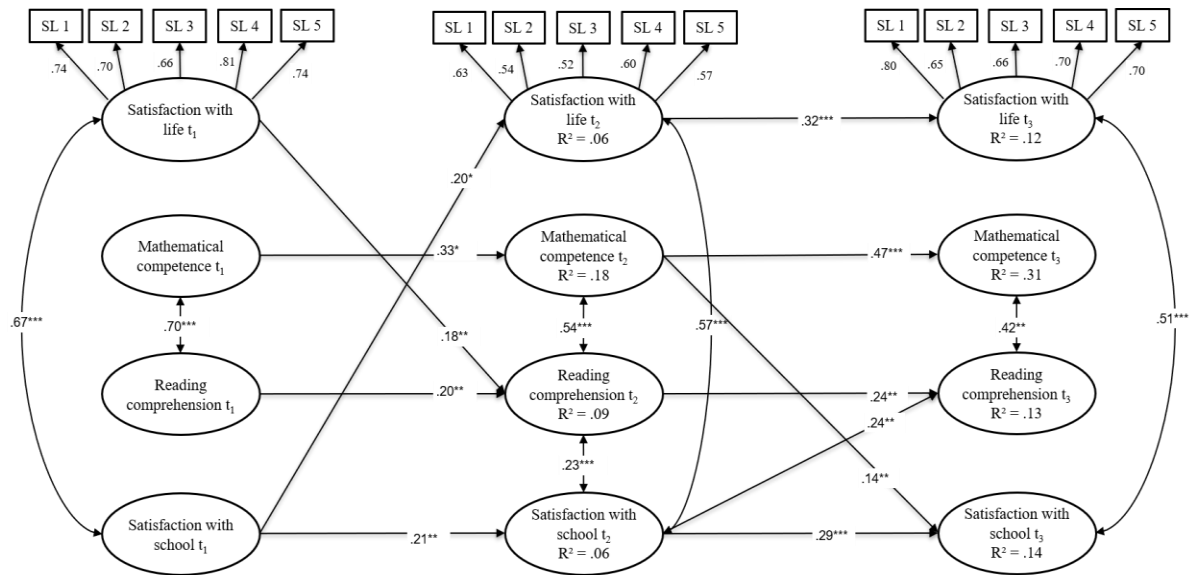
Notes. Type of school = "Realschule" (intermediate track of German secondary school

system). $N = 788$. $\chi^2(187) = 279.53$, AIC = 63884.19, BIC = 64523.92, CFI = .984,

TLI = 0.976, RMSEA = .028 SRMR = .032. Variables "Mathematical competence",

"Reading comprehension" and "Satisfaction with school" are measured by single indicators

which have not been included in the figure. Latent variables that model random intercepts

have not been included in the figure for clarity purposes. Only statistically significant paths

are shown. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure H.3

Reciprocal Relations Between Cognitive Well-Being (Measured by General Life Satisfaction and Satisfaction with School) and Academic Achievement from Grade 7 to Grade 9
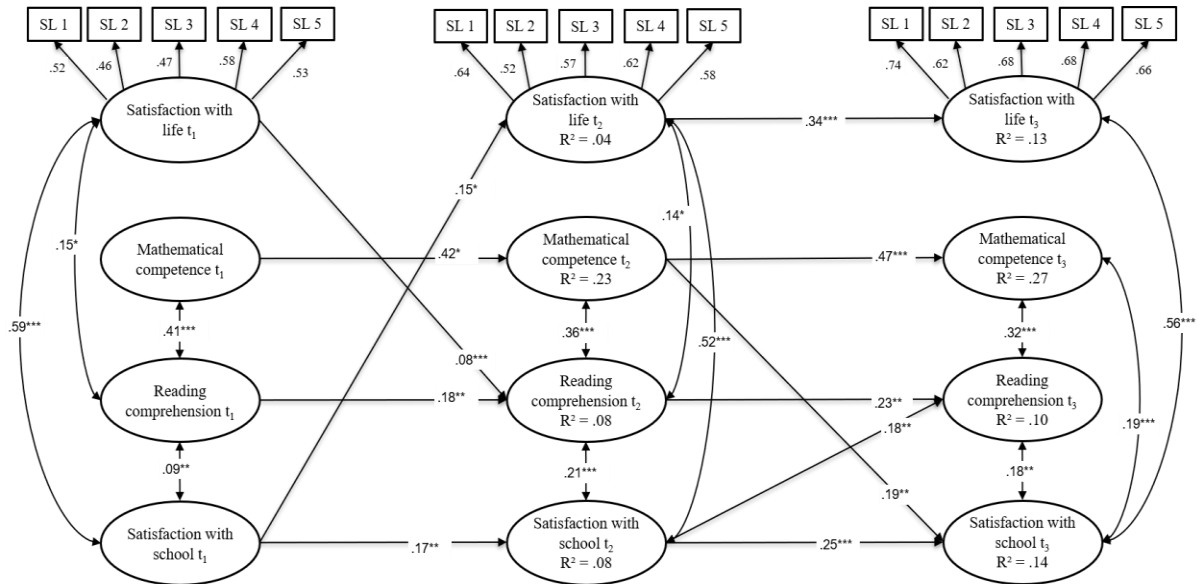
Notes. Type of school = "Gymnasium" (highest track of German secondary school system). $N = 1748$. $\chi^2(187) = 382.40$, AIC = 135958.52, BIC = 136707.40, CFI = .980, TLI = 0.972, RMSEA = .029 SRMR = .030. Variables "Mathematical competence", "Reading comprehension" and "Satisfaction with school" are measured by single indicators which have not been included in the figure. Latent variables that model random intercepts have not been included in the figure for clarity purposes. Only statistically significant paths are shown. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix I

Structural equation models for the examination of moderating effects by gender on the reciprocal relation between emotional well-being and academic achievement

Figure I.1

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School Subjects "German" and "Mathematics", Respectively) and Academic Achievement from Grade 7 to Grade 9
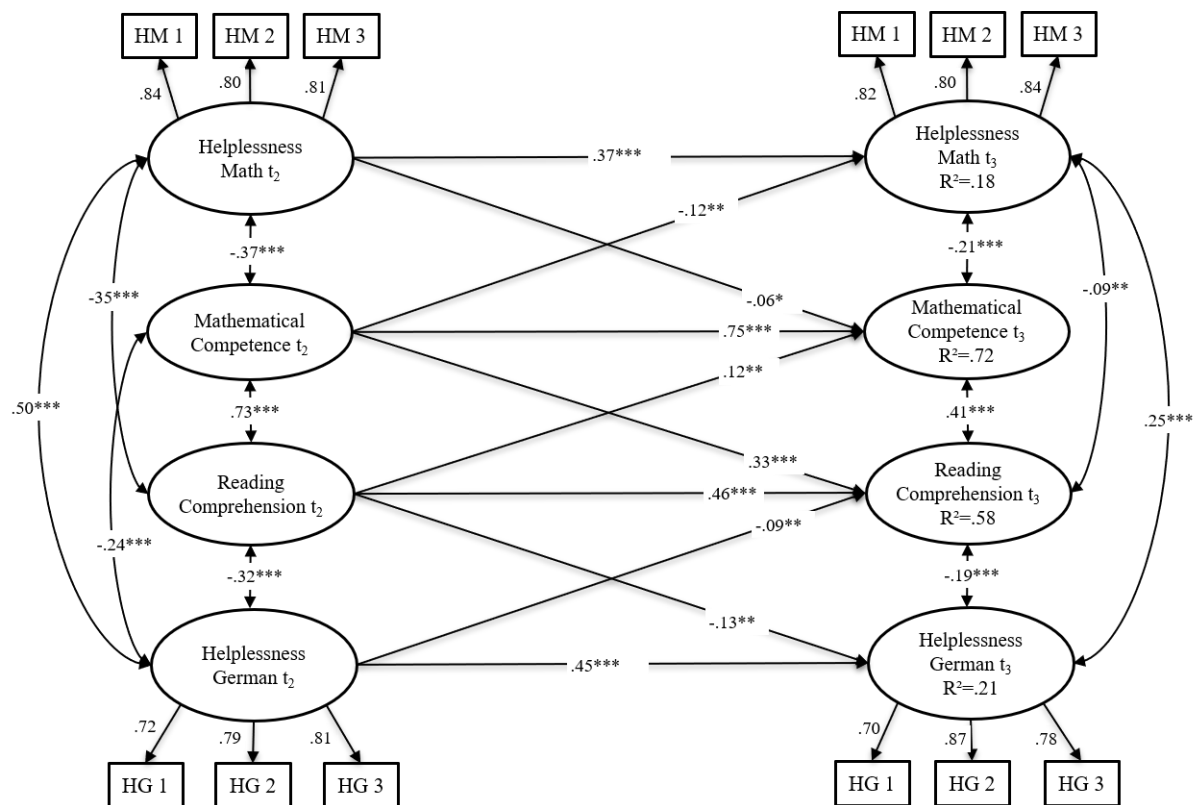
Notes. Sex = male. N = 2100. $\chi^2(80)$ =223.86, AIC = 66547.67, BIC = 66954.46, CFI = .988, TLI = 0.983, RMSEA = .032, SRMR = .026. Variables "Mathematical competence" and "Reading comprehension" are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure I.2

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School Subjects "German" and "Mathematics", Respectively) and Academic Achievement from Grade 7 to Grade 9
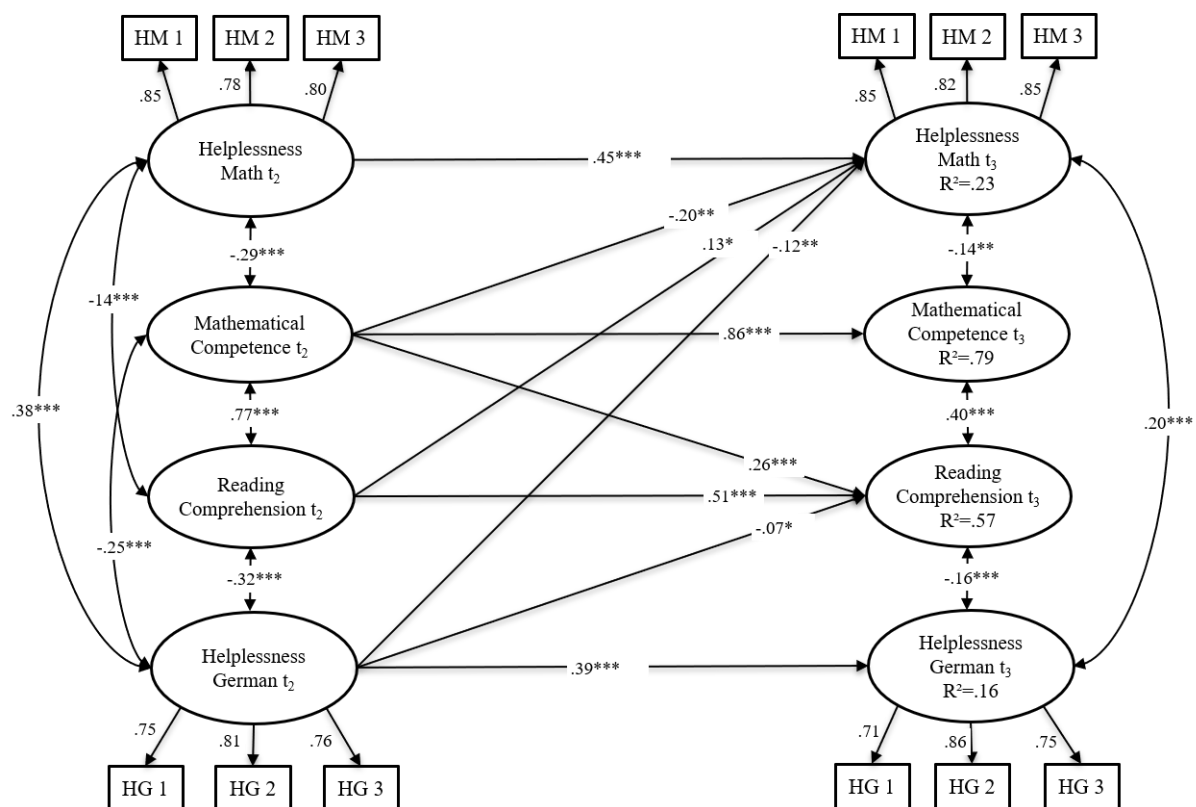
Notes. Sex = female. N = 2059. $\chi^2(80)$ =228.23, AIC = 63460.65, BIC = 63866.00, CFI = .988, TLI = 0.983, RMSEA = .031, SRMR = .022. Variables "Mathematical competence" and "Reading comprehension" are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * p < .05, ** p < .01, *** p < .001.

Appendix J

Structural equation models for the examination of moderating effects by type of school

on the reciprocal relation between emotional well-being and academic achievement

Figure J.1

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School

Subjects "German" and "Mathematics", Respectively) and Academic Achievement from

Grade 7 to Grade 9
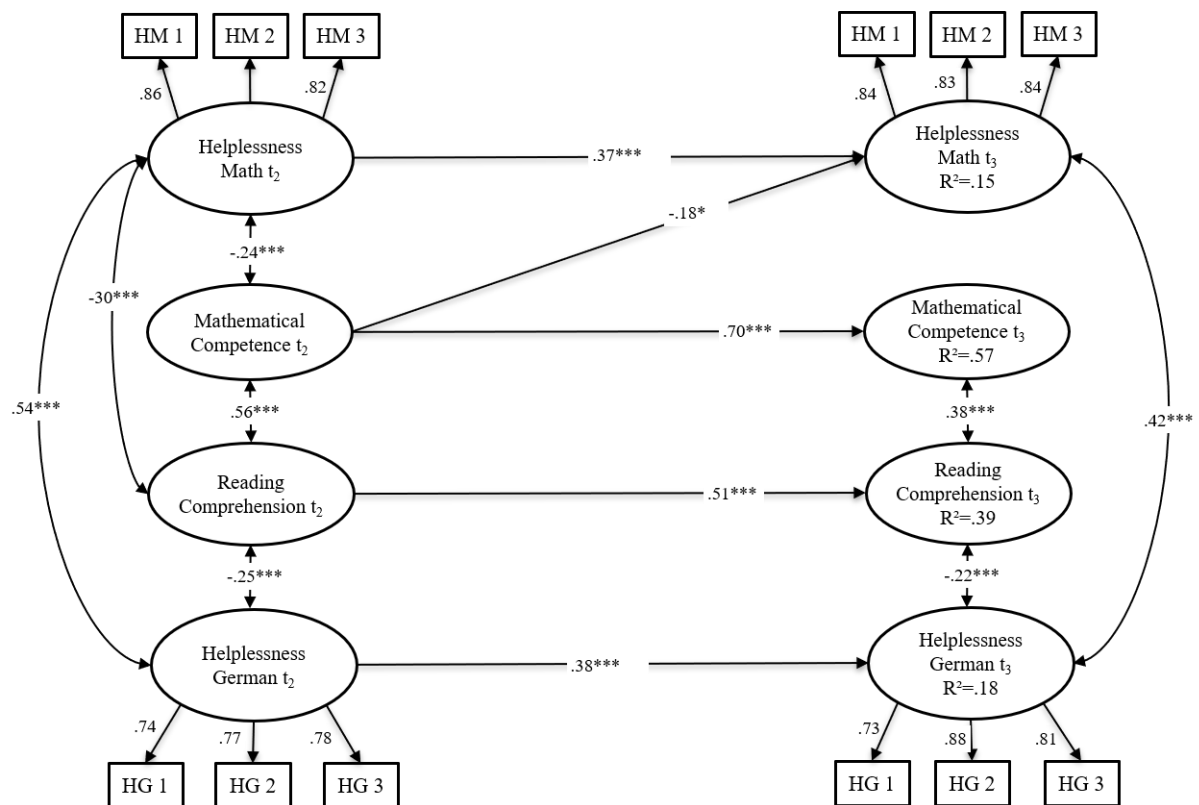
Notes. Type of school = "Hauptschule" (lowest track of German secondary school system).

$N = 577$. $\chi^2(80) = 104.68$, AIC = 17665.57, BIC = 17979.33, CFI = .991, TLI = 0.987,

RMSEA = .024, SRMR = .030. Variables "Mathematical competence" and "Reading

comprehension" are measured by single indicators which have not been included in the

figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure J.2

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School Subjects "German" and "Mathematics", Respectively) and Academic Achievement from Grade 7 to Grade 9
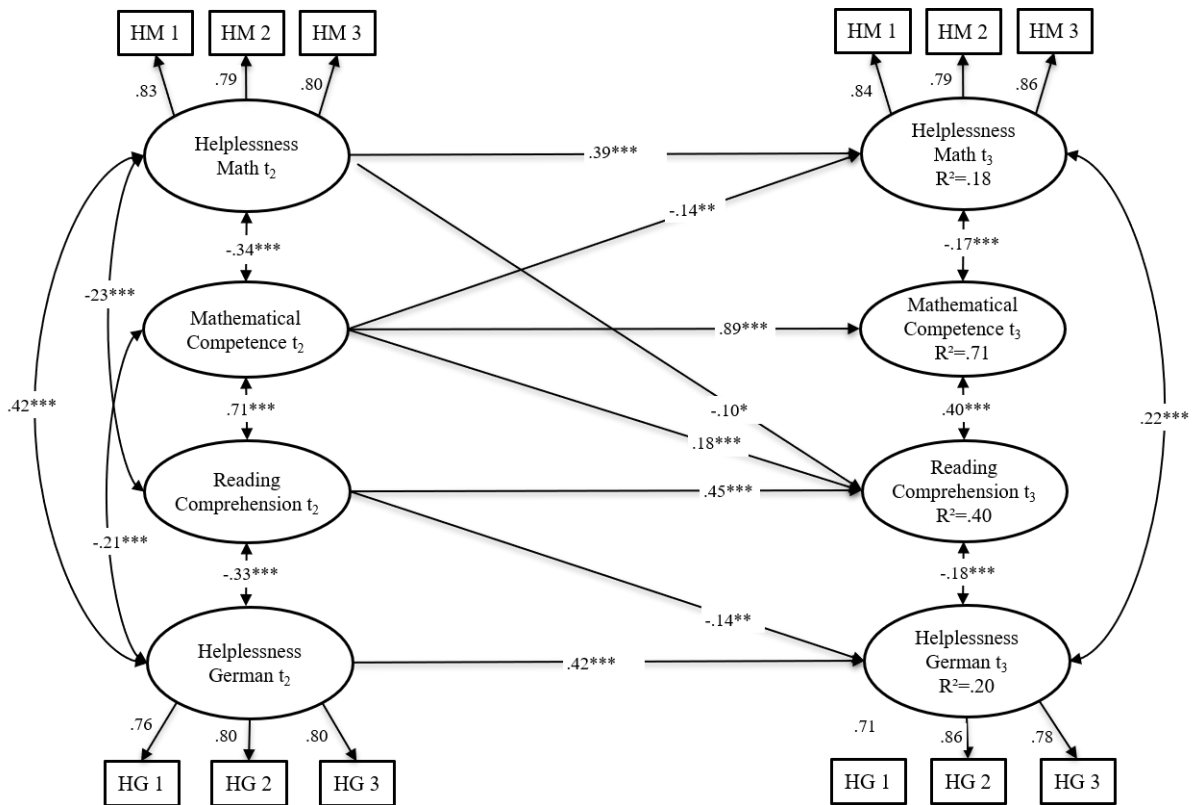
Notes. Type of school = "Realschule" (intermediate track of German secondary school system). $N = 1162$. $\chi^2(80) = 159.17$, AIC = 36065.55, BIC = 36429.72, CFI = .988, TLI = 0.981, RMSEA = .031, SRMR = .023. Variables "Mathematical competence" and "Reading comprehension" are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown.

Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure J.3

Reciprocal Relations Between Emotional Well-Being (Measured by Helplessness in School Subjects "German" and "Mathematics", Respectively) and Academic Achievement from Grade 7 to Grade 9
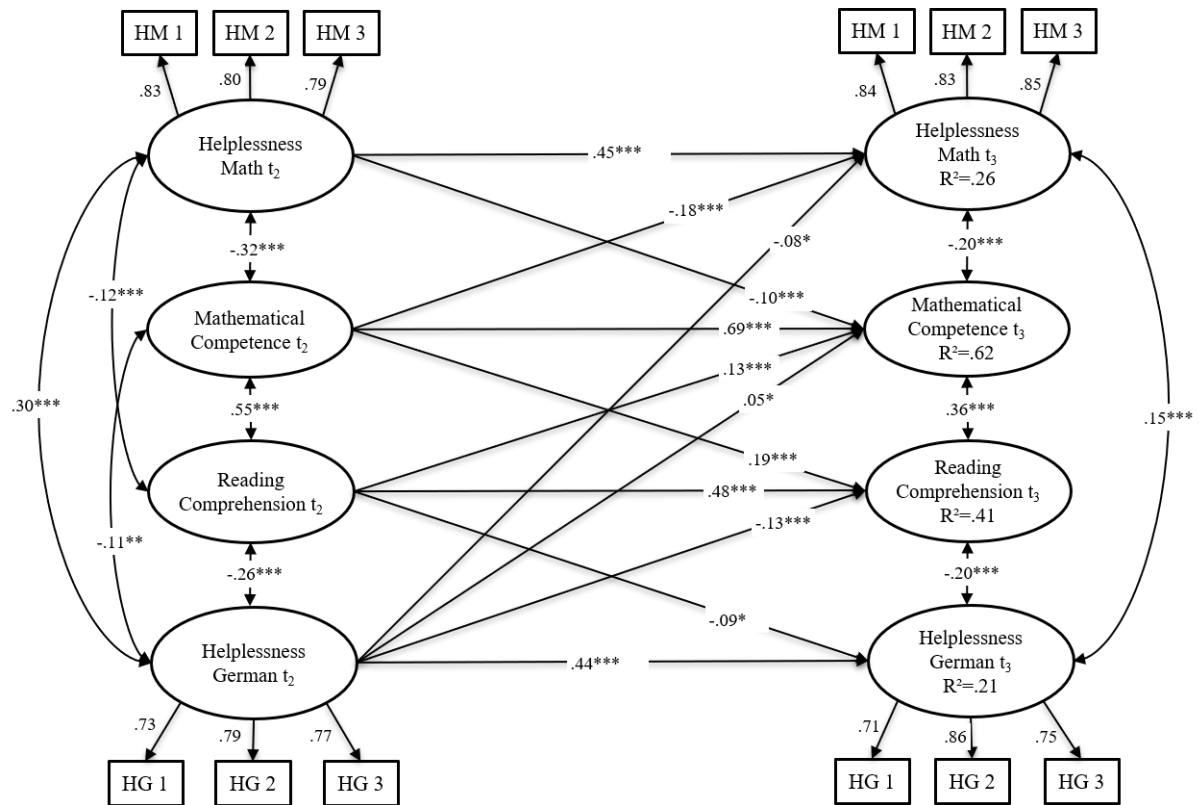
Notes. Type of school = "Gymnasium" (highest track of German secondary school system). $N = 2420$. $\chi^2(80) = 228.462$, AIC = 74479.07, BIC = 63866.00, CFI = .988, TLI = 0.983, RMSEA = .029, SRMR = .022. Variables "Mathematical competence" and "Reading comprehension" are measured by single indicators which have not been included in the figure. Only statistically significant paths are shown. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

3.2 Study II: The Longitudinal Development of Students' Well-Being in Adolescence: The Role of Perceived Teacher Autonomy Support

Abstract

Although a decline in adolescents' well-being has repeatedly been reported, longitudinal evidence for this development is rare and time-varying factors like teacher autonomy support that could be associated with this trend have sparsely been investigated. Therefore, the present study examined how the temporal development of perceived autonomy support from their German language arts teachers is related to changes in four different facets of students' well-being. Longitudinal data from 3446 adolescents from Germany ($N_{Schools}$ = 178) on five measurement points (Grades 5–9) was analyzed using latent growth curve models. Satisfaction with school, enjoyment of school, and self-rated health decreased over time, while social integration remained stable. Perceived teacher autonomy support also declined between Grades 5 and 9. Furthermore, baseline levels of perceived teacher autonomy support and facets of well-being were positively related. Finally and most importantly, our results indicated that changes in perceived teacher autonomy support were positively associated with the development of satisfaction with school, enjoyment of school, and self-rated health, but not social integration. The findings suggest that perceived teacher autonomy support plays an important role in the development of students' well-being in adolescence.

Keywords: Adolescence, longitudinal development, students' well-being, teacher autonomy support

1. The Longitudinal Development of Students' Well-Being in Adolescence: The Role of Perceived Teacher Autonomy Support

Numerous studies report a decrease in general (Casas & Gonzalez-Carrasco, 2019; Shek & Liang, 2018) and school-specific (Hagenauer & Hascher, 2010; Tian et al., 2013) well-being during adolescence. According to stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993), this worrisome trend might be at least partly explained by a mismatch between students' needs during the developmental phase and the opportunities provided by the school environment. Students' need for autonomy increases during adolescence due to physical and cognitive changes as well as shifts in and expansions of social relationships (Zimmer-Gembeck & Collins, 2003). As the fulfillment of students' basic psychological needs for competence, relatedness, and autonomy is central for their well-being (cf., Ryan & Deci, 2000), it is important for the school context to provide opportunities for students to satisfy these needs. Autonomy support by teachers can be a means of preventing negative developments in students' well-being. Perceived teacher autonomy support has been empirically shown to address students' basic psychological needs (Yu et al., 2016) and to be positively related to students' well-being (Chirkov & Ryan, 2001; Diseth & Samdal, 2014; Ferguson et al., 2011). According to stage-environment fit theory, the decline in students' well-being might be theoretically explained by the school environment becoming less responsive to students' psychological needs, which would be reflected in a decline in perceived teacher autonomy support. However, existing research is not sufficient to answer this question: First, more longitudinal studies are needed to examine the development of students' well-being during adolescence. Second, a concurrent focus on the temporal development of factors relevant to the satisfaction of students' needs, especially the need for autonomy, could help us learn more about the conditions affecting the development of students' well-being. Therefore, based on stage-environment fit theory, the present study examined whether there is a negative trend in

students' well-being during adolescence and whether it is related to changes in perceived teacher autonomy support.

2. Theoretical Background

2.1 Students' Well-Being

In the past few decades, there has been increasing interest in students' well-being. This burgeoning field of research is based on established conceptualizations of adult well-being (e.g., Diener, 1984, Diener et al., 2018; Ryff, 2014; Ryff & Keyes, 1995). However, scholars within this line of research have argued for an explicit consideration of the school context (Kanonire et al., 2020; Liu et al., 2015; Tobia et al., 2019). This makes sense because children and adolescents spend a lot of time in school, meaning that their well-being is highly dependent on this socialization context. Furthermore, explicitly considering the school context may help to identify weaknesses of the school system when it comes to students' well-being, which could in turn be informative for policymakers (see Kanonire et al., 2020). Students' well-being in school can be broadly defined in terms of emotions and cognitions based on their experiences in school (Hascher, 2008; Putwain et al., 2020; van Petegem et al., 2007). Furthermore, according to Hascher (2008), students' well-being in school is an indicator of a learning environment that supports their cognitive, emotional, and social development and enables them to have a qualitatively good school life. Few models have been presented to operationalize adolescents' school-related well-being (e.g., Hacher, 2004; Long et al., 2012; Renshaw et al., 2015). Hascher (2004, 2008) defined students' well-being in terms of six facets capturing four overarching components: cognitive evaluations (positive attitudes towards school, positive academic self-concept) and emotions related to school (enjoyment of school, absence of worries about school), as well as physical (absence of physical complaints in school) and social (absence of social problems in school) aspects associated with a positive school reality. Drawing upon this model, in the current study, students' well-being was defined as a

multifaceted construct comprising all four overarching components. Students' cognitive evaluation of school was measured by their satisfaction with school, while students' emotions related to this context were measured by their enjoyment of school. In addition, their physical well-being was measured by their self-rated health and their social well-being by the social integration into the school class.

Satisfaction with school can be seen as a "subjective, cognitive appraisal of the overall positivity of school experiences" (Huebner & Gilman, 2006, p. 140). It has been argued to be a key aspect of children's quality of life and to serve as an indicator of their school adjustment (Huebner & Gilman, 2006). Research indicates that it is positively associated with school connectedness (Zullig et al., 2011), academic self-efficacy (Huebner & McCullough, 2000), general life satisfaction (Ferguson et al., 2011; Huebner & Gilman, 2006), and academic achievement (Huebner & Gilman, 2006). Enjoyment of school captures positive feelings and emotions towards school and learning. In the present study, this referred to how much students like going to school and how interested they are in learning at school (Goetz et al., 2006; Gorard & See, 2011). Positive emotions regarding school can affect students' school engagement (Reschly et al., 2008) and are also important for learning, motivation, and achievement (Durlak et al., 2011; Pekrun, 2016). Self-rated health captures the physical facet of students' well-being. Health status is thought to play a critical role in people's reports on their own well-being (Diener et al., 2018). Empirically, physical health has been shown to correlate moderately to strongly with overall well-being and life satisfaction (Butler & Kern, 2016). Furthermore, physical complaints related to school have been found to be associated with higher levels of school reluctance and school absenteeism (Hascher & Hagenauer, 2020). Conversely, the absence of physical complaints related to school has been shown to be associated with higher academic achievement (Obermeier et al., 2021). Social integration is defined here as integration into the class community. Social functioning in the school community can serve as an indicator

for students' well-being (Noble et al., 2008), and connectedness with peers has been empirically found to be associated with well-being (Jose et al., 2012). Furthermore, positive relationships with peers are important for students' academic accomplishments and school adjustment (Ladd et al., 1996; Wentzel, 2017; Wentzel et al., 2004).

2.2 Development of Students' Well-Being in Early Adolescence

Adolescence represents a crucial period of life, as it is characterized by changes on many different levels (e.g., physical, social-emotional, cognitive; Eccles et al., 1993; Phillips, 2017; Sawyer et al., 2012). Early adolescence—which typically refers to ages 10-15 (Phillips, 2017; Sawyer et al., 2018)—coincides with the onset of puberty and is typically accompanied by the transition from elementary to secondary school. However, this life stage seems to threaten some key psychological constructs in the school context. Alongside intrinsic motivation and competence beliefs, which have been repeatedly found to decline in various domains (Gottfried et al., 2001; Wigfield et al., 2015), evidence suggests that students' well-being is at risk as well: Cross-sectional studies from several countries have found that students' well-being starts to decline at about age 10 (Casas & Gonzalez-Carrasco, 2019; González-Carrasco et al., 2017; Schütz et al., 2019). Longitudinal studies could substantiate these findings for early adolescents (Shek & Liang, 2018), but also suggested an increase in indicators of students' well-being (life satisfaction, mood) in their late adolescence (Salmela-Aro & Tuominen-Soini, 2010; Steinmayr et al., 2019). Concerning the school-related well-being facets included in the present study, previous research suggests a similar picture. Studies examining school-related cognitive well-being reported higher levels of school satisfaction among elementary school children than among secondary school children (Liu et al., 2016) and among younger adolescents compared with older adolescents (Tian et al., 2013). Furthermore, Kleinkorres et al. (2020) reported in a longitudinal study that satisfaction with school was lower

in Grade 7 than in Grade 5 and lower in Grade 9 than in Grade 7[12]. Studies of school-related affective well-being found that elementary school children compared to secondary school students and younger adolescents compared to older adolescents had higher levels of school-related positive affect. (Liu et al., 2016; Tian et al., 2013). Moreover, a longitudinal study by Hagenauer and Hascher (2010) showed a decrease in adolescents' learning enjoyment from sixth to seventh grade. Concerning school-related physical well-being Hascher and Hagenauer (2011) found that the absence of physical complaints related to school decreased from Grade 5 to Grade 7 and increased from Grade 7 to Grade 8. For self-rated health, likewise conflicting results have been reported: Breidablik et al. (2009) found a stable level over time in a 4-year longitudinal study of Norwegian adolescents aged 13 to 19 years. Following the view of other researchers (Boardman, 2006), the authors argued that self-rated health is rather defined by the general health-related self-concept of a person than by their bodily and environmental feedback. In contrast, a cross-sectional study by Wade and Vingilis (1999) uncovered a negative trend from Grade 7 to Grade 11. With regard to social well-being in school, a cross-sectional study by Tobia et al. (2019) comparing elementary and secondary school children reported a decrease in the quality of social relationships, while average scores for social integration and school connectedness did not exhibit a negative trend in a longitudinal study by Gunn et al. (2018). The latter finding could be explained by the increasing importance and stabilization of peer relationships during adolescence (Steinberg, 2010). Overall, previous findings suggest that general and school-related cognitive and affective well-being decline during early adolescence, while there are conflicting results concerning physical and social facets of students' well-being. However, the majority of the findings comes from cross-sectional studies, therefore, more longitudinal evidence is needed.

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[12] Drawing on data from the NEPS, as we do, Kleinkorres et al. (2020) analyzed reciprocal relations between students' well-being and academic achievement in Grades 5, 7, and 9. Therefore, their sample is similar to ours.

2.3 The Role of Teacher Autonomy Support for the Development of Students' Well-Being

The stage-environment fit theory provides a possible explanation for the worrisome phenomena described above. This theory postulates a mismatch between adolescents' needs and the opportunities provided by their environment (Eccles & Midgley, 1989; Eccles et al., 1993; Gutman & Eccles, 2007). More specifically, it is assumed that both adolescents' developmental needs and the social contexts in which they live are changing. If the social environment is responsive to these changing needs, positive outcomes are likely to occur (Booker, 2018; Eccles et al., 1993; Gutman & Eccles, 2007). In contrast, if adolescents' needs are not addressed by their social environment, this can lead to undesirable outcomes, such as lower intrinsic motivation (Eccles, 2004; Gutman & Eccles, 2007). Autonomy is a particularly central need during adolescence in light of the developmental tasks associated with this phase. Together with competence and relatedness, it constitutes the three basic psychological needs formulated within the framework of self-determination theory (SDT; Ryan & Deci, 2000; Ryan & Deci, 2020), the satisfaction of which is associated with increased intrinsic motivation and well-being, whereas their frustration threatens these outcomes (Haerens et al., 2015; Ryan & Deci, 2020). Autonomy refers to the feeling of being able to determine one's own actions without being controlled by others (Ryan & Deci, 2020). This need is satisfied, for example, in environments that offer opportunities to follow one's own interests. As the school represents one of the main contexts of socialization in adolescence, teachers play a crucial role in supporting students' needs. One critical event that frequently coincides with the onset of adolescence is the transition from elementary to secondary school. This transition often goes along with lower-quality student-teacher relationships, even though students are particularly in need of close relationships to adults other than their parents during this phase (Darling et al., 2003; Eccles et al., 1993; Wang et al., 2013). Furthermore, stage-environment fit theory states

that the school environment regularly fails to match students' increasing desire for self-determination and for participation in decision-making during adolescence (Eccles et al., 1993; Phillips, 2017).

A crucial factor related to this increasing desire for self-determination, and thus the students' need for autonomy, is autonomy support. Teacher autonomy support refers to the extent to which teachers encourage their students to participate in decision-making, provide choices, and take their students' perspective into account (Adie et al., 2008; Deci & Ryan, 1985; Diseth et al., 2018; Yu et al., 2016). Ryan and Solky (1996, p. 264) argue that autonomy support satisfies not only the need for autonomy but also the needs for relatedness and competence, as it "demonstrates a valuing of and confidence in the other person, and hence facilitates a depth and richness to perceived relatedness and competence that is unmatched under conditions of controlling and coercive forms of support". Recent studies have empirically demonstrated that autonomy support is a predictor of basic psychological needs satisfaction (Adie et al., 2008; Yu et al., 2016). Due to the close connection between basic psychological needs satisfaction and well-being (cf., Ryan & Deci, 2000), it seems plausible that teacher autonomy support may be a source of students' well-being as well.

Several cross-sectional studies have found a positive relation between perceived teacher autonomy support and general indicators of well-being, such as life satisfaction, among adolescents (Chirkov & Ryan, 2001; Diseth & Samdal, 2014; Ferguson et al., 2011). Furthermore, Lan and Zhang (2019) demonstrated that perceived teacher autonomy support is positively related to positive affect and negatively related to negative affect, and that it can buffer against negative feelings in adolescents who have changed schools. Studies addressing the aspects of well-being focused on in the present study have found positive associations between perceived teacher autonomy support and school satisfaction (Ferguson et al., 2011) as well as learning enjoyment (Hagenauer & Hascher, 2010). Furthermore, one study reported a

positive association between autonomy support by students' physical education teachers and their subjective evaluations of health-related quality of life (Tilga et al., 2021). To date, to our knowledge, there have been no studies examining the relationship between teacher autonomy support and social integration in the class. From a theoretical perspective, as teacher autonomy support satisfies the need for relatedness it seems plausible that it is related to social integration. Otherwise, relations with peers become increasingly important during adolescence (Steinberg, 2010) so that students' social integration might be independent of teacher autonomy support.

Evidence that students' well-being decreases because their increasing need for autonomy is not satisfied by the school environment is rare. Way et al. (2007) used cross-domain growth modelling to examine the trajectories of students' school climate perceptions and psychological and behavioural adjustment. In accordance with stage-environment fit theory, they found that perceived teacher autonomy support declined over a three-year period. Furthermore, this decline was associated with an increase in depressive symptoms. However, Way et al. (2007) focused mainly on negative psychological outcomes from which only one was related to the school-context, so more evidence on school-related well-being is needed.

Overall, to date, evidence of declines in adolescents' well-being has come mainly from cross-sectional studies, and research on the longitudinal development of school-related well-being facets is particularly rare. Furthermore, there is a lack of research on the role of need support in the form of teacher autonomy support for temporal changes in students' school-related well-being. In line with stage-environment fit theory, which postulates that adolescents' needs are increasingly poorly met as they progress through secondary school, the present study sought to examine whether there is a decline in students' well-being that is related to a decline in perceived teacher autonomy support.

2.4 The Present Research

Due to the vital importance of students' well-being in school, the present study aimed to examine the longitudinal development of four different well-being facets during adolescence using data from secondary schools in Germany. Furthermore, the concurrent development of teacher autonomy support was considered to investigate its role within this context. Adolescence represents a sensitive developmental phase characterized by cognitive, emotional, physical, and social changes and associated with identity formation (Sawyer et al., 2012). Against this background we examined four research questions (RQ). First, we examined how (a) cognitive (satisfaction with school), (b) affective (enjoyment of school), (c) physical (self-rated health), and (d) social (social integration) well-being develop over time. Drawing on stage-environment fit theory as well as previous—albeit mainly cross-sectional—findings, we had specific hypotheses (H) concerning students' cognitive and affective well-being. More precisely, we expected students' satisfaction with school (H1a), and enjoyment of school (H1b) to decrease over time on average during adolescence. Examining students' physical well-being was exploratory, as there are different possible explanations for its development: While stage-environment fit theory would argue for a declining trend in self-rated health, some researchers have argued that development is stable due to an enduring self-concept of health (Boardman, 2006; Breidablik et al., 2009). Examining students' social well-being was exploratory for the same reason: while stage-environment fit theory would argue for a declining trend, the fact that peer relations gain importance and stabilize during adolescence (Steinberg, 2010) may mean the trend is stable. In addition, conflicting results have been found in the literature regarding the development of students' physical and social well-being. In our second RQ we examined the trend in perceived teacher autonomy support. Following stage-environment fit theory, we expected the school environment to be less responsive to students' increasing need for autonomy with each progressing year, reflected in a decreasing trend in perceived teacher

autonomy support (H2). In our third and fourth RQ we examined the relation and parallel development of perceived teacher autonomy support and the individual facets of well-being, respectively. As teacher autonomy support promotes students' sense of self-determination (cf., Ryan & Deci, 2000; Deci & Ryan, 1987), which is essential for well-being, and as it has been shown to be directly related with students' cognitive, affective, and physical well-being (Ferguson et al., 2011; Hagenauer & Hascher, 2010; Tilga et al., 2021), we hypothesized that the baseline level of perceived teacher autonomy support would be positively associated with the baseline level of students' well-being. More precisely, we expected the intercepts of teacher autonomy support and satisfaction with school (H3a), enjoyment of school (H3b), and self-rated health (H3c) to be positively associated with each other. Examining the relation between teacher autonomy support and social integration was exploratory, due to different possible explanations: On the one hand, teacher autonomy support could be associated with social integration by satisfying the need for relatedness. On the other hand, as students' peer relations become more important during adolescence (Steinberg, 2010), their social integration might be independent of their teacher's autonomy support. Finally and most importantly, we expected a relation between the changes over time in perceived teacher autonomy support and students' well-being. More specifically, we assumed that the longitudinal development of students' perceived teacher autonomy support would be positively associated with the longitudinal development of satisfaction with school (H4a) and enjoyment of school (H4b). Due to different explanations for the trends in self-rated health and social integration (see first RQ), examining if changes in teacher autonomy support were related to changes in these facets of well-being was exploratory. Figure 1 shows an example of the structure of the PPGMs used to examine our research questions and hypotheses.

Figure 1

Example of the Structure of the Parallel Process Growth Models
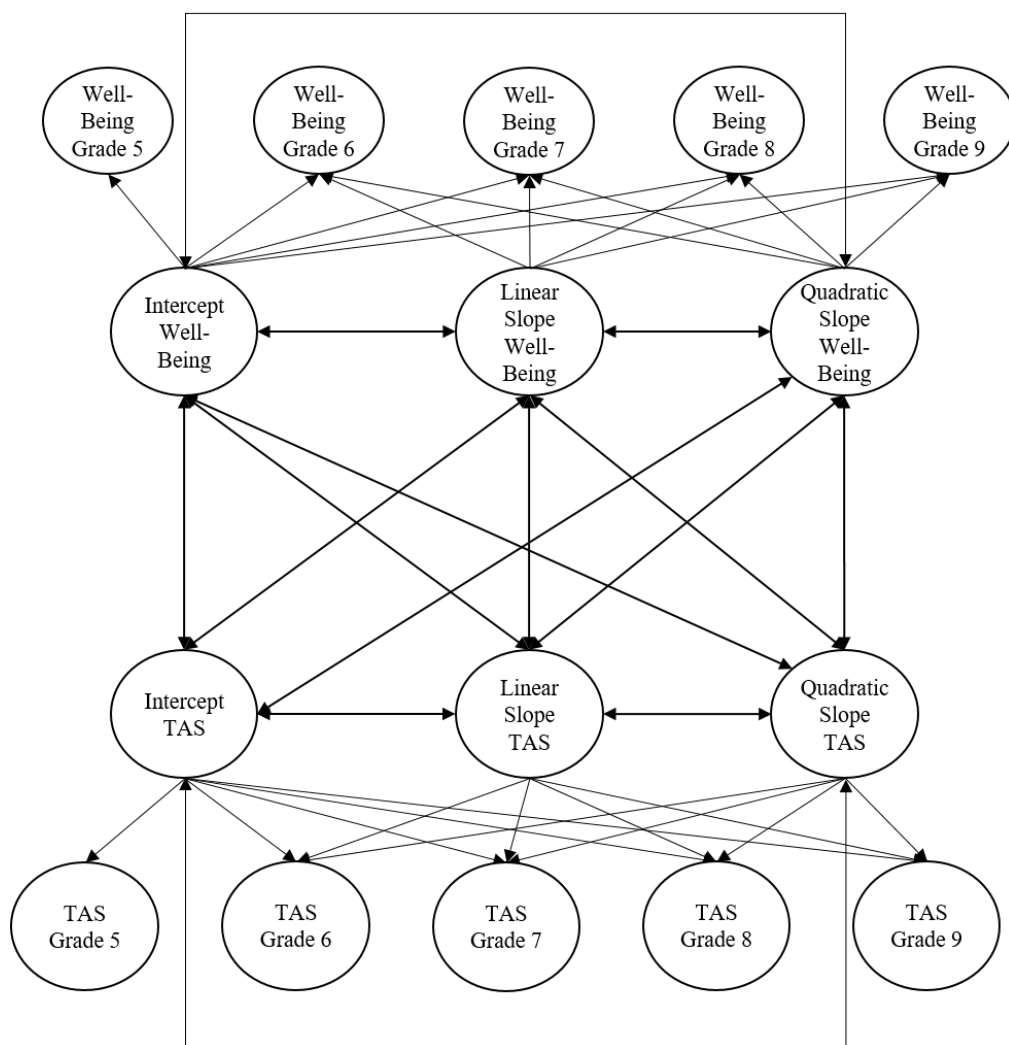
Notes. Control variables have not been included in the figure for clarity purposes. TAS = Perceived teacher autonomy support.

3. Method

3.1 Participants

Our research questions were examined based on data from Starting Cohort 3 of the National Educational Panel Study (NEPS; Blossfeld & Roßbach, 2019), a German longitudinal study designed to investigate students' educational trajectories. We focused on students who attended Grades 5 through 9 from 2010 to 2015. The original NEPS sample for Starting Cohort 3 consisted of 6,112 individuals. We only examined students who attended the same school

across all five measurement points (t_1 = Grade 5, t_2 = Grade 6, t_3 = Grade 7, t_4 = Grade 8, t_5 = Grade 9) to ensure that the school environment remained stable over time. This restricted sample comprised 3,572 individuals. For the same reasons, 126 students who skipped or repeated grades during the interval of interest were excluded. Thus, the final sample included 3,446 students (49.8% female) from 178 schools, who were on average 10.77 (SD = 0.49) years old at t_1[13]. The socioeconomic status of the students' families was measured with the highest *International Socio-Economic Index of Occupational Status* (ISEI; Ganzeboom 2010) of the student's two parents, which can take a value between 10 and 90. In the present sample, it averaged 58.54 (SD = 19.06), which is higher than other representative samples of students in Germany from this time period (Klieme et al., 2010). Among the included students, 3.5% were born in a country other than Germany, and 19.1% of students had at least one parent who was born abroad. These proportions are somewhat lower than in other representative samples of German secondary school students from this period (Klieme et al., 2010).

3.2 Materials

3.2.1 Students' Well-Being

Students' well-being was measured via multiple facets to address the complexity of this construct. *Satisfaction with school* was surveyed from t_1 to t_5. Students responded to the item "How satisfied are you with your school situation?" on an 11-point scale ranging from 0 (= *completely dissatisfied*) to 10 (= *completely satisfied*). The item was developed for the NEPS and resembles common items for measuring general life satisfaction (e.g., Diener et al., 1985).

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[13] The restricted sample did not differ significantly from the original sample in terms of the proportions of female students ($\chi^2(1)$ = 3.64, p = .056) and of students born abroad ($\chi^2(1)$ = 0.54, p = .461). However, the students' age ($t(7853.3)$ = 6.14, p < .001) and the proportion of students with parents born abroad ($\chi^2(1)$ = 6.53, p < .05) were slightly lower, while the highest ISEI was slightly higher ($t(3612.6)$ = 3.32, p < .001) in the restricted sample compared to the original sample. The higher age in the original sample could be partially explained by students who repeated a grade in elementary school. Because grade retention in elementary school is associated with a higher risk of dropping out of school later on (Jimerson et al., 2002), some of these students may have been excluded from our analyses because we focused on students who attended the same school for all five years. Deviations from the original sample in the proportion of students with parents born abroad and socio-economic status (Ingrum, 2006) may also be due to this selection effect.

Several studies indicate that satisfaction in specific domains can be reliably measured with single items (Gogol et al., 2014; Wanous et al., 1997). *Enjoyment of school* was measured with a scale based on items from Rauer and Schuck (2003). The scale was adapted for third-party assessment by parents in the NEPS framework and contains three items asking about the child's enjoyment of school and learning (e.g., "My child has a lot of fun learning at school"). Each item was rated on a 4-point scale ranging from 1 ($=$ *does not apply at all*) to 4 ($=$ *fully applies*). Parents provided information about their child's enjoyment of school at t_2, t_3, and t_4. Internal consistencies were good at all three measurement points (see Table 1). *Self-rated health* was surveyed from t_1 to t_5. It was measured with one item ("How would you describe your health status in general?") on a 5-point scale ranging from 1 ($=$ *very poor*) to 5 ($=$ *very good*). This item was modeled on traditional measures of self-rated health (e.g., Wannamethee & Sharper, 1991). *Social integration* in class was measured by two items based on questionnaires by Rauer and Schuck (2003) and Weinert er al. (2013). The items were formulated for third-party assessment by parents in the NEPS framework, asking them about their child's social connectedness in class (e.g., "My child is friends with many children in the class"). The items were answered on a 4-point scale ranging from 1 ($=$ *does not apply at all*) to 4 ($=$ *fully applies*). As with enjoyment of school, parents provided information about their child's social integration at t_2, t_3, and t_4. Measurement invariance analysis was performed for the scales measuring enjoyment of school and social integration, because these were measured with more than one item. The corresponding results are reported in the "Data Analysis" section.

To obtain more information about the validity of the facets of well-being, we examined factorial validity and construct validity. For examining factorial validity, we conducted a confirmatory factor analysis (CFA) assuming that the five different scales used in this study (4 facets of well-being + teacher autonomy support) represented individual factors. The corresponding CFA showed acceptable fit ($\chi^2(540) = 1594.16$, CFI $= .981$, RMSEA $= .024$).

To investigate construct validity, the facets of well-being were classified into a nomological network (cf. Cronbach & Meehl, 1955). For this purpose, three variables (self-esteem, prosocial behavior, political interest) were identified from the data set. We expected self-esteem to be more closely related to the construct of well-being than prosocial behavior, and the latter in turn to be more closely related to well-being than political interest. The results from Table A.1 (see Appendix A) are consistent with this assumption, supporting the validity of the facets of well-being.

3.2.2 Teacher Autonomy Support

Teacher autonomy support perceived by students was measured from t_1 to t_5 through a subset of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). More precisely, the scale for the present study comprised German translations of three LCQ items modified by Hardre and Reeve (2003). These items asked students to what extent they perceived that their German language arts teacher supported their autonomy by encouraging them to ask questions or listening to their opinions (e.g., "My German teacher tries to understand how I see things before suggesting how she/he would handle a particular situation"). The German teacher's autonomy support is of particular importance because it is a core subject in German secondary schools that takes up a large portion of the weekly instruction compared to other subjects. Students rated each item on a 4-point scale ranging from 1 (= *does not apply at all*) to 4 (= *fully applies*). Internal consistencies were acceptable to good at each of the five measurement points (see Table 1). As with the other multiple item scales, measurement invariance analysis was conducted for the teacher autonomy support scale. The corresponding results are also reported in the "Data Analysis" section.

3.2.3 Control Variables

We included age and gender (with boys as the reference group) as control variables. These variables were selected based on empirical research on differences in students' well-

being. As described above, cross-sectional studies have shown that older students have lower scores on various well-being facets. Therefore, it seemed plausible to control for age. Regarding gender, several studies have found that girls report higher satisfaction with school than boys (Kleinkorres et al., 2020; Liu et al., 2016) and have more positive emotions like fun and enjoyment towards school (Palsdottir et al., 2012). Other studies have found that girls report physical symptoms more often (Wiklund et al., 2012).

3.3 Data Analysis

Data preparation and calculation of descriptive statistics were conducted using the statistical software *R* (Version 4.1.0; R Core Team, 2021). Missing data were treated with multiple imputation. Using the *R* package "mice" (van Buuren & Groothuis-Oudshoorn, 2011), 10 different data sets were created. For this purpose, we first identified variables that correlated at least $r = .10$ with the variables of interest. Then, predictive mean matching was applied. All subsequent analyses were conducted based on the imputed data sets. Correlations, means, standard deviations, and skewness were calculated using the *R* packages "BIFIEsurvey" (Robitzsch & Oberwimmer, 2019) and "miceadds" (Robitzsch et al., 2017). To examine the research questions and hypotheses, we used M*plus* version 8.6 (Muthén & Muthén, 1998–2017).

Prior to the analyses, we tested measurement invariance across measurement points (overall and separately by gender) of all constructs measured with scales comprising at least two items (i.e., enjoyment of school, social integration, and perceived teacher autonomy support). Furthermore, we tested measurement invariance across gender within measurement points for scales comprising at least three items (i.e., enjoyment of school, perceived teacher autonomy support). We also examined for these scales whether scalar invariance by age could be assumed within the measurement points. To do this, we specified models with and without direct paths from age to the intercepts of the items. These were then compared with each other,

assuming scalar invariance if the model fit was not significantly improved by adding the direct paths. Following recommendations by other authors (Putnick & Bornstein, 2016; Widaman & Reise, 1997), we successively tested four increasingly restrictive levels of measurement invariance (configural, metric, scalar, residual invariance). We compared these differently restricted models with ΔCFI (CFI$_{\text{More restricted Model}}$ − CFI$_{\text{Less restricted Model}}$), because the χ^2-difference test is very sensitive to sample size. We followed Cheung and Rensvold's (2002) recommendation to prefer the restricted model if ΔCFI is equal to or greater than -.01. For the enjoyment of school scale, we found metric invariance across the three measurement points (overall and separately by gender), whereas scalar invariance was not supported (see Appendix B, Tables B.1). The analysis of measurement invariance with respect to gender separately for each measurement point revealed a similar result (see Appendix B, Table B.2). The fit for partial scalar invariance was just outside the range of acceptability. Regressions of item intercepts on age did not significantly worsen model fit at individual measurement points, indicating scalar measurement invariance for age (see Appendix B, Table B.3). Measurement invariance analysis for the social integration scale revealed scalar and also residual invariance across the three measurement time points (overall and separately by gender; see Appendix B, Table B.4). Finally, measurement invariance analysis for the teacher autonomy support scale revealed metric invariance across all five measurement points (overall and separately by gender), whereas scalar invariance was not supported (see Appendix B, Table B.5). However, measurement invariance analysis revealed acceptable fit when the intercepts of two items were estimated freely, indicating partial scalar invariance. The analysis with respect to gender separately for each measurement point revealed scalar and also residual measurement invariance (see Appendix B, Table B.6). Furthermore, regressions of item intercepts on age did not significantly worsen model fit at individual measurement points, indicating scalar measurement invariance for age (see Appendix B, Table B.7).

The longitudinal trends in perceived teacher autonomy support and the individual facets of students' well-being (see RQ1 and RQ2) were examined by means of univariate latent growth curve models (LGCM). These were specified for each facet of well-being and perceived teacher autonomy support separately. The effects-coding method described by Little et al. (2006) was used for model identification. We explored the functional form of the changes over time by specifying linear and quadratic growth models. Because enjoyment of school and social integration were only measured on three occasions, nonlinear changes were not estimated in these models. To examine RQ3 and RQ4, we specified parallel process growth models (PPGM). Within these PPGMs, we modeled the longitudinal development of the individual well-being facets and perceived teacher autonomy support in parallel. The baseline association between perceived teacher autonomy support and students' well-being (see RQ3) was examined via the correlations between the latent intercept factors. The correlations between the slope factors were used to evaluate the association between the trends in perceived teacher autonomy support and each facet of students' well-being (see RQ4). In the PPGMs for enjoyment of school and social integration, which were only measured at t_2, t_3, and t_4, we adjusted the time coding of perceived teacher autonomy support so that t_2 represented the intercept. All univariate LGCMs and PPGMs were calculated both without and with the inclusion of gender and age as time-invariant covariates of the intercept and slope factors. In analyses that referred to directional hypotheses, the p-values of the correlation coefficients were halved.

All constructs measured via scales comprising at least two items were modelled as latent variables in the LGCMs and PPGMs. Constructs measured with single items were modelled using a single-indicator approach. This was done to avoid treating these constructs as perfectly reliable. In accordance with other research applying a single-indicator approach,

we modelled a latent variable for each single-item measure and specified a reliability value of 0.85 (Jöreskog & Sörbom, 1982; Petrescu, 2013).

The data was hierarchically structured, as students were nested within schools. To take into account the dependence between observations (ICCs within schools ranged from .01 to .08; see Appendix C, Table C.1), student affiliation with a school was considered in the analyses[14]. Based on this information, the model parameters were calculated using maximum likelihood estimation with standard errors that are robust to non-normality and non-independence of observations. The resulting chi-square test statistic was asymptotically equivalent to the Yuan-Bentler test statistic (Muthén & Muthén, 1998–2017).

4. Results

4.1 Descriptive Results

Descriptive statistics in the form of correlations, means, standard deviations, skewness, and reliabilities for the well-being measures and for perceived teacher autonomy support can be found in Table 1. Satisfaction with school, enjoyment of school, self-rated health, social integration, and perceived teacher autonomy support were positively—and predominantly statistically significantly—related to each other. The correlations between these variables were small- to medium-sized (Cohen, 1992). The statistically significant correlations of gender with the other measures indicated that female students reported higher levels of satisfaction with school between Grades 5 and 7, and had higher scores on enjoyment of school and social integration in class between Grades 6 and 8 compared to male students (see Table 1). They also perceived higher teacher autonomy support in Grades 5, 6, and 8. However, they rated their health more negatively than male students between Grades 7 and 9. Students' age at the first measurement point was significantly negatively correlated with satisfaction with school in

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[14] The classroom level could not be included because the data did not contain usable information on it.

Grades 5, 6, 8, and 9 and self-rated health in Grade 8 (see Table 1). In addition, age was significantly positively related to perceived teacher autonomy support in Grades 5 and 6. The reported correlations were small in size (Cohen, 1992).

Table 1

Descriptive Statistics of the Variables Included in the Present Study

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
1. SWS t_1	-																						
2. SWS t_2	.37***	-																					
3. SWS t_3	.29***	.46***	-																				
4. SWS t_4	.22***	.37***	.48***	-																			
5. SWS t_5	.17***	.32***	.41***	.46***	-																		
6. EOS t_2	.18***	.25***	.20***	.14***	.09***	-																	
7. EOS t_3	.17***	.21***	.24***	.19***	.11***	.78***	-																
8. EOS t_4	.16***	.21***	.22***	.24***	.17***	.70***	.79***	-															
9. SH t_1	.27***	.20***	.17***	.13***	.15***	.11***	.13***	.10***	-														
10. SH t_2	.19***	.29***	.26***	.19***	.20***	.10***	.11***	.06*	.55***	-													
11. SH t_3	.14***	.20***	.31***	.23***	.22***	.06*	.08**	.07**	.45***	.60***	-												
12. SH t_4	.15***	.20***	.26***	.33***	.25***	.08**	.09**	.06*	.43***	.56***	.67***	-											
13. SH t_5	.13***	.17***	.22***	.21***	.29***	.05	.06*	.05*	.38***	.48***	.53***	.73***	-										
14. SI t_2	.14***	.18***	.15***	.10***	.07**	.52***	.37***	.31***	.10**	.11***	.06*	.08**	.05	-									
15. SI t_3	.14***	.16***	.16***	.08**	.08**	.42***	.44***	.33***	.11***	.14***	.10**	.10***	.05	.76***	-								
16. SI t_4	.12***	.14***	.14***	.08**	.06*	.35***	.36***	.38***	.10**	.10***	.07**	.12***	.00	.69***	.81***	-							
17. TAS t_1	.25***	.18***	.19***	.13***	.13***	.17***	.16***	.14***	.15***	.10***	.10***	.11***	.11***	.13***	.13***	.08**	-						
18. TAS t_2	.14***	.18***	.13***	.10***	.08**	.16***	.15***	.14***	.11***	.13***	.10***	.08**	.06*	.16***	.17***	.17***	.41***	-					
19. TAS t_3	.14***	.17***	.25***	.16***	.18***	.13***	.17***	.15***	.08**	.11***	.15***	.14***	.08***	.07*	.09***	.06*	.27***	.35***	-				
20. TAS t_4	.14***	.17***	.21***	.20***	.18***	.11***	.13***	.16***	.08**	.09***	.10***	.13***	.09***	.10**	.07**	.08***	.19***	.22***	.37***	-			
21. TAS t_5	.13***	.13***	.14***	.15***	.18***	.10***	.09***	.11***	.05*	.07**	.05	.11***	.11***	.06*	.05	.06	.14***	.18***	.21***	.38***	-		
22. Gender[a]	.08***	.05**	.05*	.02	.00	.16***	.17***	.16***	.03	-.00	-.05*	-.11***	-.12***	.11***	.11***	.06*	.04*	.05*	.04	.06*	.01	-	
23. Age t_1	-.05**	-.06***	-.03	-.04*	-.04*	.02	.03	.02	-.00	-.02	-.04	-.05*	-.04	.04	.03	.04	.05*	.06**	.02	.02	.00	-.07***	-
M	7.97	7.24	7.05	7.03	6.88	3.26	3.15	3.08	4.34	4.22	4.25	4.18	4.13	3.51	3.52	3.51	3.66	3.39	3.37	3.33	3.35	.50	10.77
SD	2.32	2.40	2.34	2.25	2.28	0.56	0.61	0.60	0.71	0.80	0.78	0.74	0.81	0.54	0.55	0.54	0.94	0.99	0.95	0.97	0.95	.50	0.59
Skewness	-1.52	-1.13	-0.98	-1.00	-0.93	-0.80	-0.73	-0.65	-0.79	-0.85	-0.89	-0.66	-0.77	-1.12	-1.15	-1.03	-0.55	-0.43	-0.40	-0.43	-0.52	.01	0.75
Missing	.08	.05	.06	.05	.08	.35	.36	.40	.06	.07	.07	.05	.08	.36	.37	.41	.15	.12	.12	.08	.11	.00	.00
α	-	-	-	-	-	.81	.85	.84	-	-	-	-	-	-	-	-	.79	.81	.83	.83	.84	-	-

Notes. Correlations are based on a CFA with the latent variables (Model Fit: $\chi^2(540) = 1594.16$, CFI = .981, RMSEA = .024), while the descriptive other statistics were calculated using the manifest variables. SWS = Satisfaction with school, EOS = Enjoyment of school, SH = Self-rated health, SI = Social integration, TAS = Perceived teacher autonomy support, t_1 = Measurement in Grade 5, t_2 = Measurement in Grade 6, t_3 = Measurement in Grade 7, t_4 = Measurement in Grade 8, t_5 = Measurement in Grade 9, *M* = Mean, *SD* = Standard deviation, Missing = Proportion of missing values (Range = 0-1), α = Cronbach's α. [a] Gender is a dichotomous variable (0 = male, 1 = female). Significance levels: * $p < 05$, ** $p < .01$, *** $p < .001$.

4.2 Development of Students' Well-Being in Adolescence

The development of students' well-being was examined using latent growth curve models. Table 2 contains the coefficients of these models. Furthermore, Figure 2 provides a graphical representation of the growth curves of the individual well-being facets.

Figure 2

Growth Curves of the Four Well-Being Facets
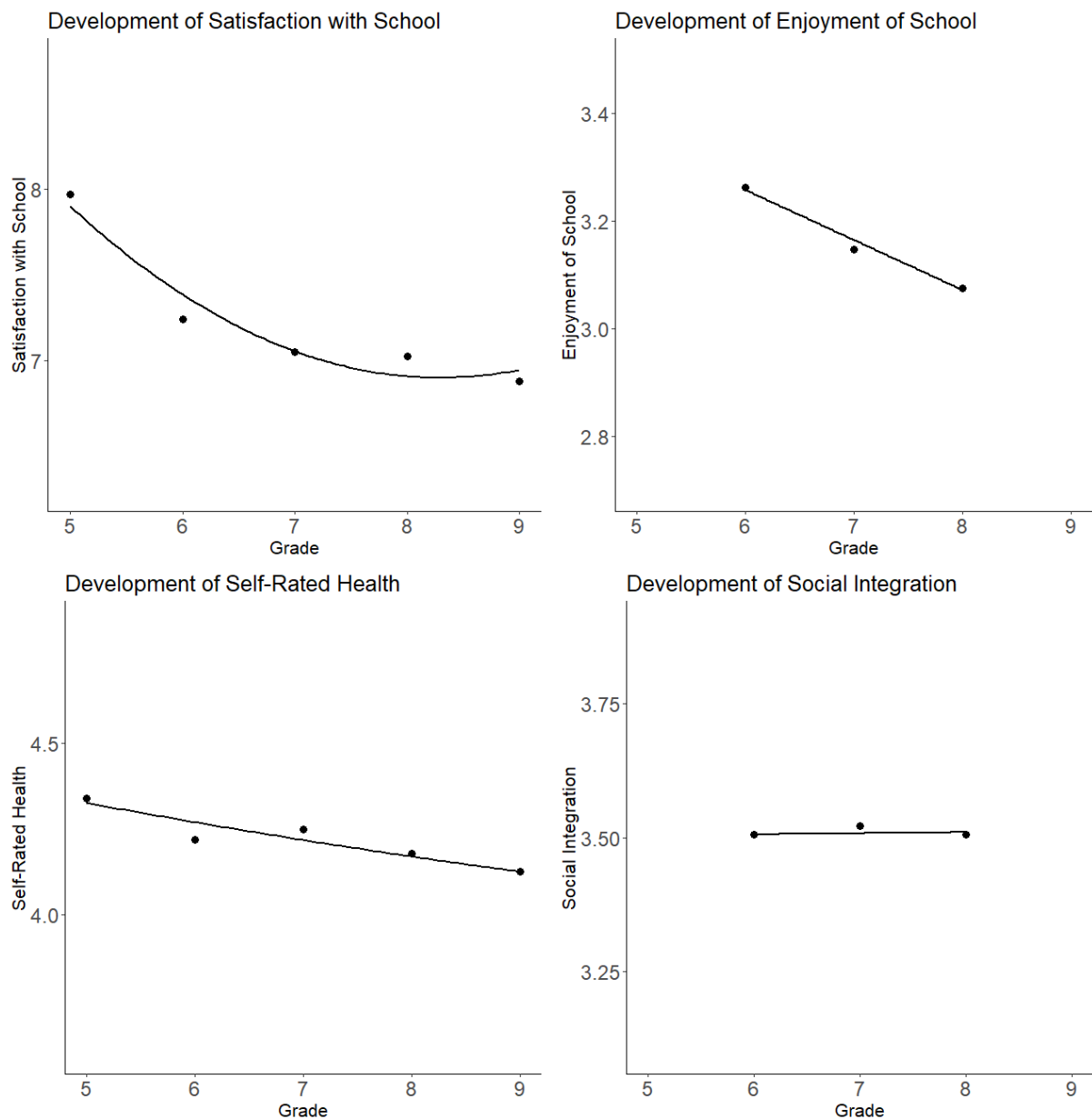
4.2.1 Satisfaction with School

The examination of the functional form of growth showed that a model with both linear and quadratic slope factors fit the data well ($\chi^2(6) = 54.26$, $p < .001$; CFI = .978; RMSEA = .048). As can be seen in Table 2, the linear slope was negative and statistically significant, suggesting that satisfaction with school scores decreased over time. More precisely, the results indicated that average satisfaction with school was 7.90 at t_1 and decreased by 0.61 scale points per year thereafter (see Figure 2 for a graphical representation). The statistically significantly positive quadratic slope indicated a mitigation of the negative trend in satisfaction with school towards the end of the time interval. The model with gender and age (see Appendix D, Tables D.1 and D.2) showed that the control variables were only associated with the intercept factor: The path estimate from gender to the intercept was statistically significantly positive ($\beta = .12$, $p < .001$), indicating that girls were, on average, more satisfied with school than boys initially. The path estimate from age to the intercept was significantly negative ($\beta = -.08$, $p = .003$), suggesting that comparatively older students within the cohort were initially less satisfied with school. As the results indicated a decrease in satisfaction with school over time, H1a was retained.

4.2.2 Enjoyment of School

The LGCM showed a statistically significantly negative linear slope, suggesting that enjoyment of school decreased between Grades 6 and 8 (see Table 2). More precisely, average enjoyment of school was 3.26 at t_2 and decreased by 0.09 scale points per year thereafter (see Figure 2 for a graphical representation). While the model with control variables (see Appendix D, Table D.1 and D.2) indicated that age was not associated to any of the latent factors, the path estimate from gender to the intercept factor was significantly positive ($\beta = .16$, $p < .001$), meaning that, on average, girls initially enjoyed school more than boys according to their parents. As the results indicated a decrease in enjoyment of school over time, H1b was retained.

4.2.3 Self-Rated Health

The examination of the functional form of growth in self-rated health showed that a model with both linear and quadratic slope factors fit the data well ($\chi^2(6) = 53.19$, $p < .001$; CFI = .984; RMSEA = .048). As can be seen in Table 2, the linear slope was negative and statistically significant, suggesting that self-rated health scores decreased over time. More precisely, the results indicated that average self-rated health was 4.33 at t_1 and decreased by 0.06 scale points per year thereafter (see Figure 2 for a graphical representation). The model with control variables (see Appendix D; Tables D.1 and D.2) showed that while age was not associated with any of the latent factors, the path estimate from gender to the slope factor was significantly negative ($\beta = -.09$, $p = .010$), suggesting that girls' health developed more negatively than that of boys. Furthermore, because the slope factor was not significantly negative for boys (see Appendix D, Table D.1), this result implies that only girls' self-rated health declined over time. In summary, the results for RQ1, which was exploratory in nature regarding students' physical well-being, indicated that self-rated health decreased over time, with this decline mainly due to girls' development.

4.2.4 Social Integration

The LGCM suggested that social integration remained stable between Grades 6 and 8, as the linear slope was slightly positive and statistically non-significant (see Table 2). Figure 2 shows a graphical representation of the trend. The model with control variables (see Appendix D, Tables D.1 and D.2) showed that while age was not associated to any of the latent factors, the path estimate from gender to the intercept factor ($\beta = .12$, $p < .001$) was significant. These findings can be interpreted as indicating that—according to their parents—girls' social integration in class was initially higher compared to that of boys. In summary, the results for RQ1, which was exploratory in nature regarding students' social well-being, indicated a stable level of social integration over time.

Table 2

Parameter Estimates of the Univariate LGCMs

Measure	Intercept (I)		Linear Slope (LS)		Quadratic Slope (QS)		Covariance		
	Mean	Variance	Mean	Variance	Mean	Variance	I, LS	I, QS	LS, QS
SWS[a]	7.90***	2.40***	-0.61***	1.07***	0.09***	0.04**	-.45	.02	-.19***
EOS[b]	3.26***	0.25***	-0.09***	0.04***	-	-	-.03***	-	-
SH[c]	4.33***	0.27***	-0.06***	0.12***	0.00	0.01***	-.06**	.01	-.02***
SI[d]	3.51***	0.33***	0.00	0.04**	-	-	-.03*	-	-
TAS[e]	3.64***	0.45***	-0.23***	0.23***	0.04***	0.01***	-.17***	.02**	-.05***

Notes. The table contains unstandardized estimates. SWS = Satisfaction with school, EOS = Enjoyment of school, SH = Self-rated health, SI = Social Integration, TAS = Perceived teacher autonomy support.

[a] The fit of the model with SWS was good: $\chi^2(6) = 54.26$, p < .001; CFI = .978; RMSEA = .048.

[b] The fit of the model with EOS was good: $\chi^2(20) = 104.71$, p < .001; CFI = .995; RMSEA = .035.

[c] The fit of the model with SH was good: $\chi^2(6) = 53.19$, p < .001; CFI = .984; RMSEA = .048.

[d] The fit of the model with SI was good: $\chi^2(3) = 8.89$, p < .05; CFI = .999; RMSEA = .024.

[e] The fit of the model with TAS was good: $\chi^2(64) = 154.91$, p < .001; CFI = .995; RMSEA = .020.

Significance levels: [†] $p < .10$ * $p < .05$, ** $p < .01$, *** $p < .001$.

4.3 The Role of Perceived Teacher Autonomy Support for the Development of Students' Well-Being in Adolescence

4.3.1 Development of Perceived Teacher Autonomy Support over Time

The examination of the functional form of growth showed that a model with both linear and quadratic slope factors fit the data well ($\chi^2(64) = 154.90$, *p* < .001; CFI = .995; RMSEA = .020). As can be seen in Table 2, the linear slope was negative and statistically significant, suggesting that perceived teacher autonomy support decreased over time. More precisely, average perceived teacher autonomy support was 3.64 at t_1 and decreased by 0.23 scale points per year thereafter. The statistically significantly positive quadratic slope indicated a mitigation of this negative trend in perceived teacher autonomy support towards the end of the time interval. The model with gender and age (see Appendix D, Tables D.1 and D.2)

showed that these control variables were only associated to the intercept factor. The path estimate of gender was statistically significantly positive ($\beta = .05$, $p = .043$), indicating that, on average, girls initially perceived their teachers as more supportive of their autonomy than boys. The path estimate from age to the intercept factor was also positive ($\beta = .06$, $p = .010$), suggesting that older students initially perceived their teachers as more supportive of their autonomy. Because the results showed a decline in perceived teacher autonomy support over time, H2 was retained. Figure 3 shows a graphical representation of the growth curve of perceived teacher autonomy support.

Figure 3

Growth Curve of Perceived Teacher Autonomy Support
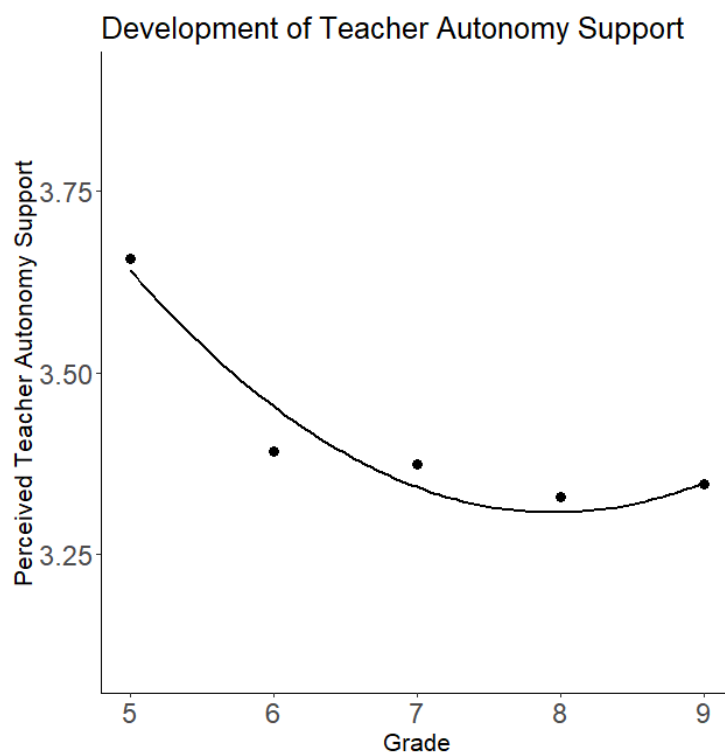
4.3.2 The Role of Perceived Teacher Autonomy Support for the Development of

Satisfaction with School

The model for satisfaction with school and perceived teacher autonomy support is shown in Figure E.1 (See Appendix E; for the model with control variables see Appendix F,

Figure F.1). As can be seen, the association between the intercept factors was statistically significantly positive ($r = .43$, $p < .001$), suggesting that a higher baseline level of perceived teacher autonomy support was associated with a higher baseline level of satisfaction with school. H3a was therefore retained. Furthermore, the linear slope factors were statistically significantly positively related ($r = .39$, $p < .001$), which means that a negative trend in perceived teacher autonomy support was accompanied by a negative trend in satisfaction with school. This result was in accordance with our hypothesis. Therefore, H4a was retained. Figure E.1 also shows that the intercept and slope factors of both variables are interrelated. More specifically, we observed negative correlations between the intercept of satisfaction with school and the slope of perceived teacher autonomy support ($r = -.18$, $p = .001$) and between the intercept of perceived teacher autonomy support and the slope of satisfaction with school ($r = -.15$, $p = .013$). This means that higher initial satisfaction with school was associated with greater decreases in perceived teacher autonomy support, and vice versa.

4.3.3 The Role of Perceived Teacher Autonomy Support for the Development of Enjoyment of School

The model specifying parallel processes between perceived teacher autonomy support and enjoyment of school is displayed in Figure E.2 (See Appendix E; for the model with control variables see Appendix F, Figure F.2). The association between the intercept factors was statistically significantly positive ($r = .25$, $p < .001$), suggesting that perceived teacher autonomy support was positively associated with enjoyment of school at baseline. This finding was in line with H3b, which was therefore retained. The relation between the linear slope factors was also positive ($r = .13$, $p < .001$), which indicated that a negative trend in perceived teacher autonomy support was associated with a negative trend in enjoyment of school between Grades 6 and 8. As this finding was in accordance with H4b, it was retained.

4.3.4 The Role of Perceived Teacher Autonomy Support for the Development of Self-Rated Health

Figure E.3 (See Appendix E) depicts the PPGM for self-rated health and perceived teacher autonomy support (for the model with control variables see Appendix F, Figure F.3). As indicated by the statistically significantly positive relation between the intercept factors ($r = .22$, $p < .001$), higher baseline levels of perceived teacher autonomy support was associated with higher initial self-rated health. This finding was in line with H3c, which was retained. For RQ4, which was exploratory in nature regarding students' physical well-being, we found that the relation between the linear slope factors was also positive ($r = .29$, $p < .001$), indicating that students whose perceptions of autonomy support from their teacher changed over time also changed in terms of their self-rated health.

4.3.5 The Role of Perceived Teacher Autonomy Support for the Development of Social Integration

As can be seen in Figure E.4 (See Appendix E; for the model with control variables see Appendix F, Figure F.4), the relation between the intercept factors of perceived teacher autonomy support and social integration was statistically significantly positive ($r = .23$, $p < .001$). Thus, for RQ3, which was exploratory in nature regarding students' social well-being, the results indicated that baseline levels of these variables were positively associated to each other. However, for RQ4, which was also exploratory in nature regarding students' social well-being, the association between the slope factors was statistically non-significant ($r = .09$, $p = .301$), meaning that perceived teacher autonomy support and social integration did not develop similarly between Grades 6 and 8.

5. Discussion

Students' well-being is seen as an important educational goal (Organisation for Economic Co-operation and Development [OECD], 2017; Kanonire et al., 2020). Accordingly,

it is important to monitor its development over the course of students' school years. Previous research has shown that students' well-being decreases during early adolescence, but most prior studies applied cross-sectional designs and focused on only one or a few facets of well-being. It seems plausible that this negative trend could be related to the school environment being increasingly less responsive to students' needs. However, little is known about time-varying factors that may be related to the trend in students' well-being. Therefore, the present study analyzed longitudinal data collected in German secondary schools to examine the temporal trend of students' well-being and how it is related to changes in perceived teacher autonomy support during adolescence.

5.1 Development of Students' Well-Being over Time

In accordance with previous studies investigating the development of general (Casas Gonzalez-Carrasco, 2019; González-Carrasco et al., 2017; Schütz et al., 2019; Shek & Liang, 2018) and school-specific well-being (Hagenauer & Hascher, 2010; Tian et al., 2013), our results pointed to a decline in different facets of students' well-being (i.e., satisfaction with school, enjoyment of school, self-rated health) over early adolescence. Although the results have to be interpreted with caution as satisfaction with school and self-rated health were measured by single items, and enjoyment of school was only measured from Grade 6 to Grade 8, these declines are similar to negative trends in other school-related variables in adolescence, such as intrinsic motivation and competence beliefs (Gottfried et al., 2001; Wigfield et al., 2015). Moreover, they fit within stage-environment fit theory framework (Eccles et al., 1993; Eccles & Midgley, 1989) that theoretically explains these declines. Concerning self-rated health, results showed different trends depending on gender: results for girls indicated a negative trend, which is consistent with stage-environment fit theory and previous research findings (Tobia et al., 2019). In contrast, the trend for boys' self-rated health was stable, which is consistent with the notion that adolescents have an enduring self-concept of health

(Boardman, 2006; Breidablik et al., 2009); also for this finding the literature provides examples with similar empirical results (Breidablik et al., 2009). Apparently, boys' self-rated health is less affected during adolescence than that of girls. Given this finding, it appears that the overall negative trend is mainly driven by girls' self-reports of their health. The results might have been different if school-related health had been assessed, although our findings are descriptively similar to Hascher and Hagenauer (2011), who found a decline in school-related physical well-being between fifth and seventh grade, followed by an increase from seventh to eighth grade. Furthermore, it should be noted that self-rated health was measured by a single item, which limits the reliability of this finding. The results concerning social integration were unambiguous, indicating no change over time. While this result is in conflict with studies finding a decrease from elementary to secondary school (Tobia et al., 2019), it is in line with research reporting stable values for social integration over time (Gunn et al., 2018). The high baseline level and stability of social integration over time might be explained by the increasing importance of peers during adolescence (Steinberg, 2010). It should be noted, however, that social integration, like enjoyment of school, was measured between Grades 6 and 8, and the results might have been different if the entire period from Grade 5 to Grade 9 had been considered.

5.2 The Role of Perceived Teacher Autonomy Support for the Development of Students' Well-Being over Time

Perceived teacher autonomy support exhibited a negative trend over the course of adolescence, which is in line with previous research (Way et al., 2007) and the theoretical notion that the school environment becomes less responsive to adolescents' needs with each successive school year (Eccles et al., 1993; Eccles & Midgley, 1989). Furthermore, it was positively related to different facets of students' well-being. This is consistent with previous studies demonstrating positive associations between perceived teacher autonomy support and

school-specific well-being facets such as satisfaction with school and learning enjoyment (see Ferguson et al., 2011; Hagenauer & Hascher, 2010). This finding could be explained by the importance of teacher autonomy support for satisfying students' basic psychological needs (Adie et al., 2008; Ryan & Solky, 1996; Yu et al., 2016), which are associated with higher levels of well-being (Ryan & Deci, 2000). Moreover, our results indicated that the development of perceived teacher autonomy support was positively associated with the development of the well-being facets satisfaction with school, enjoyment of school, and self-rated health. In accordance with stage-environment fit theory (Eccles et al., 1993, Eccles & Midgley, 1989), these findings could be interpreted as indicating that students' needs—especially the need for autonomy—are not addressed sufficiently by their environment, resulting in a decline in their well-being. It should be noted, however, that both the LGCM and PPGM indicated a stable trend in boys' self-rated health, so the significant relation between trends in perceived teacher autonomy support and self-rated health should be interpreted in light of this. In contrast to the other facets of students' well-being, the development of social integration was not associated with the development of perceived teacher autonomy support. This could be due to the stability of social integration over the focused time interval. Furthermore, it seems plausible that the development of social integration among peers is independent of the development of autonomy-supportive behaviors by teachers. However, it remains unclear why the baseline levels of these two variables are associated with each other. Overall, the results point to the importance of the learning environment, i.e., autonomy support, during the phase of early adolescence, when the psychological need for autonomy is crucial for the development of important student characteristics.

5.3 Limitations and Strengths

Although the current study provides important insights into the development of adolescents' well-being and its correlates, some limitations must also be considered. One such

limitation concerns the operationalization of students' well-being. More specifically, some of our constructs were measured with single items only. This problem was countered by a single-indicator approach, in which reliability of these items was set to a certain value. However, using single items may cause both random and nonrandom errors (Bollen, 1989), which can affect the results. Furthermore, scalar invariance for the enjoyment of school scale across measurement time points could not be empirically ensured. This implies that the intercepts of the items vary over time, which could be due to structural changes in the latent construct across the years (cf. Frenzel et al., 2012). Consequently, the change in latent variable scores over time for this variable should be interpreted with caution. Another limitation concerns the generalizability of our study. First, we focused on adolescents from Germany, so it remains unclear how the results can be generalized to other educational systems and other cultural contexts, especially to Eastern societies that are more collectivist in structure. Second, our sample only included students who attended the same school and class throughout early adolescence. The rationale behind this was to hold the school environment constant. Nevertheless, other relations and trends in the variables are possible for students who change or repeat grades or have to change schools, which would be interesting to investigate. A further limitation was that we did not include variables concerning the satisfaction of students' basic psychological needs (see Ryan & Deci, 2000; Ryan & Deci, 2020). Therefore, our results do not provide empirical insight into a possible mediation of the relationship between teacher autonomy support and students' well-being via need satisfaction. Finally, students only rated the autonomy support provided by their German language arts teachers. As German language arts is a core subject in German secondary schools, students spend multiple hours per week with their German teachers; hence, interaction with this teacher is very important for students' experiences at school. Nevertheless, it remains unclear how autonomy support by other teachers is related to students' well-being at school and its temporal development. Dietrich et

al. (2015) showed that a classroom's shared perception of teacher support in one subject (German or math) was positively associated with intrinsic value and effort in the same subject, but negatively associated with intrinsic value and effort in the other subject, which they explained with respect to dimensional comparison theory (Möller & Marsh, 2013). Thus, the findings were interpreted as indicating that students compared their teachers for different subjects to one another (Dietrich et al., 2015). Something similar is plausible with respect to teachers' autonomy supportive behavior; therefore, students' perception of autonomy support in one subject could be biased by teachers from other subjects being more or less autonomy-supportive.

However, the study's limitations are also offset by a number of strengths. First, to the best of our knowledge, our study is the first to examine the development of multiple facets of students' well-being and a time-varying covariate of the school context (i.e., perceived teacher autonomy support) simultaneously. This was done by examining longitudinal data with three to five different measurement points across five years of adolescence. As much of the research on students' well-being and its development is based on cross-sectional or short-term longitudinal designs, this represents an important extension to the literature. Second, as we used data from the NEPS (Blossfeld & Roßbach, 2019), we were able to draw on a large sample. Therefore, the results of the present study promise high external validity. Third, we considered multiple facets of students' well-being. It has been emphasized that students' well-being is a multifaceted construct that needs to be measured using multiple aspects (Liu et al., 2015; Long et al., 2012; Renshaw et al., 2015). The present study addresses this requirement and provides a fine-grained picture of different facets of students' well-being and how they develop over time.

5.4 Implications for Future Research and Educational Practice

The current study shed light on the temporal development of various facets of students'
well-being and their longitudinal relations with perceived teacher autonomy support. However,
more research is needed to support and complement the presented findings. One aspect that
should be explored in future studies is whether there are different patterns of results for
different subgroups. For example, because our findings suggest that gender is related to some
of the intercept and slope factors, a multi-group analysis of gender differences in the
development of well-being during adolescence would be a useful complement to
comprehensive analyses of the entire student population such as those presented in this study.
It would also be interesting to compare groups of students who repeated a grade or changed
schools with those who did not. Another desideratum might be to examine autonomy support
not only by German language arts teachers, but also by teachers of other (core) subjects, such
as mathematics. This would make it possible to control for biases in the perception of autonomy
support that arise from students comparing their teachers for different subjects (Dietrich et al.,
2015). In this context, it would also be conceivable to operationalize well-being on a subject-
specific basis in order to examine relations between perceived teacher autonomy support and
students' well-being within and across subjects. Furthermore, other potentially relevant
variables for the development of students' well-being could be considered. According to stage-
environment fit theory (Eccles et al., 1993), the transition from elementary to secondary school
is accompanied by a decline in the quality of student-teacher relationships and a mismatch
between the level of the learning materials and students' cognitive capacities. Therefore, it
would be interesting to consider variables capturing these changes in the school environment
when examining the development of students' well-being. Moreover, in future analyses, it may
be reasonable and important to include controlling teaching behavior alongside teacher
autonomy support when examining relations to students' well-being and its development.

Looking at motivation, Haerens et al. (2015) found evidence that a dark motivational pathway should be examined separately from a bright motivational pathway. Perceived teacher autonomy support and controlling teaching behavior had low negative correlations with each other and were differently related to various types of motivation, suggesting that they are separate constructs. Based on these results, it is conceivable that they are also individually related to students' well-being.

The results of the present study also provide important implications for educational practice. Given that our study suggests a decline in perceived teacher autonomy support and, possibly as a result, students' well-being, it would be useful to raise in-service and pre-service teachers' awareness of the critical period of adolescence. More specifically, they should be sensitized to the fact that students need particular support during this phase in order to experience school well-being. In addition, teachers' competence to perceive students' individual need for autonomy could be strengthened, and they could be equipped with tools to increase students' autonomy. This is important, as autonomy-supportive behavior is relevant not only for well-being but also for other outcomes, such as intrinsic motivation (Ryan & Deci, 2020).

6. Conclusion

The present study provided new insights into the development of students' well-being during adolescence. To the best of our knowledge, this is the first study to examine the development of students' well-being under consideration of a time-varying covariate (i.e. teacher autonomy support) by means of PPGMs. Using this approach, we were able to show that various facets of students' well-being (school satisfaction, enjoyment of school, self-rated health) decreased over time and that this decline was associated with a decline in teacher autonomy support.

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Appendix

Appendix A

Concurrent and Discriminant Validity

Table A.1

Intercorrelations Among the Facets of Students' Well-Being and the Concurrent and Discriminant Validity Scales

Well-Being Facet	Self Esteem [a]		Prosocial Behavior [b]		Political Interest [c]
SWS	.39	>	.26[d]	>	.14[d]
EOS			.20	>	.10[e]
SH t_1	.30	>	.12[d]	>	.06[e]
SI t_2			.12	>	.05[f]

Notes. SWS = Satisfaction with school, EOS = Enjoyment of school, SH = Self-rated health, SI = Social integration. All correlations reached statistical significance at the 5% level.

[a] Because the self-esteem variable was measured at the first measurement point, only correlations with the well-being facets measured at that measurement point were calculated.

[b] Because the variable prosocial behavior was measured at the second measurement point, only correlations with the well-being facets measured at that measurement point were calculated.

[c] Because the variable political interest was measured at the fourth measurement point, only correlations with the well-being facets measured at that measurement point were calculated.

[d] The correlation differs from the correlation to the left of it at the 0.1% level of significance.

[e] The correlation differs from the correlation to the left of it at the 1% level of significance.

[f] The correlation differs from the correlation to the left of it at the 5% level of significance.

Appendix B

Examination of Measurement Invariance

Table B.1

Examination of Measurement Invariance of the Enjoyment of School Scale Over

Measurement Points

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	ΔCFI	Δχ^2	Δdf	p(Δχ^2)
Overall (N = 3,446)									
configural	82.26	15	<.001	.996/0.991	.036/.019				
metric	94.07	19	<.001	.996/0.992	.034/.024	.000	11.86	4	.018
scalar	507.57	25	<.001	.972/0.960	.075/.055	-.024	413.50	6	<.001
scalar partial[a]	291.21	21	<.001	.984/0.973	.061/.041	-.012	197.14	2	<.001
Gender: Male (n = 1,729)									
configural	59.00	15	<.001	.995/0.988	.041/.022				
metric	67.36	19	<.001	.994/0.989	.038/.027	.000	8.36	4	.079
scalar	289.79	25	<.001	.969/0.956	.078/.059	-.025	222.43	6	<.001
scalar partial[a]	166.76	21	<.001	.983/0.971	.063/.044	-.011	99.40	2	<.001
Gender: Female (n = 1,717)									
configural	34.97	15	<.001	.997/0.994	.027/.017				
metric	41.59	19	<.001	.997/0.994	.026/.024	.000	6.62	4	.157
scalar	250.03	25	<.001	.970/0.957	.072/.053	-.027	208.44	6	<.001
scalar partial[a]	148.24	21	<.001	.983/0.971	.059/.041	-.014	106.65	2	<.001

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals.
[a] The intercepts of two items assessing enjoyment of school were freely estimated across points of measurement.

Table B.2

Examination of Measurement Invariance of the Enjoyment of School Scale Over Gender on Single Occasions

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
t_2:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	25.05	3	<.001	.992/0.985	.065/.149	-.008	25.05	3	<.001
scalar	116.97	6	<.001	.962/0.962	.103/.224	-.030	91.92	3	<.001
scalar partial [a]	71.45	4	<.001	.977/0.965	.099/.201	-.015	46.40	1	<.001
t_3:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	26.58	3	<.001	.994/0.989	.067/.134	-.006	26.58	3	<.001
scalar	138.63	6	<.001	.968/0.968	.113/.219	-.026	112.05	3	<.001
scalar partial [a]	96.40	4	<.001	.978/0.967	.115/.202	-.018	69.82	1	<.001
t_4:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	17.78	3	<.001	.996/0.993	.052/.110	-.004	17.78	3	<.001
scalar	105.20	6	<.001	.975/0.975	.098/.189	-.021	87.42	3	<.001
scalar partial [a]	75.31	4	<.001	.982/0.973	.101/.170	-.014	57.53	1	<.001

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals. Model identification was achieved by fixing the intercept of the latent variable to 0 and the variances to 1.
[a] The intercepts of two items assessing enjoyment of school were freely estimated across points of measurement.

Table B.3

Examination of Scalar Measurement Invariance of the Enjoyment of School Scale Over Age on Single Occasions

Measurement time point	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
t_2	4.75	3	.191	.999/0.999	.011/.008	-.001	4.75	3	.191
t_3	3.61	3	.307	1.000/1.000	.006/.008	-.000	3.61	3	.307
t_4	4.58	3	.205	1.000/0.999	.010/.009	-.000	4.58	3	.205

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals. Scalar measurement invariance was examined on each occasion by comparing a model that included regressions of the intercept of each item on age with a model that did not include these regressions. The models with regressions are exactly identified and are not shown in this table.

Table B.4

Examination of Measurement Invariance of the Social Integration Scale Over Measurement Points

Modell	χ^2	*df*	*p*	CFI/TLI	RMSEA/ SRMR	ΔCFI	Δχ^2	Δ*df*	$p(\Delta\chi^2)$
Overall (*N* = 3,446)									
configural	1.90	3	.593	1.00/1.001	.001/.004				
metric	4.97	5	.420	1.00/1.000	.005/.014	.000	3.07	2	.215
scalar	13.02	9	.162	.999/0.999	.009/.017	-.001	8.05	4	.090
residual	24.93	13	.024	.998/0.998	.015/.039	-.002	19.96	8	.010
Gender: Male (*n* = 1,729)									
configural	2.12	3	.549	1.00/1.001	.002/.006				
metric	7.94	5	.160	.999/0.998	.015/.025	-.001	5.82	2	.054
scalar	15.15	9	.087	.998/0.997	.018/.029	-.001	7.21	4	.125
residual	21.56	13	.062	.998/0.997	.017/.044	-.001	13.62	8	.092
Gender: Female (*n* = 1,717)									
configural	1.88	3	.598	1.00/1.002	.003/.006				
metric	3.21	5	.668	1.00/1.002	.002/.013	.000	1.33	2	.514
scalar	17.92	9	.036	.997/0.994	.023/.021	-.003	14.71	4	.005
residual	30.27	13	.004	.994/0.993	.027/.081	-.006	27.06	8	<.001

Notes. *df* = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals.
Indictor-specific covariances were equally estimated for both items in order to identify the models.

Table B.5

Examination of Measurement Invariance of the Teacher Autonomy Support Scale Over Measurement Points

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
Overall (N = 3,446)									
configural	205.54	81	<.001	.993/0.989	.021/.019				
metric	227.24	89	<.001	.992/0.988	.021/.022	-.001	21.70	8	<.01
scalar	554.47	101	<.001	.975/0.967	.036/.045	-.017	327.23	12	<.001
scalar partial [a]	357.77	93	<.001	.985/0.979	.029/.030	-.007	130.53	4	<.001
residual partial [b]	428.60	101	<.001	.982/0.975	.031/.032	-.010	201.36	12	<.001
Gender: Male (n = 1,729)									
configural	75.60	50	<.001	.997/0.994	.017/.014				
Metric	93.16	58	<.001	.996/0.993	.019/.020	-.001	17.66	8	.024
Scalar	268.01	70	<.001	.978/0.967	.040/.049	-.018	174.85	12	<.001
scalar partial [a]	163.35	62	<.001	.989/0.981	.031/.031	-.007	70.19	4	<.001
residual partial [c]	183.84	66	<.001	.987/0.979	.033/.032	-.009	90.68	8	<.001
Gender: Female (n = 1,717)									
configural	60.45	50	<.001	.999/0.997	.011/.014				
Metric	72.56	58	<.001	.998/0.997	.012/.018	-.001	12.11	8	.146
Scalar	259.28	70	<.001	.978/0.966	.040/.049	-.020	198.83	12	<.001
scalar partial [a]	139.72	62	<.001	.991/0.984	.027/.029	-.007	67.16	4	<.001
residual partial [b]	175.91	70	<.001	.988/0.981	.030/.033	-.010	103.35	12	<.001

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals.

[a] The intercepts of two items assessing teacher autonomy support were freely estimated across points of measurement.

[b] The intercepts of two items and the residual variance of one item assessing teacher autonomy support were freely estimated across points of measurement.

[c] The intercepts and residual variances of two items assessing teacher autonomy support were freely estimated across points of measurement.

Table B.6

Examination of Measurement Invariance of the Teacher Autonomy Support Scale Over Gender on Single Occasions

Modell	χ^2	df	p	CFI/TLI	RMSEA/ SRMR	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
t_1:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	1.06	3	.787	1.00/1.002	.000/.015	.000	1.06	3	.787
scalar	15.26	6	.018	.994/0.994	.030/.029	-.006	14.20	3	.002
residual	17.76	9	.038	.995/0.996	.024/.042	-.005	16.70	6	.010
t_2:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	7.69	3	.053	.998/0.996	.030/.050	-.002	7.69	3	.053
scalar	13.22	6	.040	.997/0.997	.026/.067	-.001	5.53	3	.137
residual	13.37	9	.147	.998/0.999	.016/.063	.000	5.68	6	.460
t_3:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	5.54	3	.136	.999/0.998	.021/.036	-.001	5.54	3	.136
scalar	14.80	6	.022	.997/0.997	.029/.050	-.002	9.36	3	.025
residual	16.08	9	.065	.997/0.998	.021/.044	-.002	10.54	6	.104
t_4:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	4.58	3	.205	.999/0.999	.017/.032	-.001	4.58	3	.205
scalar	20.81	6	.002	.995/0.995	.038/.053	-.005	16.33	3	<.001
residual	24.14	9	.004	.994/0.996	.031/.067	-.006	19.64	6	.003
t_5:									
configural	0.00	0	1	1.00/1.000	.000/.000				
metric	2.25	3	.522	1.00/1.000	.000/.021	.000	2.25	3	.522
scalar	3.43	6	.753	1.00/1.001	.000/.025	.000	1.18	3	.758
residual	4.95	9	.839	1.00/1.001	.000/.021	.000	2.70	6	.845

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals. Model identification was achieved by fixing the intercept of the latent variable to 0 and the variances to 1.

Table B.7

Examination of Scalar Measurement Invariance of the Teacher Autonomy Support Scale

Over Age on Single Occasions

Measurement time point	χ^2	*df*	*p*	CFI/TLI	RMSEA/ SRMR	ΔCFI	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$
t_1	24.65	3	<.001	.990/0.979	.046/.022	-.010	24.65	3	<.001
t_2	31.66	3	<.001	.991/0.983	.053/.027	-.009	31.66	3	<.001
t_3	10.89	3	.012	.998/0.995	.027/.012	-.002	10.89	3	.012
t_4	7.41	3	.060	.999/0.998	.020/.011	-.001	7.41	3	.060
t_5	6.74	3	.081	.999/0.998	.018/.008	-.001	6.74	3	.081

Notes. df = Degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Square Residuals. Scalar measurement invariance was examined on each occasion by comparing a model that included regressions of the intercept of each item on age with a model that did not include these regressions. The models with regressions are exactly identified and are not shown in this table.

Appendix C

ICC Values of all Analysis Variables

Table C.1

ICC Values of all Variables

Variable	t_1	t_2	t_3	t_4	t_5
SWS	.06	.04	.03	.04	.02
EOS	-	.03	.03	.02	-
SH	.01	.02	.02	.02	.01
SI	-	.01	.01	.01	-
TAS	.05	.08	.07	.07	.07

Notes. SWS = Satisfaction with school, EOS = Enjoyment of school, SH = Self-rated health, SI = Social integration, TAS = Perceived teacher autonomy support, t_1 = Measurement in Grade 5, t_2 = Measurement in Grade 6, t_3 = Measurement in Grade 7, t_4 = Measurement in Grade 8, t_5 = Measurement in Grade 9.

Appendix D

Parameter Estimates of the Univariate LGCMs Controlled for Gender and Age

Table D.1

Parameter Estimates of the Univariate LGCMs Under Control of Gender and Age

Measure	Intercept (I)		Linear Slope (LS)		Quadratic Slope (QS)		Covariance		
	Mean	Variance	Mean	Variance	Mean	Variance	I, LS	I, QS	LS, QS
SWS [a]	7.73***	2.35***	-0.56***	1.06***	0.09***	0.04**	-.43	.02	-.19***
EOS [b]	3.18***	0.24***	-0.10***	0.04***	-	-	-.03***	-	-
SH [c]	4.31***	0.27***	-0.03†	0.12***	0.00	0.01***	-.05**	.01	-.02***
SI [d]	3.46***	0.19***	0.01	0.02**	-	-	-.02***	-	-
TAS [e]	3.61***	0.45***	-0.24***	0.23***	0.04***	0.01***	-.17***	.02**	-.05***

Notes. The table contains unstandardized estimates. SWS = Satisfaction with school, EOS = Enjoyment of school, SH = Self-rated health, SI = Social Integration, TAS = Perceived teacher autonomy support.

[a] The fit of the model with SWS was good: $\chi^2(10) = 58.62$ p < .001; CFI = .981; RMSEA = .037.

[b] The fit of the model with EOS was good: $\chi^2(34) = 159.61$, p < .001; CFI = .993; RMSEA = .033.

[c] The fit of the model with SH was good: $\chi^2(10) = 57.14$, p < .001; CFI = .986; RMSEA = .037.

[d] The fit of the model with SI was good: $\chi^2(11) = 24.72$, p < .05; CFI = .998; RMSEA = .018.

[e] The fit of the model with TAS was good: $\chi^2(88) = 235.42$, p < .001; CFI = .992; RMSEA = .022.

Significance levels: † $p < .10$ * $p < .05$, ** $p < .01$, *** $p < .001$.

Table D.2

Regressions From Gender and Age to the Model Parameter Estimates of the Univariate LGCMs

	Independent Variables						
	Gender [a]				**Age**		
Parameter Estimate	β		(SE)	*p*	β		(SE)	*p*
Satisfaction with School								
Intercept	.12	***	(.03)	<.001	-.08	**	(.03)	.003
Linear Slope	-.05		(.04)	.224	.02		(.04)	.611
Quadratic Slope	.01		(.05)	.857	-.02		(.05)	.715
Enjoyment of School								
Intercept	.16	***	(.02)	<.001	.02		(.02)	.295
Linear Slope	.02		(.03)	.450	-.00		(.03)	.969
Self-Rated Health								
Intercept	.04		(.02)	.127	.00		(.03)	.993
Linear Slope	-.09	*	(.03)	.010	-.05		(.04)	.174
Quadratic Slope	.01		(.04)	.850	.04		(.04)	.366
Social Integration								
Intercept	.12	***	(.03)	<.001	.04		(.03)	.146
Linear Slope	-.07		(.04)	.080	.01		(.03)	.847
Teacher Autonomy Support								
Intercept	.05	*	(.03)	.043	.06	*	(.03)	.010
Linear Slope	.03		(.04)	.420	-.01		(.04)	.870
Quadratic Slope	-.04		(.04)	.266	-.02		(.04)	.705

Notes. [a] Gender is a dichotomous variable (0 = Male, 1 = Female).
Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix E

Parallel Process Growth Models for Well-Being Facets and Perceived Teacher

Autonomy Support

Figure E.1

PPGM for Satisfaction With School and Perceived Teacher Autonomy Support
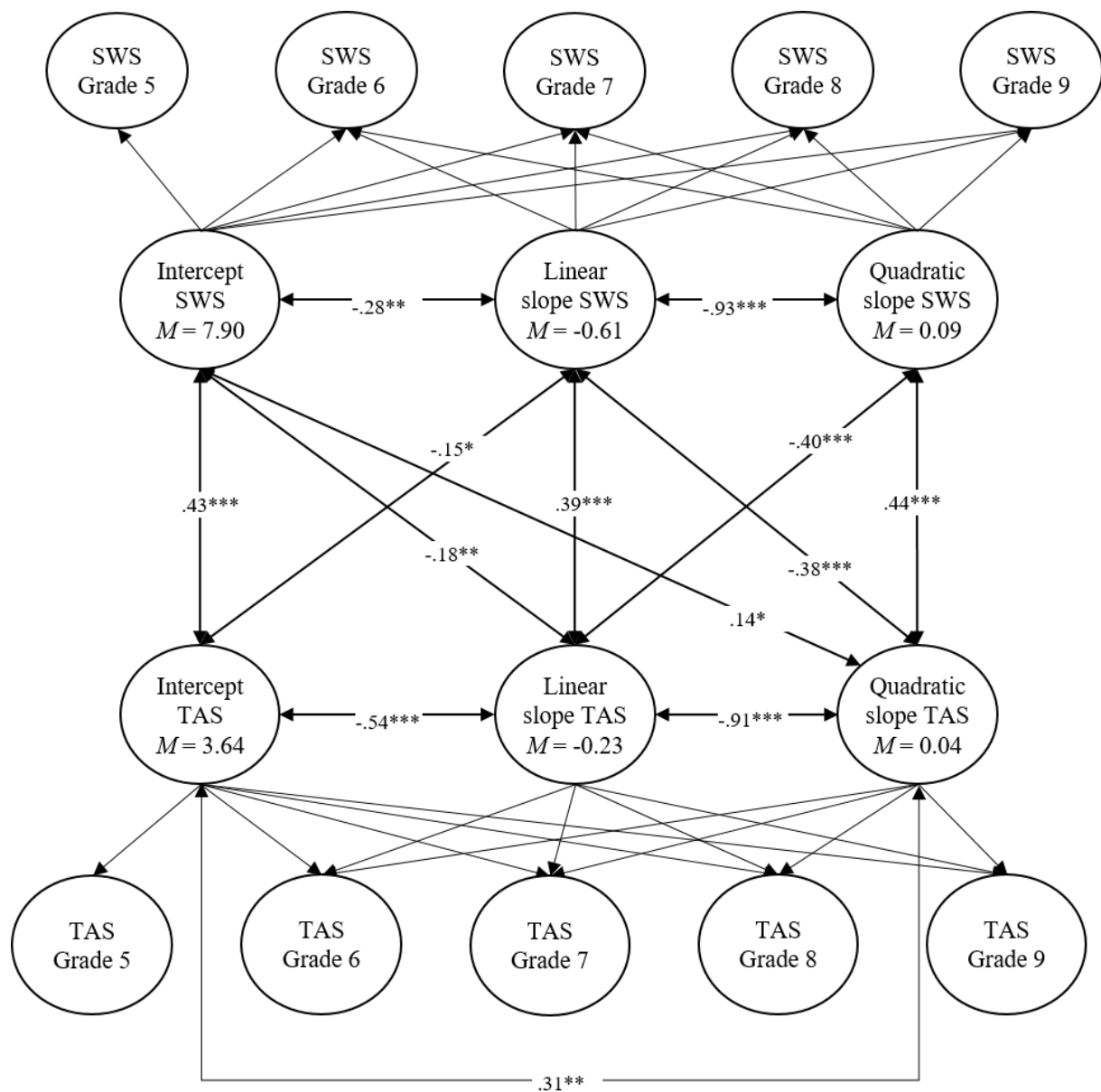
Notes. SWS =Satisfaction With School, TAS = Perceived Teacher Autonomy Support.

$N = 3,446$. $\chi^2(136) = 397.63$, $p < .001$, CFI = .988, RMSEA = .024. Manifest indicators of the

latent variables are not included in the figure for simplicity's sake. Only statistically

significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure E.2

PPGM for Enjoyment of School and Perceived Teacher Autonomy Support
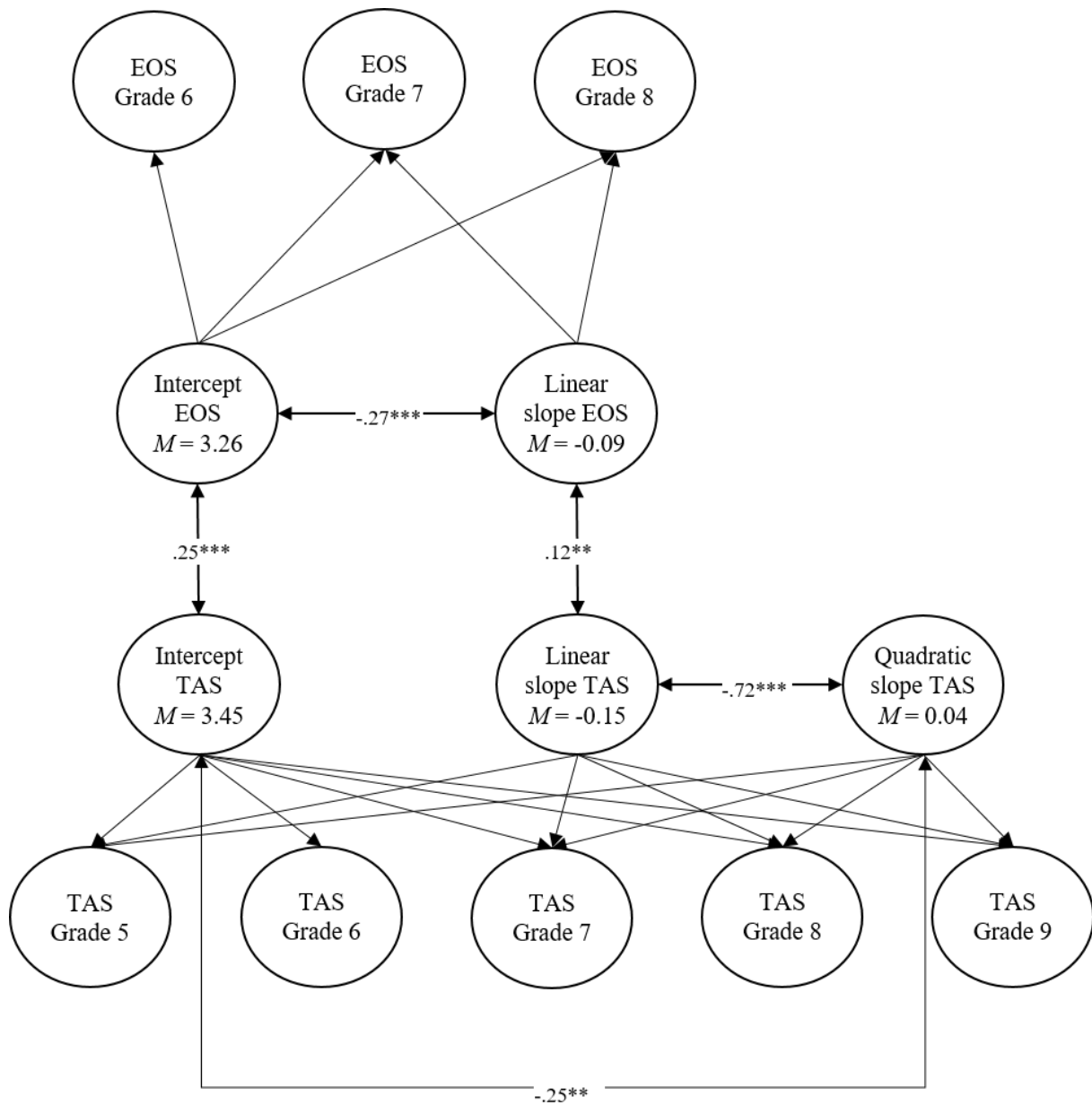
Notes. EOS =Enjoyment of School, TAS = Perceived Teacher Autonomy Support. N = 3,446.
$\chi^2(213)$ = 574.64, $p < .001$, CFI = .990, RMSEA = .022. Manifest indicators of the latent variables are not included in the figure for simplicity's sake. Only statistically significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure E.3

PPGM for Self-Rated Health and Perceived Teacher Autonomy Support
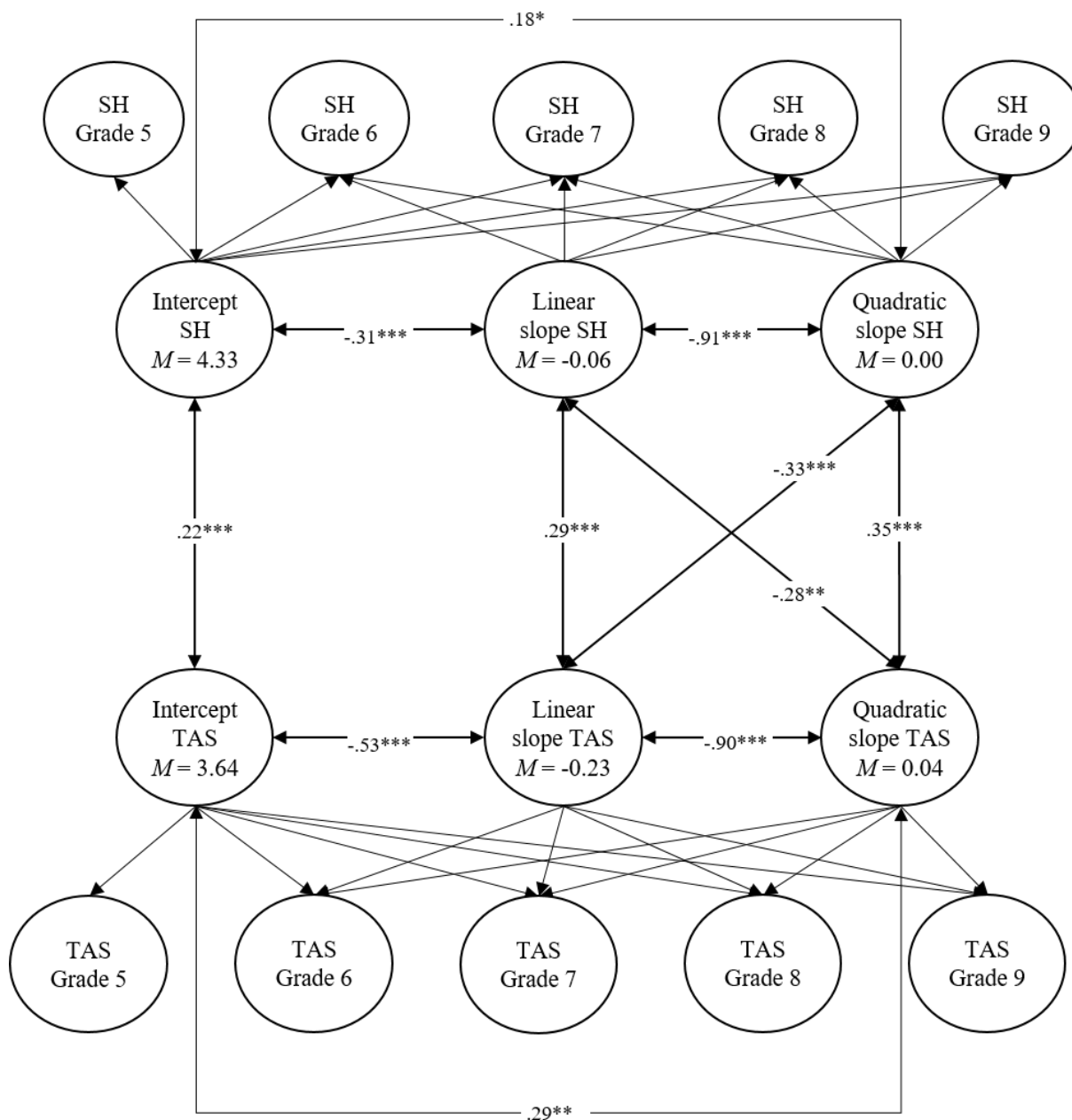
Notes. SH =Self-Rated Health, TAS = Perceived Teacher Autonomy Support. $N = 3,446$.

$\chi^2(136) = 298.35$, $p < .001$, CFI = .993, RMSEA = .019. Manifest indicators of the latent variables are not included in the figure for simplicity's sake. Only statistically significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure E.4

PPGM for Social Integration and Perceived Teacher Autonomy Support
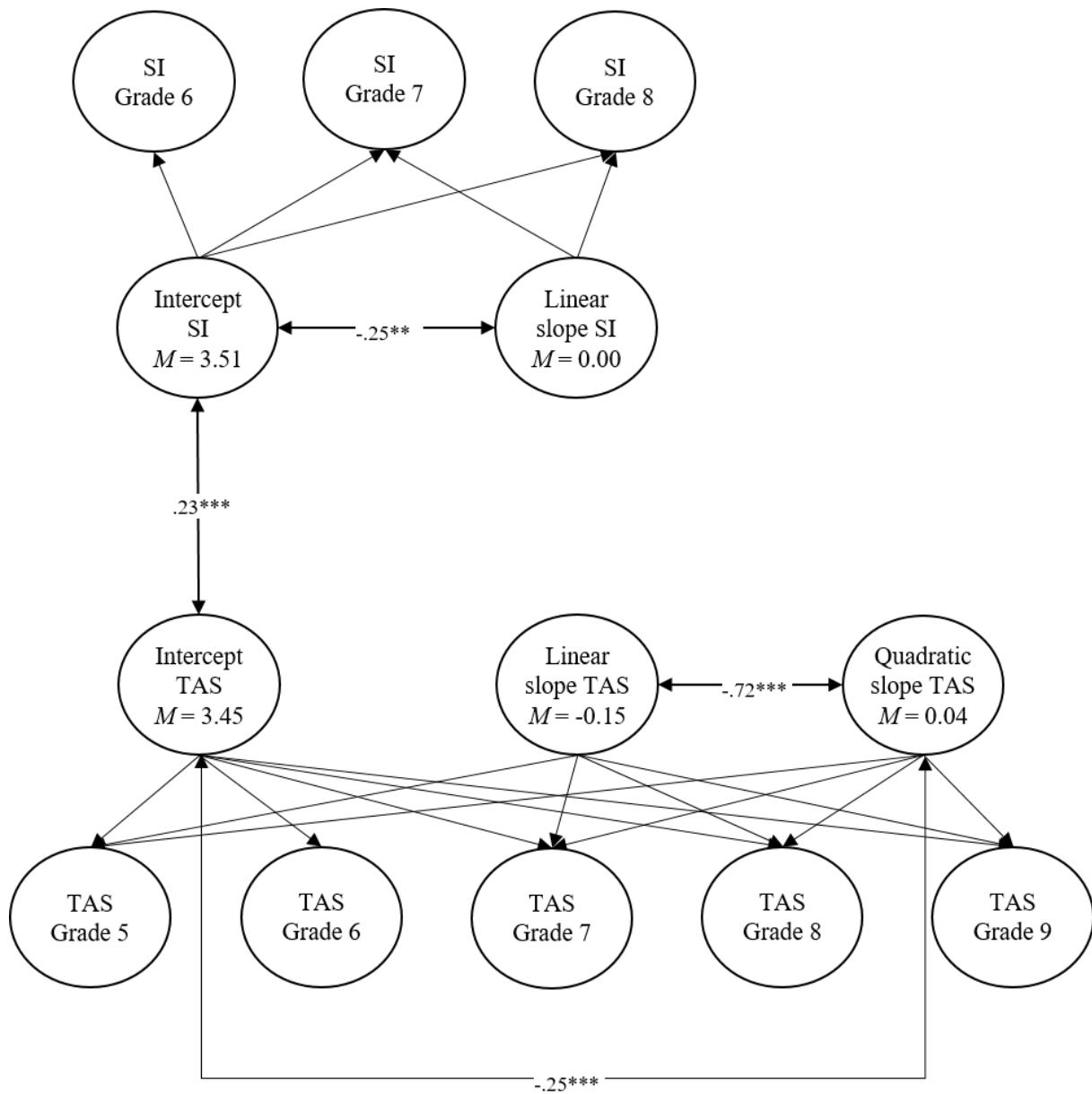
Notes. SI =Social Integration, TAS = Perceived Teacher Autonomy Support. $N = 3,446$.

$\chi^2(151) = 371.32$, $p < .001$, CFI = .992, RMSEA = .021. Manifest indicators of the latent variables are not included in the figure for simplicity's sake. Only statistically significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Appendix F

Parallel Process Growth Models for Well-Being Facets and Perceived Teacher

Autonomy Support Controlled for Gender and Age

Figure F.1

PPGM for Satisfaction With School and Perceived Teacher Autonomy Support

Notes. SWS =Satisfaction With School, TAS = Perceived Teacher Autonomy Support.

$N = 3,446$. $\chi^2(174) = 596.39$, $p < .001$, CFI = .981, RMSEA = .027. Manifest indicators of the

latent variables are not included in the figure for simplicity's sake. Only statistically

significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure F.2

PPGM for Enjoyment of School and Perceived Teacher Autonomy Support

Notes. EOS =Enjoyment of School, TAS = Perceived Teacher Autonomy Support. *N* = 3,446.
χ²(267) = 1248.05, *p* < .001, CFI = .974, RMSEA = .033. Manifest indicators of the latent
variables are not included in the figure for simplicity's sake. Only statistically significant
paths are shown.

Significance levels: * *p* < .05, ** *p* < .01, *** *p* < .001.

Figure F.3

PPGM for Self-Rated Health and Perceived Teacher Autonomy Support
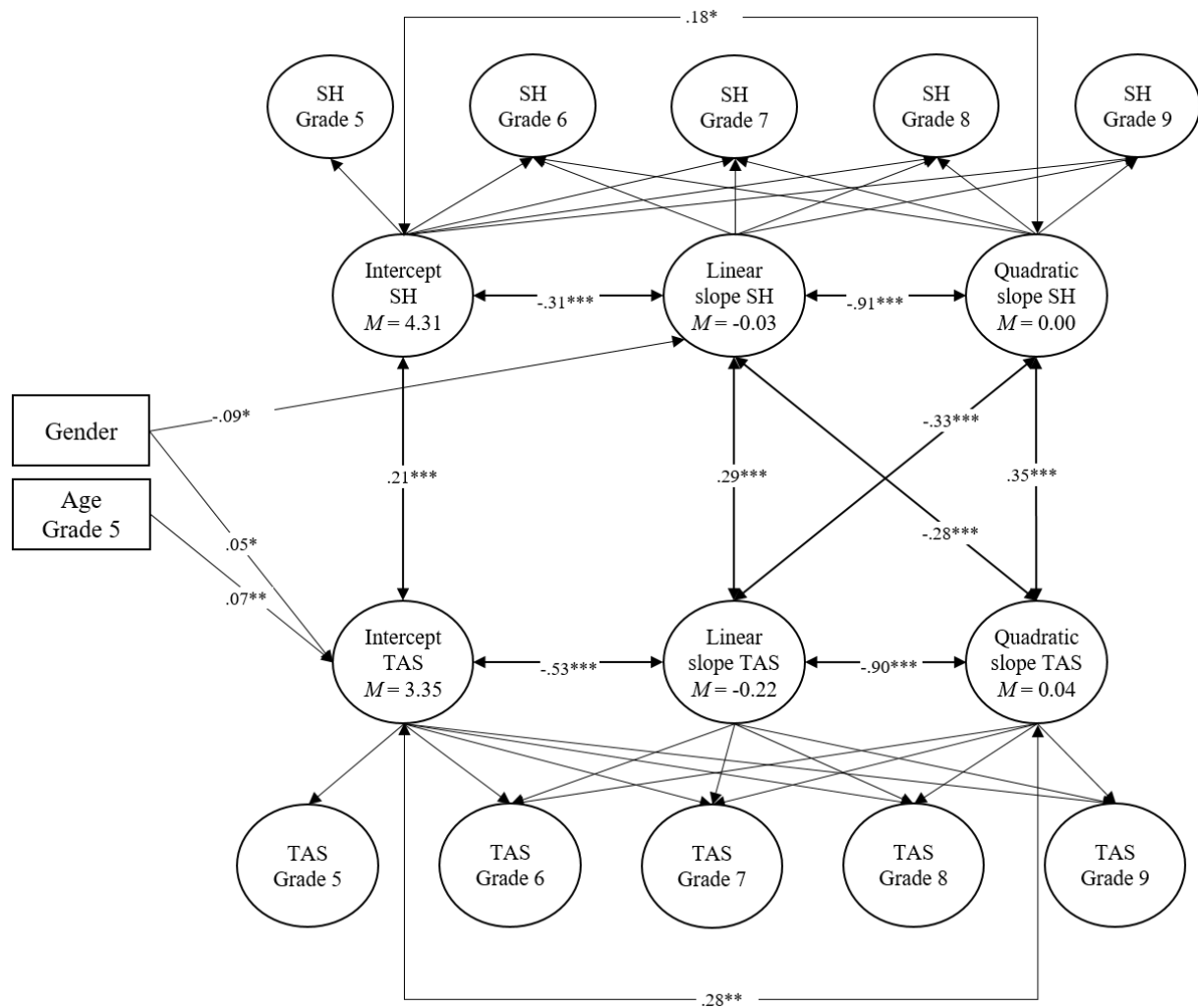
Notes. SH =Self-Rated Health, TAS = Perceived Teacher Autonomy Support. $N = 3,446$.

$\chi^2(174) = 499.37$, $p < .001$, CFI = .986, RMSEA = .023. Manifest indicators of the latent variables are not included in the figure for simplicity's sake. Only statistically significant paths are shown.

Significance levels: * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure F.4

PPGM for Social Integration and Perceived Teacher Autonomy Support

Notes. SI = Social Integration, TAS = Perceived Teacher Autonomy Support. *N* = 3,446.

χ²(174) = 499.37, *p* < .001, CFI = .986, RMSEA = .023. Manifest indicators of the latent

variables are not included in the figure for simplicity's sake. Only statistically significant

paths are shown.

Significance levels: * *p* < .05, ** *p* < .01, *** *p* < .001.

3.3 Further Analyses (Study III): Comparing Parental and School Pressure in Terms of Their Relations with Students' Well-Being

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Abstract

Towards the end of the elementary school years, children experience increased learning demands and pressure to perform, which can threaten their well-being. However, while parents and teachers are considered the main sources of academic pressure, a systematic comparison of the two has not yet been conducted. Therefore, this study examined the relation between those sources of academic pressure and five different facets of well-being among elementary school children. Our sample comprised 342 fourth graders (45.9% female, M_{age}=10.29) participating in the field test of the Progress in International Reading Literacy Study (PIRLS) 2021 in Germany. Parental and school pressure were negatively related to most facets of students' well-being, with our findings suggesting a stronger relation between parental pressure and well-being. The general pattern of results remained stable when controlling for gender and academic achievement, but some effects became non-significant. Limitations of the study and implications for research and practice are discussed.

Keywords: Elementary school, multicomponent model, parental pressure, school pressure, students' well-being

1. Comparing Parental and School Pressure in terms of their Relations with Students'

Well-Being

The experiences students gain and the skills they learn in school have a long-term impact on their lives and can influence individual development both positively and negatively (Schaps & Solomon, 2003; Tian et al., 2017). In addition to the acquisition of academic competencies, students' well-being has drawn increased focus in recent decades, and researchers have emphasized that students should be perceived as more than just learners (Seligman et al., 2009; Suldo et al., 2006). According to Seligman et al. (2009), a greater focus on well-being in the school context could reduce depression rates among school-aged children, increase their life satisfaction, and improve their learning abilities. Currently, students' well-being is considered one of the central goals of educational processes (Kanonire et al., 2020; Organisation for Economic Cooperation Development [OECD], 2017).

Due to the significance attached to students' well-being, it is important to identify variables that may negatively affect it. Academic pressure, characterized for example by high expectations of success or high demands for completion of schoolwork (Hirvonen et al., 2019; Quach et al., 2015), can be seen as such a variable. In the last two decades, an increase in the proportion of students perceiving academic pressure has been observed in many Northern and Western European countries (Löfstedt et al., 2020), and the percentage of schoolchildren feeling pressured is high (Pascoe et al., 2020). External pressure is associated with lower well-being in adolescent schoolchildren (Deb et al., 2015; Torsheim & Wold, 2001), which may be due to a lack of autonomy and self-determination (Ryan & Deci, 2000, 2020).

Against this background, the aim of the present study was to shed light on the relation between academic pressure and well-being among elementary school children. Most previous studies on this topic have focused on older students (Deb et al., 2015; Liu & Lu, 2012; Torsheim & Wold, 2001), while little is known about younger students (for exceptions see Choi et al.,

2019; Hirvonen et al., 2019). The elementary school years are a unique period for a child's development, and findings based on secondary school students cannot be easily generalized to this age group. First, elementary school children have little experience with the school and grading system, and the end of elementary school marks the first major stress test, as their future school careers depend largely on their performance. Second, children at a young age are highly dependent on the authorities around them and may therefore be particularly vulnerable to pressure placed on them. Third, the family is still the most important socialization agent at the elementary school age while the school becomes increasingly relevant (Grusec & Hastings, 2007). Because of the last point, another aim of the present study was to find out whether academic pressure from people within the school or from parents is more threatening for students' well-being, as the different sources of academic pressure have never before been systematically compared.

2. Theoretical Background

2.1 Students' Well-Being

Several different definitions and models of general well-being have been presented (Diener, 1984; Diener et al., 2018; Ryff, 1989, 2014; Seligman, 2011). One of the most prominent models is that of *subjective well-being* ([SWB]; Diener, 1984). It incorporates Bradburn's (1969) distinction between positive and negative affect and additionally considers a cognitive component of well-being, namely satisfaction with life. Diener et al. (1999) later expanded the classical model of SWB to include satisfaction in specific domains, which refer to different areas like the workplace, the family, or the school.

School, along with the family, is a particularly important area when it comes to students' well-being. Therefore, several researchers have stressed that it is insufficient to measure students' general well-being and have called for explicit consideration of the school context (Hascher, 2008; Kanonire et al., 2020; Liu et al., 2015; Tobia et al., 2019): One reason

is that children spend a large amount of time in school, and thus their overall well-being is highly dependent on their experiences related to this socialization context. Furthermore, a focus on school-related well-being is important for identifying weaknesses of the school system itself, which is of interest for policymakers (Kanonire et al., 2020). Students' school-related well-being can be defined in terms of their cognitions and emotions based on their school experiences (Hascher, 2008; Putwain et al., 2020; van Petegem et al., 2007). Hascher's (2004, 2008) model is based on this definition and comprises six facets capturing four overarching components of students' well-being: cognitive (positive attitudes towards school, positive academic self-concept), emotional (enjoyment of school, absence of worries about school), physical (absence of physical complaints in school), and social (absence of social problems in school) well-being. A strength of this model is that it takes into account the multifaceted nature of students' well-being. Several researchers have claimed that it is necessary to consider multiple aspects of students' well-being that describe it comprehensively to obtain a fine-grained picture of the construct (Liu et al., 2015; Long et al., 2012; Pollard & Lee, 2003; Renshaw et al., 2015). However, many studies focused only on one or two well-being aspects when examining school-aged children (Heffner & Antaramian, 2016; Pollard & Lee, 2003).

Drawing upon Hascher's (2004, 2008) model, we also addressed the multifaceted nature of students' well-being by considering the different components and its central indicators: cognitive (satisfaction with school), emotional (enjoyment of school, worries about school), physical (physical complaints related to school), and social (social integration) well-being. According to Huebner and Gilman (2006), satisfaction with school constitutes a key aspect of children's quality of life and can also serve as an indicator of school adjustment. Furthermore, it has been empirically found that satisfaction with school is positively related to school connectedness (Zullig et al., 2011) and academic self-efficacy (Huebner & McCullough, 2000). Emotions at school play a crucial role for students' learning, motivation and

achievement (Durlak et al., 2011; Pekrun, 2016). Enjoyment of school can be considered as a positive emotion related to the school context. Reschly et al. (2008) argued that positive emotions associated with school, such as joy or excitement, can have a positive impact on students' school engagement. Furthermore, enjoyment of school has been found to be negatively related to school reluctance and truancy (Hascher & Hagenauer, 2020). Conversely, negative emotions like worries about school reflect low student well-being (Hascher, 2010; Lauermann et al., 2017). Such negative emotions can affect learning and achievement, as they lead to task-irrelevant cognitions that absorb attention (Hascher, 2010). The role of physical health as an indicator for well-being can be intuited and the OECD lists physical well-being as an individual component of students' well-being (Borgonovi & Pál, 2016). Accordingly, physical complaints about school represent a negative indicator of students' school-related well-being. It has been shown that physical complaints about school are positively related with school reluctance (Hascher & Hagenauer, 2020). Furthermore, physical complaints can be a symptom of psychological distress and can interfere with school and social adjustment (Vila et al., 2009). As such, they also represent important information about students' well-being in school. Social integration as an indicator of students' social functioning in their school community can be seen as another indicator of their well-being (Noble et al., 2008). While positive relationships with peers are positively associated with academic accomplishments and school adjustment (Ladd et al., 1996; Wentzel, 2017), poor social relationships and loneliness contribute to school dislike (Rönkä et al., 2017).

2.2 Pressure through School and Parents as Predictors of Students' Well-Being

As students' well-being is considered significant, it is important to identify factors that promote or harm it. Academic pressure can be seen as such a factor. It can be defined in terms of high expectations of success from others or high demands placed on the completion of schoolwork by parents or teachers, as well as students' fear of failure (see Hirvonen et al., 2019;

Quach et al., 2015).[15] With regard to its relation with well-being, previous studies could show that academic pressure is associated with higher levels of health complaints and physical symptoms in adolescents (Murberg & Bru, 2007; Torsheim & Wold, 2001). Furthermore, Liu and Lu (2012) surveyed Chinese high school students and found a positive association between academic pressure and depressive symptoms. One study examining students between the ages of 10 and 12 reported that lower levels of academic pressure were associated with higher levels of SWB (Choi et al., 2019). In another study by Hirvonen et al. (2019), a positive relationship was reported between academic pressure and negative affectivity in sixth grade elementary school children. Studies focusing explicitly on pressure applied by parents found positive associations with anxiety, depressive symptoms and perceived stress in adolescents (Kulakow et al., 2021; Quach et al., 2015).

The negative relation with well-being could be explained by self-determination theory (SDT; Ryan & Deci, 2000, 2020). This theory differentiates three basic psychological needs (autonomy, competence, and relatedness) that are essential for optimal functioning and personal well-being. While satisfaction of these needs is associated with higher well-being, non-satisfaction of any of these needs is associated with lower well-being (Reis et al., 2000; Ryan & Deci, 2000). The need for autonomy can be defined as the perception that one's decisions and actions come from oneself and are not determined by others (Ryan & Deci, 2000, 2020). Academic pressure can be perceived by students as heteronomy which is the counterpart of autonomy and includes situations in which pressure is exerted on someone to exhibit a certain behavior (Deci & Ryan, 2013). Therefore, academic pressure can have a negative influence on well-being by thwarting students' need for autonomy.

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[15] Various terms are used in the literature to describe the pressure or stress experienced by students (e.g., school-related pressure, school-related stress, academic stress, academic pressure, parental pressure). In addition to stress resulting from pressure to perform, these terms sometimes include stress resulting from conflicts with peers or teachers (Murberg & Bru, 2007).

According to theories of socialization (Grusec & Hastings, 2007; Parsons & Bales, 1955) both, school and family are important contexts of socialization. Accordingly, these contexts play a crucial role in the satisfaction of children's psychological needs. While parents play the most important role during childhood, the influence of people within the school context and the peer group gradually increases as children grow older. Consistent with this, a study examining 16- to 18-year-old adolescents found that only pressure exerted in the school context was significantly negatively related to mental health, while pressure exerted by parents had no effect (Deb et al., 2015). Given the aforementioned importance of parents in childhood, which is emphasized in socialization theories (e. g., Grusec & Hastings, 2007), it is, however, conceivable that during elementary school, academic pressure exerted by parents (hereafter referred to as "parental pressure") is more important for students' well-being than academic pressure exerted by people (e.g., teachers) within the school (hereafter referred to as "school pressure"). Moreover, in Germany, curricular differentiation (i.e., tracking) begins after fourth grade in most federal states, so parents might have a strong interest in ensuring that their children do well at the end of elementary school so that they qualify for higher-track schools. This could lead to high parental pressure that is negatively perceived by students and thus affects their well-being. Unfortunately, relations between academic pressure and well-being have been primarily investigated in samples of secondary school students, and past investigations have failed to simultaneously consider various sources of academic pressure. Directly comparing school pressure and parental pressure would help to better understand the crucial factors for students' well-being.

2.3 Relevance of Individual Factors for Students' Well-Being

When examining the effects of academic pressure, it is important to also take students' individual characteristics into account, which partially determine their well-being. One such characteristic that may have an impact on students' well-being is gender. Several studies

reported that girls exhibited higher values on positive aspects of well-being such as satisfaction with school (Kleinkorres et al., 2020; Liu et al., 2016). Other studies found that girls reported more often about physical issues and reported higher levels of anxiety than boys (Wiklund et al., 2012). Another important factor in students' well-being, in addition to gender, is their individual learning and achievement experience. Because positive experiences in this regard can enhance students' sense of competence, they might also have a positive impact on well-being in line with self-determination theory (e.g., Ryan & Deci, 2020). Indeed, there is evidence that schoolchildren's well-being is related to prior academic achievement, suggesting that higher achievement in school has a positive effect on students' well-being (Kleinkorres et al., 2020; Ng et al., 2015; Rodríguez et al., 2020; Steinmayr et al., 2016). Based on these considerations, both gender and academic achievement should be included as control variables when investigating influencing factors.

2.4 The Present Research

Given the importance of students' well-being (Kanonire et al., 2020; van Petegem et al., 2007) it is necessary to obtain a deeper understanding of the conditions under which students can experience it. Consequently, there is a need for research on harmful factors such as academic pressure. This is particularly true for elementary school students.

To optimally address the school context and the multifaceted nature of students' well-being, we considered five facets to measure the overarching components in the present study: satisfaction with school, enjoyment of school, worries about school, physical complaints related to school, and social integration. For these selected facets, it was first analyzed whether they form a common superordinate factor or whether they are correlated individual factors. Due to the exploratory nature, no hypothesis was formulated and a model with a superordinate factor was tested against a model with correlated factors.

In addition, based on the notion that well-being depends on the degree to which behavior is self-determined (Ryan & Deci, 2000, 2020), we expected that parental pressure and school pressure would be negatively associated with positive facets of students' well-being (i.e., satisfaction with school, enjoyment of school, social integration) and positively associated with negative facets of students' well-being (worries about school, physical complaints related to school; Hypothesis 1a [H1a]), even when controlling for the influence of gender and academic achievement (Hypothesis 1b [H1b]).

Finally, we compared different sources of academic pressure. Based on theories of socialization (Grusec & Hastings, 2007; Parsons & Bales, 1955), we hypothesized that each facet of elementary school children's well-being would be more strongly associated with parental pressure than with school pressure when considering both variables simultaneously (Hypothesis 2a [H2a]). Again, we assumed that the results would be robust when controlling for the impact of gender and academic achievement (Hypothesis 2b [H2b]).

3. Method

3.1 Participants

In total, 374 fourth graders in German elementary schools participated in the study, which was part of the field test of the Progress in International Reading Literacy Study 2021 (PIRLS; Mullis & Martin, 2019). PIRLS is an international study that has been conducted every five years since 2001 and currently involves 65 participating countries and regions. The main goal of the study is to assess the status and trends in children's reading achievement in fourth grade, but it also collects extensive information on contextual factors at home and school (Mullis & Martin, 2019). Participation in the study was required and approved by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder (Federal States) in the Federal Republic of Germany. Because the study was part of the national educational monitoring system, participation in the achievement test and completion of the student

questionnaire were compulsory for all students. The study was conducted in accordance with the human research standards. The International Association for the Evaluation of Educational Achievement (IEA), which conducts PIRLS, has standardized quality control procedures to ensure appropriate administration of the study in the participating countries and regions. In addition, all federal states in Germany have subjected the materials and proceedings to a data protection appraisal.

The PIRLS field test was conducted in early 2020 just before the COVID-19 pandemic outbreak. Schools were selected based on several stratification characteristics (e.g., proportion of students with an immigration background) to obtain a representative sample of fourth graders. The resulting sample included students from 18 different schools from three federal states in Germany. Classes within a school were randomly selected. One class with 25 individuals had to terminate the test session before completing because a school bus needed to depart, which led to missing values on all self-report measures of interest. In addition, six individuals had to be excluded because they had functional or intellectual disabilities or due to language barriers[16]. Another student had to be excluded because data backup failed. Therefore, the final sample consisted of 342 fourth graders (45.9% female[17]) from 17 classes in 17 different schools distributed across the three participating federal states. The mean number of students per class was 20.11 (Range: 10 – 26). Students were 10.29 years old on average ($SD = 0.54$). When asked about the number of books at home as an indicator for socioeconomic background, 72.51% of students reported that their family owned 100 books or less, while 25.73% stated that their family possessed more than 100 books. A proportion of 1.75% of the students made no statement about the number of books at home. Compared to other

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[16] The presence of intellectual disabilities was assessed by the school principal or other qualified staff members or was certified in the form of a test result. Language barriers were considered to be present when students had less than one year of instruction in the test language (for details, see Martin et al., 2017, pp. 52–53)

[17] Participants could choose between "male", "female" and "other" to indicate their gender. The option "other" was not chosen by any child.

representative samples of German fourth graders (Ludewig et al., 2022), socioeconomic status was slightly lower in the present sample. Furthermore, the sample included about 23.90% children with an immigration background, which was operationalized by the language spoken at home ("I sometimes speak German and sometimes speak another language at home", or "I never speak German at home"). This percentage was consistent with what has recently reported in other representative samples of German fourth graders (Ludewig et al., 2022).

3.2 Instruments

3.2.1 Students' Well-Being

We used five established scales to measure the different components of students' school-related well-being. Students' *satisfaction with school* captured their positive cognitions towards school and was assessed with one item ("How satisfied are you with your school?") on a 6-point scale ranging from 1 (= *completely dissatisfied*) to 6 (= *completely satisfied*). The item originates from Schwarzer and Jerusalem (1999) and was slightly rephrased. It is similar to common items for measuring general life satisfaction (Diener et al., 1985). *Enjoyment of school* addressed students' positive emotions towards school (e.g., "School is a place where I enjoy being"). It was measured with three items on a 4-point scale (1 = *strongly disagree*, 2 = *somewhat disagree*, 3 = *somewhat agree*, 4= *strongly agree*). For the analysis, one of the items was recoded because it was worded negatively. The scale is a subset of the instrument from Darge et al. (2010). Negative emotions towards school were captured through *worries about school* that students reported. The scale was based on the corresponding subscale from Hascher's (2004) questionnaire on SWB in school and comprised four items (e.g., "In the last four school weeks, I have been worried about how I am going to get my homework done"). Students evaluated each item on a scale ranging from 1 (= *strongly disagree*) to 4 (= *strongly agree*). *Physical complaints related to school* captured students' physical well-being at school. This scale was also based on a subscale from Hascher's (2004) questionnaire on SWB in school

and comprised four items asking about the frequency of illness symptoms in recent weeks (e.g., "In the last four school weeks, I had headaches"). Students responded to each item on a 4-point scale (0 = *never* to 3 = *always*). The social component of students' well-being was considered via the *social integration* subscale of the short version of the self-report questionnaire measuring the dimensions of students' integration in school (Venetz et al., 2014) and addressed to what extent students felt integrated into class. The subset of items we used in our analyses consisted of three items (e.g., "I get along very well with my classmates") and was queried on a 4-point scale from 1 (=*strongly disagree*) to 4 (=*strongly agree*). Reliabilities of all well-being measures were acceptable to good (see Table 1 for correlations, means, standard deviations, reliabilities, and missing rates).

3.2.2 Academic Pressure

Academic pressure by parents and the school was measured in the PIRLS field test with instruments based on a scale from Hagenauer (2011). The two scales were largely congruent in content, but differed slightly in wording depending on whether they addressed the school or family context (for a comparison of the items of both scales, see Appendix A, Table A1). The items captured whether students experienced pressure applied by people within the school and their parents. Each scale comprised four items that students evaluated on a 4-point scale from 1 (= *strongly disagree*) to 4 (= *strongly agree*). Reliabilities of both measures of academic pressure were acceptable (see Table 1 for correlations, means, standard deviations, reliabilities, and missing rates).

3.2.3 Academic Achievement

In the field test of PIRLS 2021 in Germany, which was conducted in 2020, eight international test booklets were administered, each composed of two texts[18]. A total of 230

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[18] The test booklets were constructed from a pool of 14 literary and informational texts.

questions (115 constructed-response items and 115 multiple-choice items[19]) were administered that dealt with different reading comprehension processes (focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information, and evaluate and critique content and textual elements; see Mullis & Martin, 2019). Each student completed a single booklet and hence answered a subset of these questions (minimum = 31 questions, maximum = 40 questions). Weighted likelihood estimates (WLE) were calculated based on the students' performance. A one-parameter logistic model (1-PL model) was computed, with missing data treated according to standard procedures in large-scale international assessments (for details, see Martin et al., 2017, p. 297)[20]. The resulting WLE scores were standardized; the reliability was good (WLE reliability = .86).

3.3 Procedure

The test session was conducted by trained test administrators and lasted approximately four hours, including breaks. It was separated into two parts. In the first part, students completed the reading tasks on tablets provided by the test administrator. Subsequently, students answered questions about the content. The reading test was split into two blocks of 40 minutes each with a break in between. In the second part, students were given questionnaires asking for sociodemographic information, family characteristics, and student characteristics (e.g., academic pressure, well-being). The questionnaire was also divided into two blocks. The first half of the questionnaire was part of the international survey and was completed by students at the computer. The second half of the questionnaire comprised questions that were part of the national supplement and was filled out by students in paper-based form.

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[19] Compound multiple-choice items that were worth two points were scored according to common procedures in large-scale international assessments (for details, see Martin et al., 2017, p. 31).
[20] During the scaling procedure, seven of the 230 items were eliminated because of very low (< 5%) or very high (> 95%) solution probabilities.

3.4 Data Analysis

Descriptive statistics for all variables and all analyses were calculated in *R* (Version 3.6.3; R Core Team, 2020). More precisely, the R package "lavaan" was used (Rosseel, 2012). In a first step, a model with five first-order factors was tested to confirm that the different well-being scales represent unique factors. In a second step, a model with a second-order factor (superordinate factor for students' well-being) was tested to examine if there is a common source of variance for the single facets of students' well-being. Finally, the two models were compared. To examine H1 and H2, structural equation models (SEM) were specified with students' well-being regressed on measures of academic pressure. Regardless of what testing the structure of students' well-being would yield, we focused on modeling paths between measures of academic pressure and each facet of students' well-being to obtain more detailed information about the relations. However, associations between academic pressure and the factor of global school-related well-being were additionally provided in the case of a good model fit of the second-order model. Because directed hypotheses were formulated, the *p*-values of the regression coefficients between academic pressure and students' well-being were halved and the corresponding confidence intervals were calculated at the 90%-level. The confidence intervals of the other regression coefficients and of the R^2-values were calculated at the 95%-level. H1b and H2b were examined by including gender and academic achievement as predictors of well-being. In these SEMs, in which multiple exogenous variables were considered simultaneously, these were allowed to correlate with each other. All psychological constructs were modeled as latent variables. To take into account the fact that satisfaction with school was measured with only a single item, we modeled this variable as a single indicator of a latent variable and specified a reliability value of 0.85 (Jöreskog & Sörbom, 1982; Petrescu, 2013). Furthermore, we specified indicator-specific covariances for the items that were similarly formulated in both scales measuring academic pressure.

The model parameters[21] were calculated by means of maximum likelihood estimation with robust standard errors and scaled test statistics that are asymptotically equal to the Yuan-Bentler test statistic (Rosseel, 2012). To evaluate model fit, we examined the Akaike information criterion (AIC), Bayesian information criterion (BIC), comparative fit index (CFI), and root mean square error of approximation (RMSEA). We used robust estimators of the CFI and the RMSEA (Brosseau-Liard et al., 2012). Because the χ^2-difference test is very sensitive to sample size, we reported the ΔCFI in addition to the test and also used the latter measure to compare the nested models. We followed Cheung and Rensvold's (2002) recommendation to prefer the restricted model if ΔCFI is equal to or greater than -.01. The data were hierarchically structured as students were nested within classes. To account for the resulting dependence of the observations (ICCs within classes ranged from .00 to .11), student class membership was considered in our analyses to compute cluster-robust standard errors of the parameters estimated in the SEMs (Rosseel, 2012). Finally, missing data was handled within the SEMs with the full information maximum likelihood estimation (FIML; Graham & Coffman, 2012).

4. Results

4.1 Descriptive Results

Correlations between variables of interest were mostly statistically significant and ranged from small to large size (see Table 1). The well-being measures were low to moderately correlated with each other. For example, satisfaction with school was negatively related to physical complaints related to school, suggesting that students who were more satisfied with school also experienced less physical discomfort at school. Moreover, school and parental pressure correlated highly positively with each other, and both exhibited a moderate negative relation with academic achievement.

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[21] Standardized parameters are reported throughout the results section.

Table 1

Correlations, Means, Standard Deviations, Reliabilities, and Missing Rates of all Relevant

Constructs of the Present Study

	1	2	3	4	5	6	7	8
1. SWS								
2. EOS	.37***							
3. WS	-.25***	-.18**						
4. PC	-.24***	-.29***	.37***					
5. SI	.30***	.21***	-.13*	-.15**				
6. SP	-.12	-.08	.28***	.21***	-.07			
7. PP	-.17*	-.08	.29***	.20**	-.19**	.53***		
8. AA	.27***	.18**	-.29***	-.35***	.16**	-.34***	-.32***	
9. Gender [a]	.14*	.19***	-.05	-.06	-.02	-.18**	-.10	.12*
M	4.72	2.90	2.41	0.68	3.47	3.04	2.87	0.00
SD	1.60	0.85	0.97	0.66	0.64	0.65	0.72	1.00
Reliability	-	.75[b]	.82	.83	.80	.71	.71	.86[c]
Missing rate	.08	.11	.09	.10	.11	.25[d]	.25[d]	.01

Note. N = 342. SWS = Satisfaction with school, EOS = Enjoyment of school, WS = Worries about school, PC = Physical complaints related to school, SI = Social integration, SP = School pressure, PP = Parental pressure, AA = Academic achievement. [a] Gender is a dichotomous variable (1 = male, 2 = female). [b] Reliability estimates are based on Cronbach's alpha (Cronbach, 1951). [c] WLE reliability. [d] Analyses of missing values for school pressure and parental pressure revealed that the group of individuals with missing values on the respective variable did not differ from the rest of the sample in terms of age (school pressure: $t(150.75) = -0.17$, $p = .861$; parental pressure: $t(130.87) = -0.77$, $p = .441$), gender (school pressure: $\chi^2(1) = 0.02$, $p = .888$; parental pressure: $\chi^2(1) = 0.15$, $p = .703$), and socioeconomic status (school pressure: $\chi^2(1) = 0.08$, $p = .771$; parental pressure: $\chi^2(1) = 0.25$, $p = .615$), but did differ in terms of academic achievement (school pressure: $t(143.81) = 4.01$, $p < .001$; parental pressure: $t(144) = 3.99$, $p < .001$). This finding could be due to the fact that the scales measuring academic pressure were administered at the end of the test session. Significance codes: * $p < .05$, ** $p < .01$, *** $p < .001$.

4.2 Multicomponent Model of Well-Being

The confirmatory factor analyses revealed acceptable model fit indices for both the first-order model and the second-order model of well-being (see Figures 1 and 2). The model comparison showed no deterioration in model fit based on the CFI value (ΔCFI = -.006;

$\Delta\chi^2(5) = 12.50$, $p = .029$), indicating that both models represented the data equally adequately.

The result indicated that the different facets of students' well-being share a common source of variance.

Figure 1

First-Order Model of the Five Different Student Well-Being Components
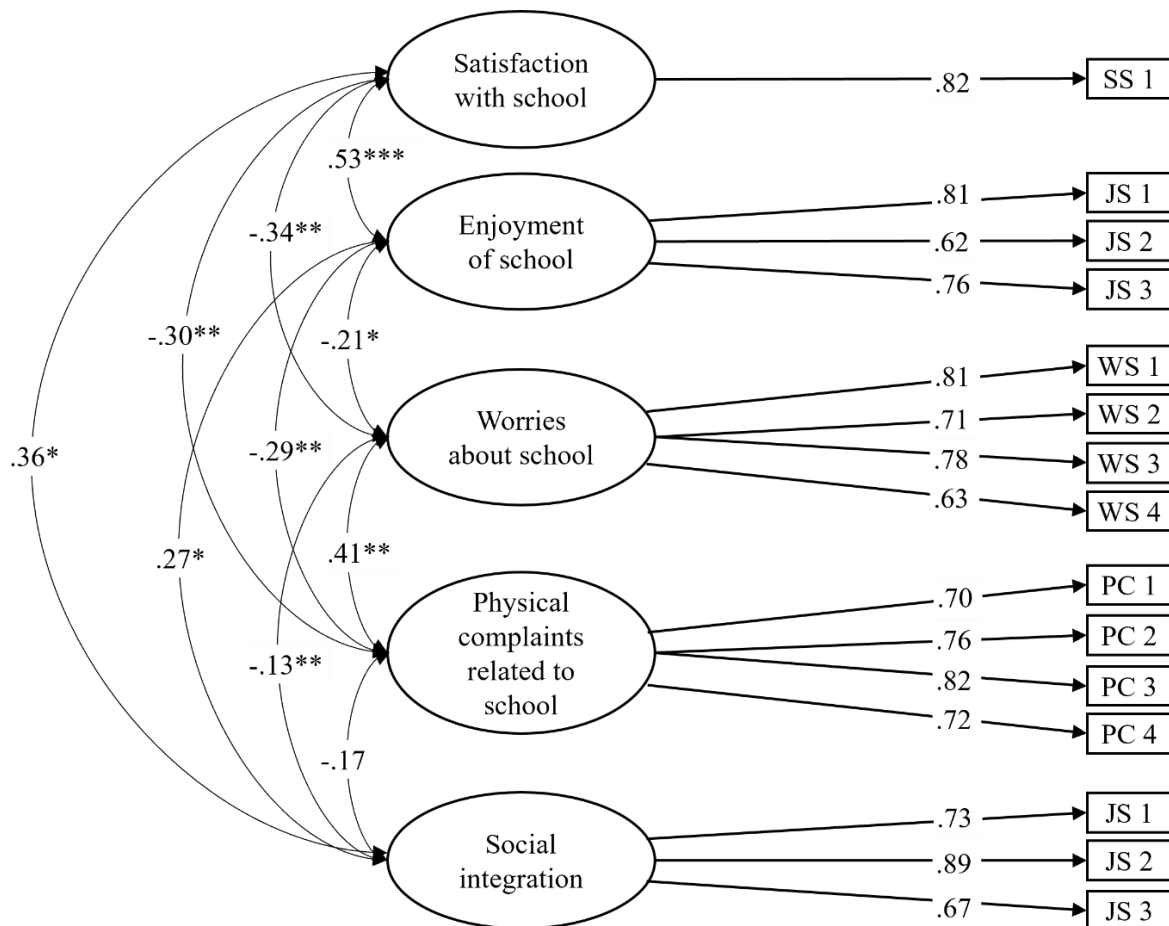
Notes. $N = 342$. $\chi^2(81) = 144.35$, $p < .001$; AIC = 11370.54; BIC = 11577.61; CFI = .959;

RMSEA = .049. Significance codes: $^+ p < .10$, $* p < .05$, $** p < .01$, $*** p < .001$.

Figure 2

Second-order Model of Students' Well-Being
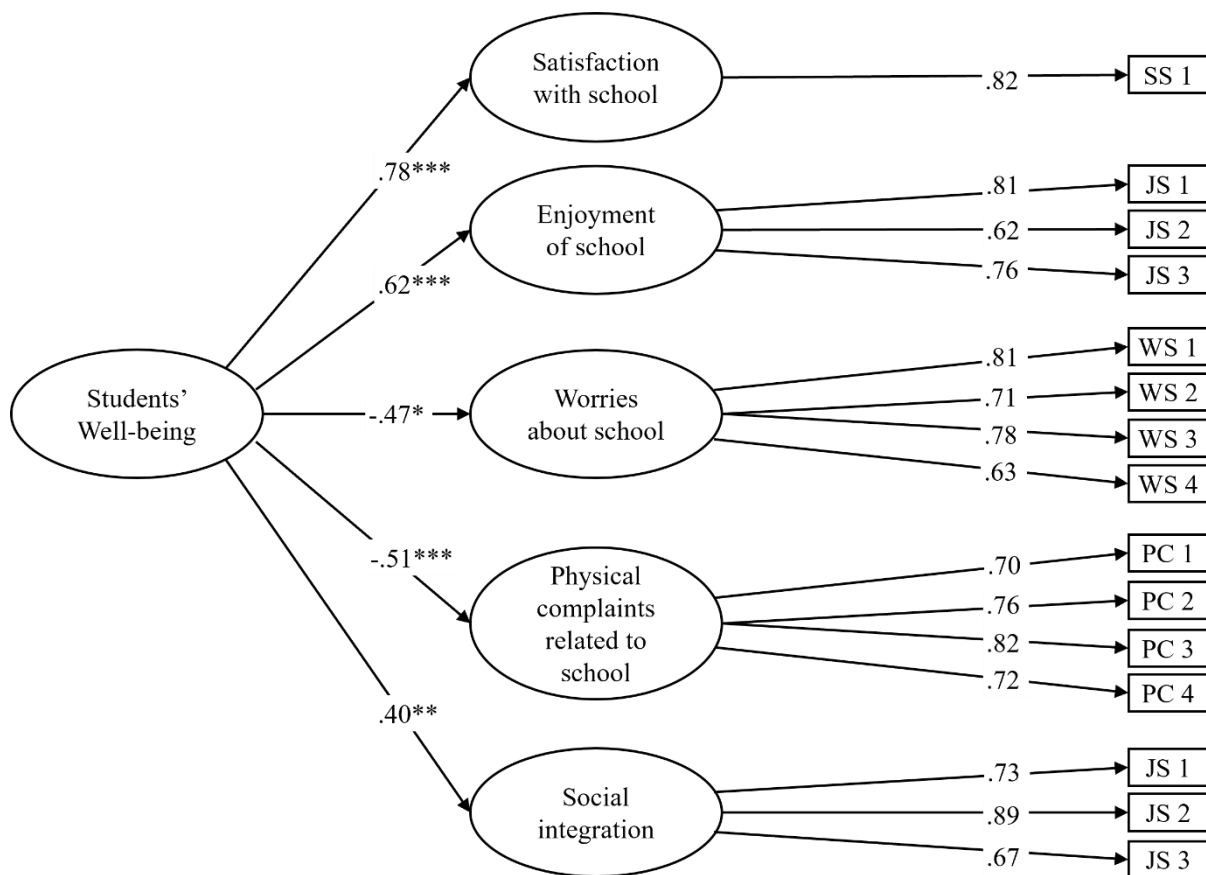
Notes. N = 342. χ²(86) = 157.75, *p* < .001; AIC = 11377.30; BIC = 11565.21; CFI = .953;

RMSEA = .051. Model identification was achieved by fixing the variances of the latent

variables to 1.

Significance codes: ⁺ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.

4.3 Relation between Students' Well-Being and School and Parental Pressure,

respectively

The figures presenting the results on the relations between the measures of academic

pressure and the individual facets of well-being can be found in Appendix B (Figures B.1

through B.5). The figures presenting the results on the relations between the measures of

academic pressure and the overarching well-being factor can be found in Appendix C (Figures

C.1 through C.6). The SEM with school pressure as the independent variable and the individual

well-being facets as dependent variables is displayed in Figure B.1 (see Appendix B). The regression coefficient for school pressure on worries about school was negative and statistically significant ($\beta = .33$, $p < .001$, $R^2 = .11$), meaning that a higher level of school pressure was associated with more worries about school. Furthermore, the model indicated that school pressure was significantly positively associated with physical complaints related to school ($\beta = .20$, $p = .044$, $R^2 = .04$). However, although the directions of most coefficients were as expected, none of the other coefficients were statistically significant ($\beta_{SWS} = -.12$, $p = .061$; $\beta_{EOS} = .01$, $p = 1.000$; $\beta_{SI} = -.09$, $p = .083$). Coefficients from the SEM with parental pressure as the independent variable can be found in Figure B.2 (see Appendix B). As expected, there were significant negative relations between parental pressure and satisfaction with school ($\beta = -.26$, $p < .001$, $R^2 = .07$) as well as social integration ($\beta = -.25$, $p = .010$, $R^2 = .06$). Therefore, a higher level of perceived parental pressure was associated with lower satisfaction with school and lower social integration. Furthermore, the regression coefficients for physical complaints related to school ($\beta = .26$, $p < .001$, $R^2 = .07$) and worries about school ($\beta = .34$, $p < .001$, $R^2 = .12$) were statistically significantly positive. Accordingly, students who perceived greater pressure by parents reported more physical complaints and worries about school. Finally, despite pointing in the hypothesized direction, the regression coefficient for parental pressure on enjoyment of school was non-significant ($\beta = -.10$, $p = .140$). In summary, the results partially supported H1a that both measures of academic pressure were related to each facet of students' well-being.

Checking the robustness of the results, including gender and achievement as predictors of the facets of well-being in the SEMs did not change the pattern of relations between the measures of academic pressure and students' well-being, but did cause a decrease in the strength of the coefficients (see Appendix B; Figures B.3 and B.4). In the SEM with school pressure as independent variable (see Appendix B, Figure B.3), the regression coefficient for

school pressure on worries about school was still positive and statistically significant ($\beta = .27$, $p < .001$), but slightly lower. Correlations between the independent variables were comparable in magnitude to the bivariate correlations reported in Table 1. For the SEM with parental pressure as independent variable (see Appendix B, Figure B.4), the same four statistically significant relations emerged in the model with control variables as before: the regression coefficients for parental pressure on satisfaction with school ($\beta = -.17$, $p = .049$) and social integration ($\beta = -.23$, $p = .045$) were negative, while the regression coefficients for parental pressure on worries about school ($\beta = .26$, $p = .003$) and physical complaints related to school ($\beta = .13$, $p = .037$) were positive. Correlations between the independent variables were comparable to the bivariate correlations reported earlier (see Table 1). Overall, the results supported H1b, as the regressions of students' well-being on school pressure and parental pressure were robust to including gender and academic achievement as control variables.

4.4 Comparison of School and Parental Pressure in terms of their Relation with Students' Well-Being

When school and parental pressure were considered in one model simultaneously (see Figure 3), the pattern of relations between facets of students' well-being and measures of academic pressure was similar to the one found in the SEMs containing each measure of academic pressure independently. However, only the paths from parental pressure to satisfaction with school ($\beta = -.23$, $p = .049$) and to social integration ($\beta = -.30$, $p = .042$) were statistically significant. A follow-up analysis with pathways from measures of academic pressure to the overarching factor of students' well-being revealed that only parental pressure was significantly related to students' overall school-related well-being (see Appendix C, Figure C.5). However, it should be noted that the confidence intervals of the coefficients of school pressure and parental pressure were overlapping. In summary, the results indicated that parental pressure is more strongly associated with satisfaction with school and social integration than

school pressure, but the same cannot be said of enjoyment of school, worries about school, and physical complaints related to school. Therefore, H2a was only partly supported.

Figure 3

Regression of Students' Well-Being on School and Parental Pressure
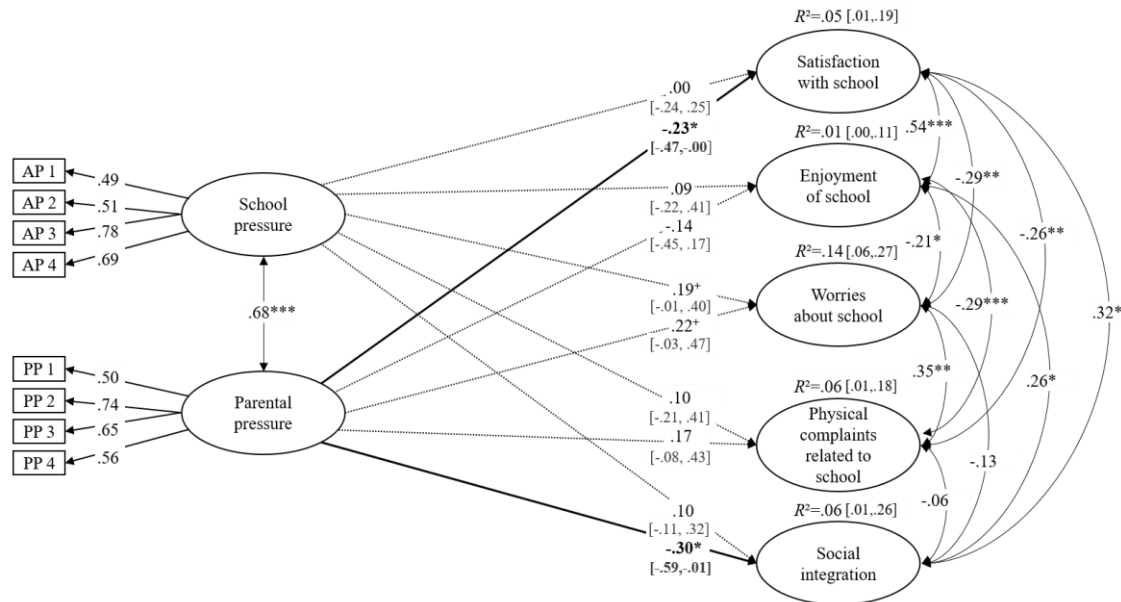
Notes. $N = 342$. $\chi^2(207) = 322.57$, $p < .001$, AIC = 16520.03, BIC = 16872.83, CFI = .9478, RMSEA = .040. Indicators of the individual well-being components are not included in the figure for purposes of clarity. Model identification was achieved by fixing the variances of the latent well-being variables to 1. Lines that are solid and bold indicate significant paths. Significance codes: $^+ p < .10$, $* p < .05$, $** p < .01$, $*** p < .001$.

Regressions of school pressure, parental pressure, and the control variables on facets of students' well-being are shown in Figure B.5 (see Appendix B). Although the overall pattern of relations between measures of academic pressure and students' well-being changed only slightly, introducing gender and academic achievement into the model was accompanied by a decrease in the magnitude of the coefficients, resulting in statistically non-significant paths from measures of academic pressure to facets of students' well-being. Gender was significantly

positively associated with enjoyment of school ($\beta = .21$, $p = .002$). Academic achievement was significantly positively associated with satisfaction with school ($\beta = .26$, $p = .009$) and significantly negatively associated with physical complaints related to school ($\beta = -.34$, $p < .001$) and worries about school ($\beta = -.19$, $p = .010$). Correlations between the independent variables were comparable to the bivariate correlations reported in Table 1. H2b had to be rejected because it stated that the results of H2a would be robust to the inclusion of gender and academic achievement. However, the follow-up analysis showed that at least the significant negative association between parental pressure and the overarching factor of students' well-being was robust to the inclusion of the control variables (see Appendix C, Figure C.6).

5. Discussion

Students' well-being is an important educational goal (Kanonire et al., 2020; OECD, 2017). However, a clear and generally accepted definition is lacking (Tobia et al., 2019). Furthermore, systematic research on its structure, especially in populations of elementary school children, is sparse. Moreover, due to the significance of students' well-being, it is of relevance to identify factors that may undermine it. Teachers and parents both play a central role in children's socialization process and may both put pressure on them. To date, however, it is unclear which source of pressure poses a greater threat to children's well-being. The present study was designed to contribute to a deeper understanding of the relationship between students' well-being and academic pressure. Therefore, students' well-being was operationalized by means of multiple facets and it was tested whether they stood alone or loaded onto a common underlying factor. Additionally, relations of academic pressure by people within the school and parents with students' well-being were investigated simultaneously.

5.1 Multicomponent Model of Students' Well-Being

To address the multifaceted nature of elementary school children's well-being, a multicomponent model was used. The aspects included were intended to reflect a student's school adjustment and the extent to which the school environment supports a student's cognitive, emotional, and social development (Hascher, 2008). The results indicated that the school-related well-being indicators satisfaction with school, enjoyment of school, worries about school, physical complaints related to school and social integration had a common source of variance which justifies the procedure of using these facets to measure students' well-being. Because both the correlated factor model and the model with a second-order factor fit the data well, our results indicated that the facets included in the model can be viewed as parts of well-being, but that they are also separable from one another and therefore capture different aspects and qualities of students' well-being. This result ties in with previous empirical studies that have examined a common underlying factor for various aspects of well-being in elementary (Kanonire et al., 2020; Liu et al., 2015) and secondary school children (Renshaw et al., 2015). Furthermore, this result underscores the multifaceted nature of students' well-being and the importance of comprehensively measuring it in order to evaluate it and its relations to other constructs precisely.

5.2 Relation between Students' Well-Being and Academic Pressure

In line with previous literature, we found relations between academic pressure and students' well-being among elementary school students (Choi et al., 2019; Hirvonen et al., 2019). Pressure from school and parents appeared to be particularly relevant to negative emotions towards school (i.e., worries about school), even when controlling for gender and academic achievement. This aligns with findings that parental and school pressure are associated with higher levels of anxiety and depression in samples of secondary school children (Kulakow et al., 2021; Liu & Lu, 2012), as well as with the findings by Hirvonen et al. (2019)

who found a positive relation between academic pressure and negative affect in elementary school children. Additionally, parental pressure was associated with lower levels of satisfaction with school and social integration and with higher levels of physical complaints related to school. These results are consistent with previous findings by Choi et al., (2019), who found a negative relation between academic pressure and life satisfaction in elementary school children, and Torsheim & Wold (2001) who reported a positive association between academic pressure and health complaints in secondary school children, although it should be noted that these two studies did not focus on parental pressure. However, in contrast to previous studies reporting negative associations between academic pressure and positive affect (Choi et al., 2019), we found no significant coefficients in the regressions of enjoyment of school on school or parental pressure. Our results suggest that academic pressure tends to increase students' negative emotions rather than decrease their positive emotions towards school. In addition, it was surprising that school pressure was not relevant to satisfaction with school. Based on previous studies (Choi et al., 2019), we would have expected a negative effect on students' positive cognitions toward school. Finally, unlike parental pressure, school pressure was not related to social integration, which may be due to the fact that social integration in our study was operationalized in terms of students' relationships with other students in their class or school. Nevertheless, most of the reported findings were as expected and revealed negative associations between academic pressure and well-being which can be explained by SDT (Ryan & Deci, 2000, 2020): A basic assumption of this theory is that the feeling of being able to determine one's own actions is necessary for well-being and motivation. As external pressure from the family or school context poses a threat to autonomous and self-determined behavior, it can lead to lower well-being in students.

Directly comparing the two measures of academic pressure in terms of their associations with individual facets of students' well-being revealed only scattered evidence

that parental pressure is more threatening for students' well-being than school pressure. Only the associations with satisfaction with school and social integration were more pronounced for parental pressure than for school pressure. Furthermore, when controlling for gender and academic achievement, no significant paths emerged between measures of academic pressure and students' well-being. However, as the follow-up analysis with pathways from measures of academic pressure to the overarching factor of students' well-being revealed, only parental pressure was significantly related to students' overall school-related well-being, even after accounting for control variables. Furthermore, the results of the simple regressions with the two measures of academic pressure suggested that parental pressure is somewhat more important than school pressure for students' well-being because it was associated with more different facets of students' well-being. This result can be explained in terms of theories of socialization (Grusec & Hastings, 2007; Parsons & Bales, 1955), according to which the family is the primary socialization context for an individual during childhood, while the influence of the school and peer group gradually increases. Therefore, the present finding may be explained as indicating that in elementary school, the family still has a greater influence on students' well-being than the school environment, while the influence of the academic context increases in secondary school (Grusec & Hastings, 2007; Parsons & Bales, 1955). Moreover, in Germany, tracking generally begins after Grade 4. Therefore, parental pressure in fourth grade might be more significant for students' well-being than school pressure. Accordingly, the result stands in contrast to findings from samples of older students, where school might already be a more prominent socialization agent than the family (Deb et al., 2015).

5.3 Limitations and Strengths

In order to appropriately interpret the results, it is important to be aware of some methodological limitations of the present study. The first limitation concerns the data collection, which was cross-sectional and therefore did not provide empirical evidence that the

measures of academic pressure exert a causal influence on students' well-being. Due to the subjective nature of the scales used to interrogate students' perceived academic pressure and well-being, the cross-sectional design does not preclude the possibility that higher well-being leads to lower perceptions of academic pressure. Moreover, it is also possible that academic pressure and well-being are reciprocally related. A further limitation is that the socioeconomic background of the sampled students was slightly lower compared to other samples of fourth graders (Ludewig et al., 2022). This somewhat limits the representativeness of the sample. The field test had to be stopped early due to the COVID-19 pandemic. It is conceivable that the sample would have been more representative in terms of socioeconomic background if more students had been able to participate. Another limitation concerns the measurement of the variables in our study. Satisfaction with school was only measured with a single indicator, which may lead to random and nonrandom errors (Bollen, 1989), even though we corrected for the uncertainty concerning reliability. Furthermore, the two measures of academic pressure correlated highly with each other, which may be because the scales were deliberately constructed to be similar. This high correlation could have led to multicollinearity in our models, which would explain why the number of statistically significant paths from measures of academic pressure to facets of students' well-being was low in the SEMs considering both measures simultaneously, in contrast to the pattern of relations that emerged from the bivariate correlations. At the same time, although the scales measuring academic pressure were constructed in a similar manner, there were still slight differences in the content of the wording of the individual items in the respective scales (see Appendix A, Table A1). In this regard, it should be noted that the items measuring school pressure were worded more broadly and asked about the extent to which there is a stressful school climate rather than asking about the specific pressure that certain individuals inflict on students, as is the case with the items measuring parental pressure. Consequently, students may not have interpreted them as equally threatening

to themselves, which should be considered when interpreting the results. Another issue that needs to be discussed in relation to academic pressure is the relatively high proportion of missing values, which is likely due to the fact that both scales were administered at the end of the questionnaire. Our in-depth analyses revealed that students with missing values on one of the two academic pressure scales had significantly lower scores on academic achievement. This could be interpreted to mean that individuals with higher cognitive abilities (as indicated by the higher average achievement scores of the total sample) were more likely to complete the subsequent questionnaire to the end, so that some lower-performing individuals may have been systematically excluded. Thus, it was important to control for academic achievement in our models. Furthermore, we treated the missing data with a state-of-the-art statistical approach.

Nevertheless, the study also has important strengths that have to be highlighted. First, in line with a comprehensive theoretical framework, students' well-being was operationalized via multiple facets, which is an advantage over many studies that considered only one or two aspects of the construct (Heffner & Antaramian, 2016). Moreover, we were able to support the assumption that students' well-being should be measured with multicomponent models considering cognitive, affective, physical, and social aspects by showing that the different facets measuring these components loaded onto a common underlying factor. Second, the sample size in the present study was high, promising robust results. Third, we simultaneously focused on different sources of academic pressure, which is an important extension of previous research, which primarily examined either school or parental pressure and its relation with students' well-being (Choi et al., 2019; Kulakow et al., 2021; Quach et al., 2015; Torsheim & Wold, 2001). Additionally, we controlled for the impact of gender and academic achievement as core related variables. Thereby, it is important to note that academic achievement was assessed with a reliable and valid competence test rather than self-reported grades.

5.4 Implications for Future Research and Educational Practice

The present study revealed new insights into the relation between students' well-being and different measures of academic pressure. However, there is a need for further research to substantiate the present findings and provide a more detailed picture. In this regard, it would first be important to replicate the results presented in this study. In terms of operationalizing students' well-being, the results should be corroborated by the use of scales that measure the constructs more comprehensively, particularly satisfaction with school, and by using other school-related indicators for the different components. For example, the cognitive component of students' well-being could be measured through attitudes towards school or academic self-concept (cf. Hascher, 2004, 2008) and the physical component with positive indicators like self-estimated health. In addition, indicators of psychopathology such as anxiety or depression could be included to examine differential effects between academic pressure and well-being and ill-being in terms of a dual-factor model (Suldo & Schaffer, 2008). With respect to the relations between students' well-being and measures of academic pressure, it would be interesting to compare elementary and secondary school children. Because previous studies repeatedly found relations between academic pressure and students' well-being that we only could partly replicate, it is possible that there is a shift from a stronger parental to a stronger school-based influence on students' well-being (see socialization theories; Grusec & Hastings, 2007; Parsons & Bales, 1955). In addition, it would be interesting to consider students' own goals and ambitions regarding their academic performance. It is conceivable that children who set higher goals for themselves either perceive external pressure as less high or that these children's well-being is less affected by external pressure because parents' or teachers' expectations match their own ambitions. In this context, it would be interesting to investigate whether pressure can lead to positive outcomes such as the experience of self-efficacy if it is seen as a challenge that can eventually be mastered (see SDT; Ryan & Deci, 2000, 2020).

Another focus of future research could be to use a more objective approach to examine the relation between academic pressure and students' well-being. This could be done in a multi-level analysis by specifying mean school pressure and well-being scores for students in each classroom and relating them to each other. This would also address the problem of self-report bias (see, e.g, Podsakoff et al., 2003) arising from only taking into account schoolchildren's subjective evaluations (Tobia et al., 2019). In general, it would be meaningful to use information about academic pressure and students' well-being reported by parents and teachers in addition to students' reports. In addition to these implications for future research, the results are also interesting for educational practice. Due to the many positive outcomes associated with students' well-being (Datu & King, 2018; Forrest et al., 2013; Gutman & Vorhaus, 2012; McKnight et al., 2002), teachers' and parents' awareness for schoolchildren's well-being should be raised, for example, by integrating the topic into teacher training. Moreover, both socialization agents should become aware of the negative impact that the pressure they put on elementary school children can have on their well-being and academic performance.

6. Conclusion

As students' well-being is an important educational goal, research on this topic is of great relevance. The present study provides deeper insights into the relation between academic pressure and multiple facets that reflect key components of students' well-being. More precisely, directly comparing different sources of academic pressure in the elementary school context allows for a more nuanced picture of how it affects students during their early school careers.

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Appendix

Appendix A

Items of the Scales Measuring Academic Pressure

Table A.1

Comparison of Measures of Academic Pressure

Scale	Items
School Pressure	In our school, a lot is demanded
	In our school, we get in trouble if we don't do our homework
	In our school, we have to put in a lot of effort
	In our school, good grades are very important
Parental Pressure	My parents demand that I study a lot for school
	My parents scold me when I do not do my homework
	If I get bad grades, I get in trouble with my parents
	It is very important to my parents that I have good grades

Appendix B

Relations Between Academic Pressure and the Individual Components of Students' Well-Being

Figure B.1

Regression of Students' Well-Being on School Pressure
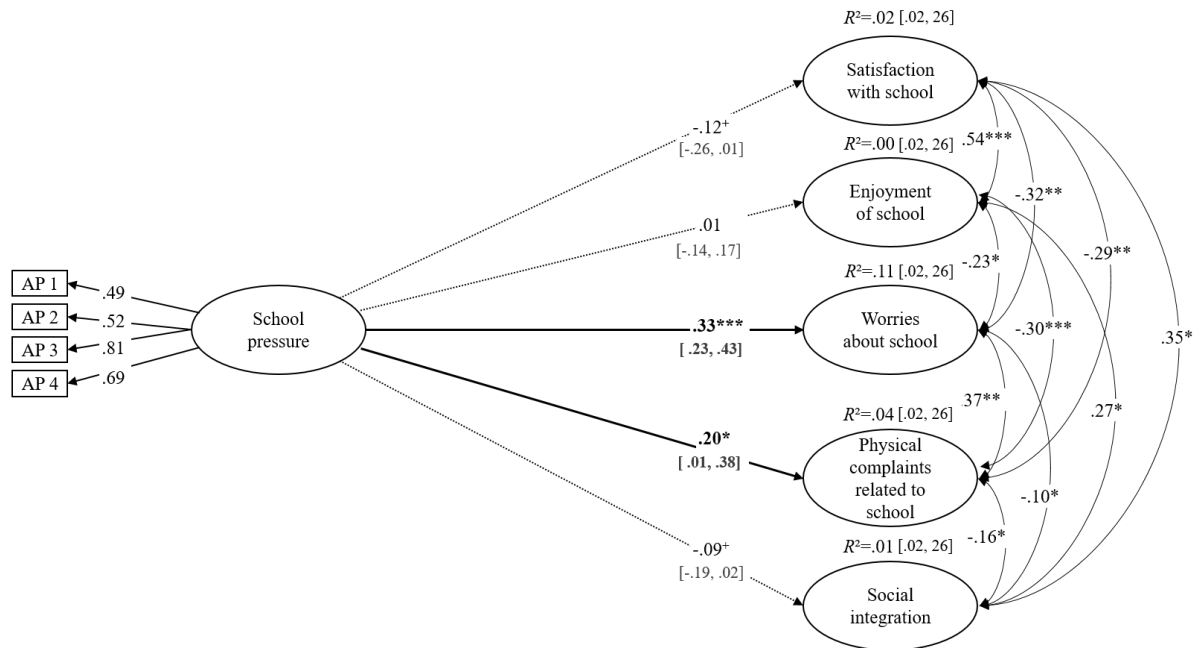
Notes. $N = 342$. $\chi^2(138) = 249.65$, $p < .001$; AIC = 13899.18; BIC = 14171.45; CFI = .941; RMSEA = .049. Indicators of the individual well-being components are not included in the figure for purposes of clarity. Model identification was achieved by fixing the variances of the latent well-being variables to 1. Lines that are solid and bold indicate significant paths. Significance codes: $^+ p < .10$, $* p < .05$, $** p < .01$, $*** p < .001$.

Figure B.2

Regression of Students' Well-Being on Parental Pressure

Notes. $N = 342$. $\chi^2(138) = 194.90$, $p < .001$; AIC $= 14085.71$; BIC $= 14357.98$; CFI $= .968$;

RMSEA $= .035$. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: [+] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure B.3

Regression of Students' Well-Being on School Pressure Controlling for Gender and

Academic Achievement

Notes. N = 342. χ²(164) = 307.43, *p* < .001; AIC = 15291.28; BIC = 15628.74; CFI = .927;

RMSEA = .051. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: ⁺ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.

Figure B.4

Regression from Students' Well-Being on Parental Pressure Controlling for Gender and
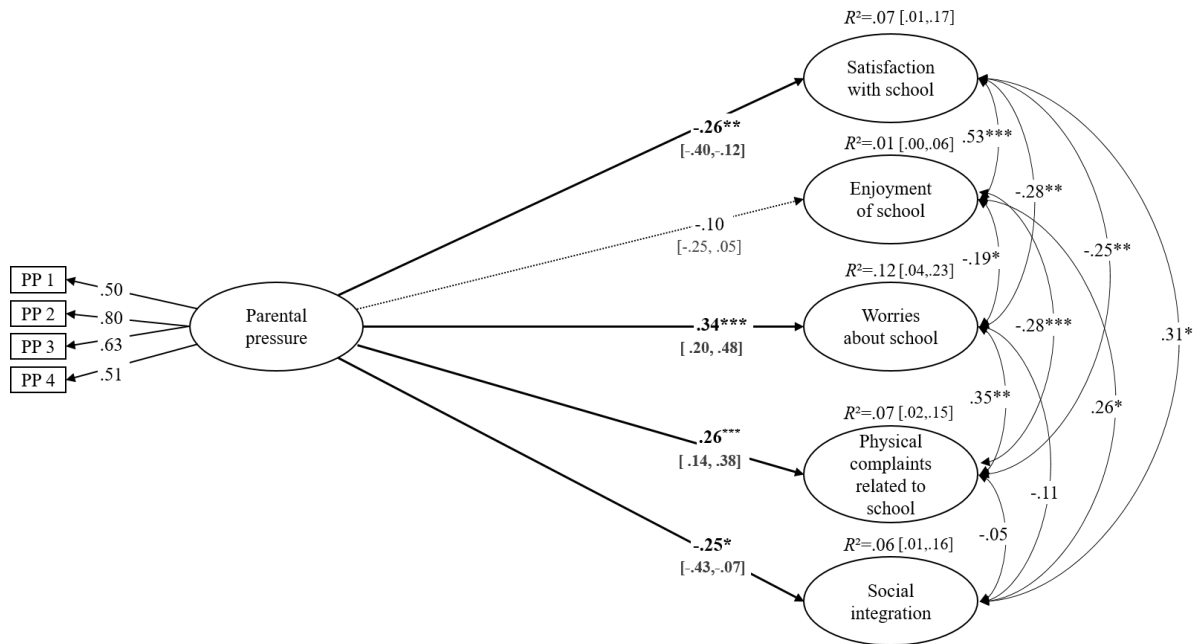
Academic Achievement

Notes. $N = 342$. $\chi^2(164) = 227.35$, $p < .001$; AIC = 15473.84; BIC = 15811.30; CFI = .965;

RMSEA = .034. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: $^+ p < .10$, $* p < .05$, $** p < .01$, $*** p < .001$.
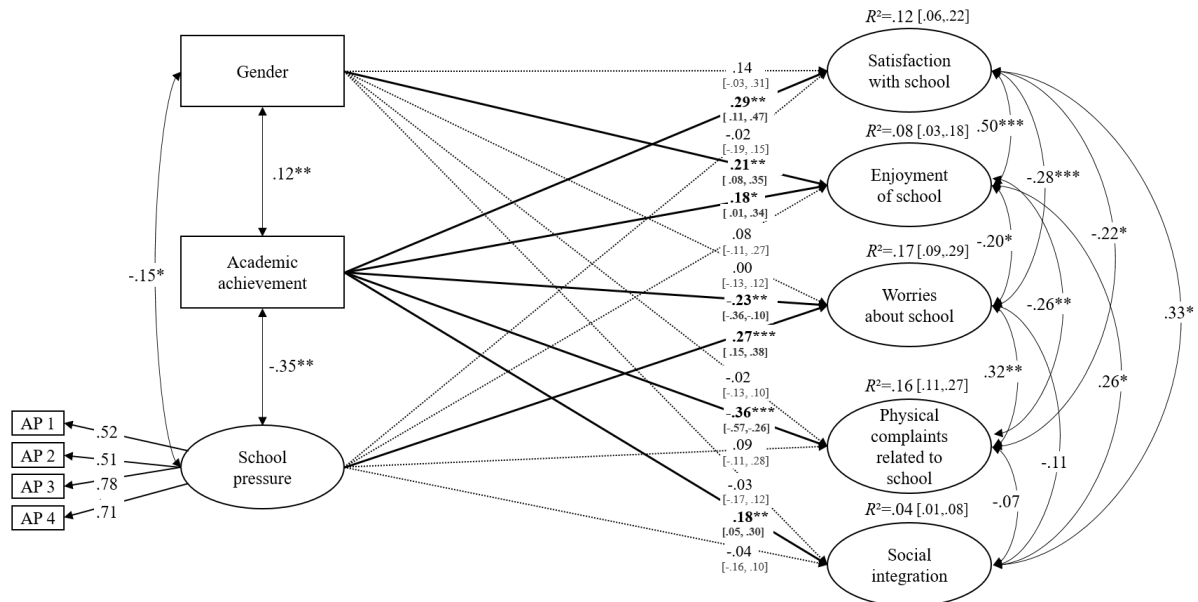
Figure B.5

Regression of Students' Well-Being on School and Parental Pressure Controlling for Gender

and Academic Achievement

Notes. N = 342. χ²(239) = 389.84, *p* < .001; AIC = 17907.57; BIC = 18333.23; CFI = .934;

RMSEA = .043. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: ⁺ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.

Appendix C

Relations Between Academic Pressure and the Second-Order Factor of Students' Well-Being

Figure C.1

Regression of Students' Well-Being on School Pressure

Notes. $N = 342$. $\chi^2(147) = 279.83$, $p < .001$, AIC = 13913.68, BIC = 14151.44, CFI = .929, RMSEA = .052. Indicators of the individual well-being components are not included in the figure for purposes of clarity. Model identification was achieved by fixing the variances of the latent well-being variables to 1. Lines that are solid and bold indicate significant paths. Significance codes: $^+ p < .10$, $^* p < .05$, $^{**} p < .01$, $^{***} p < .001$.
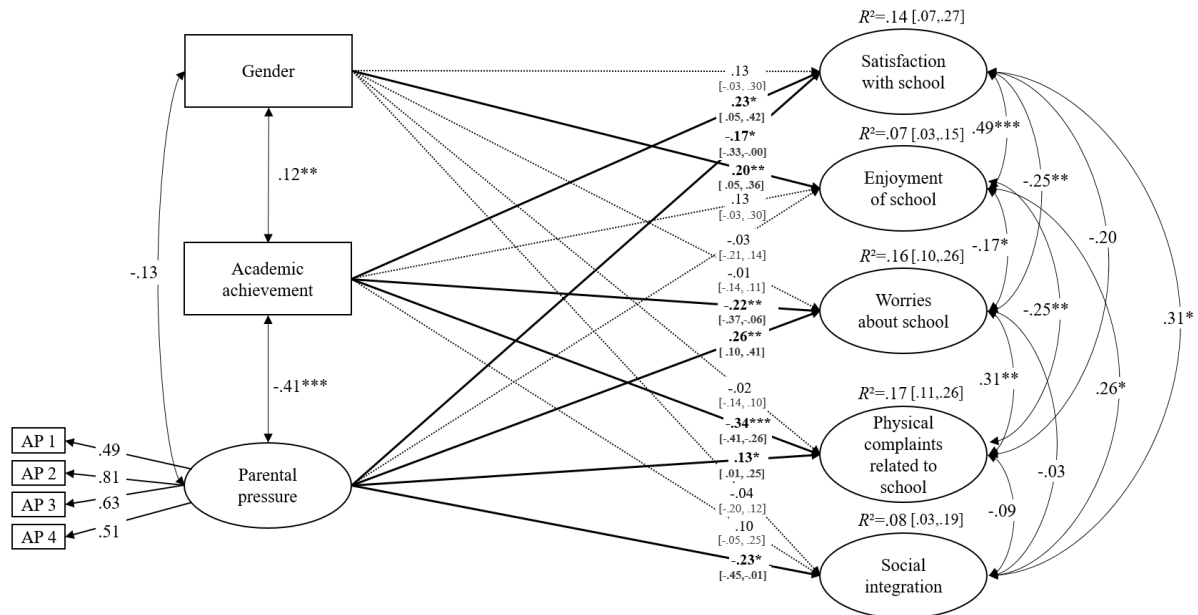
Figure C.2

Regression of Students' Well-Being on Parental Pressure

Notes. N = 342. χ²(147) = 218.64, *p* < .001, AIC = 14095.69, BIC = 14333.45, CFI = .959, RMSEA = .039. Indicators of the individual well-being components are not included in the figure for purposes of clarity. Model identification was achieved by fixing the variances of the latent well-being variables to 1. Lines that are solid and bold indicate significant paths. Significance codes: ⁺ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.
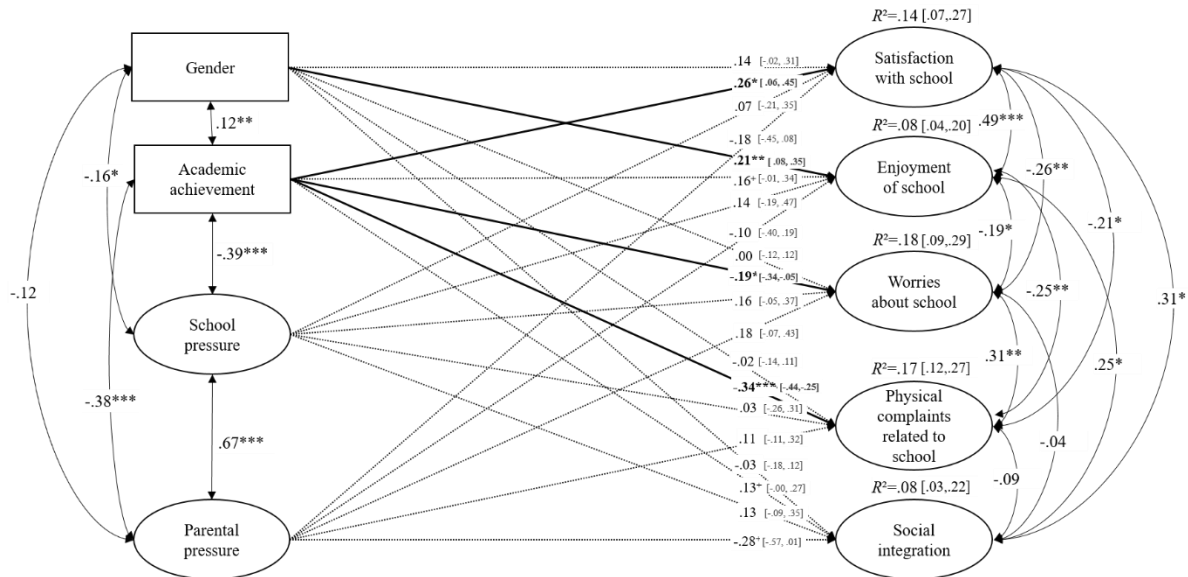
Figure C.3

Regression of Students' Well-Being on School Pressure Controlling for Gender and

Academic Achievement

Notes. N = 342. χ²(222) = 542.96, *p* < .001, AIC = 15349.48, BIC = 15644.76, CFI = .908,

RMSEA = .067. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: $^+$ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.

Figure C.4

Regression from Students' Well-Being on Parental Pressure Controlling for Gender and

Academic Achievement
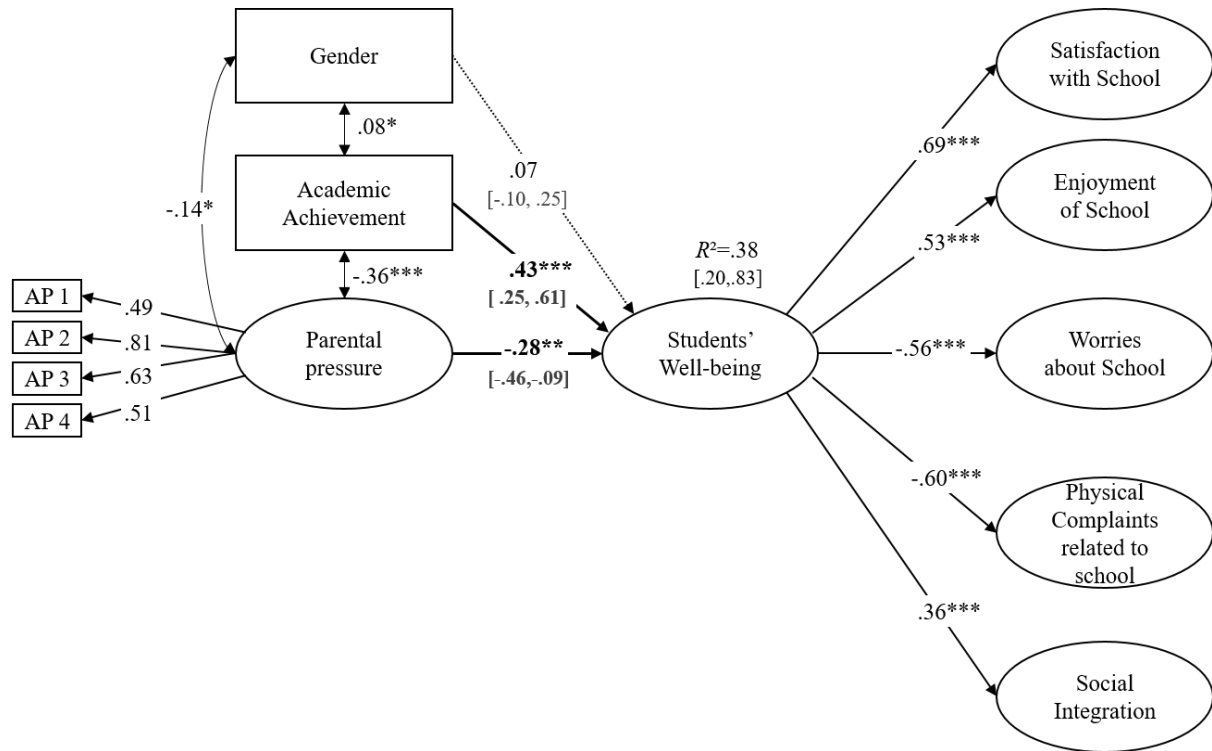
Notes. N = 342. χ²(222) = 474.22, *p* < .001, AIC = 15529.82, BIC = 15825.10, CFI = .925,

RMSEA = .060. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.
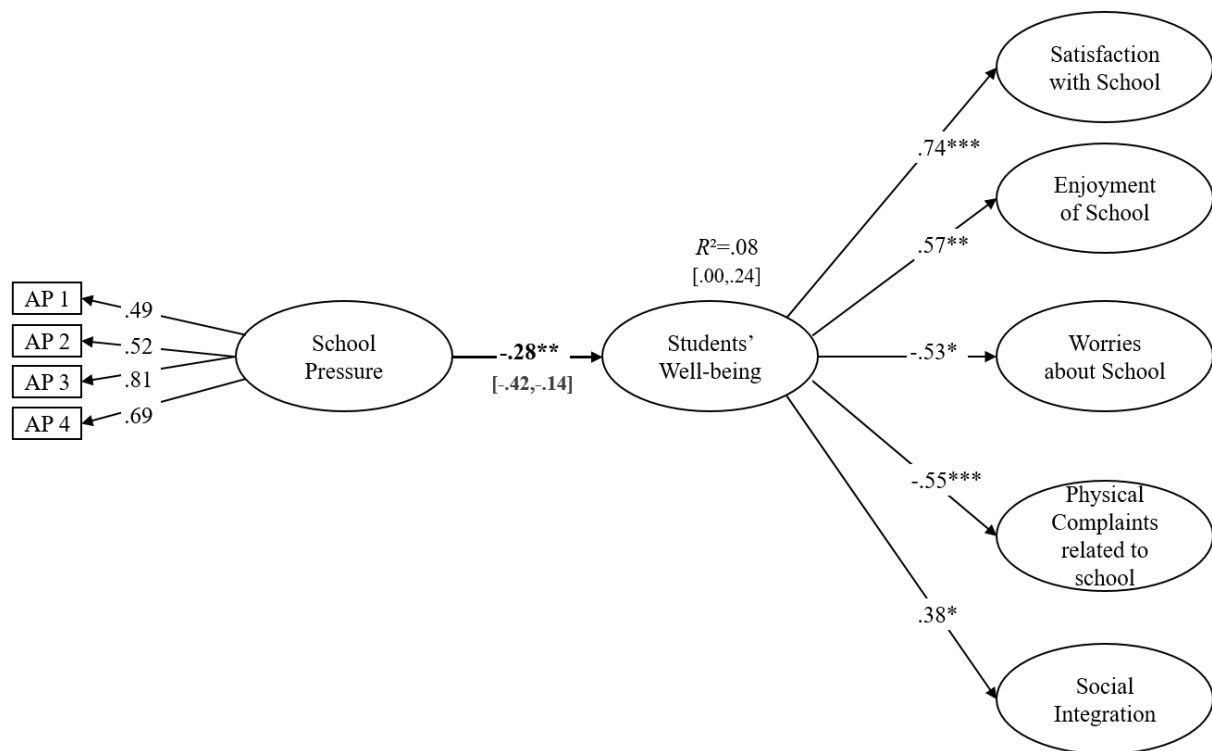
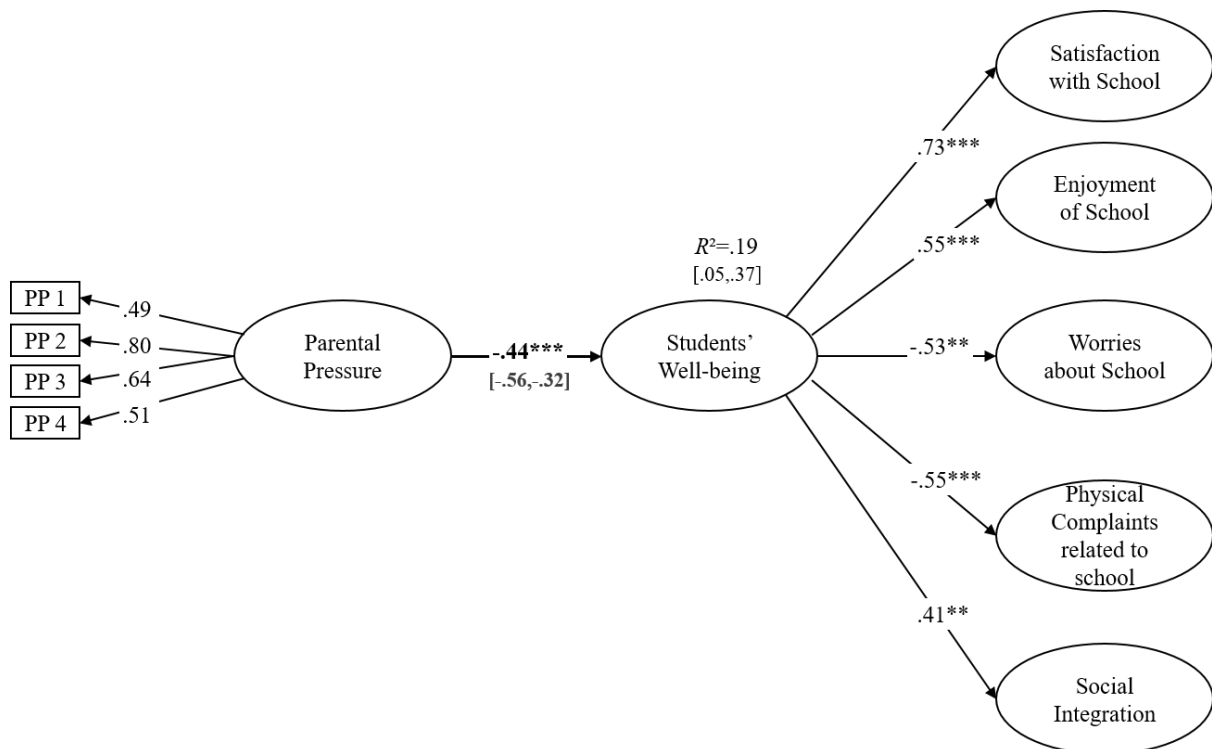Significance codes: $^+$ *p* < .10, * *p* < .05, ** *p* < .01, *** *p* < .001.

Figure C.5

Regression of Students' Well-Being on School and Parental Pressure
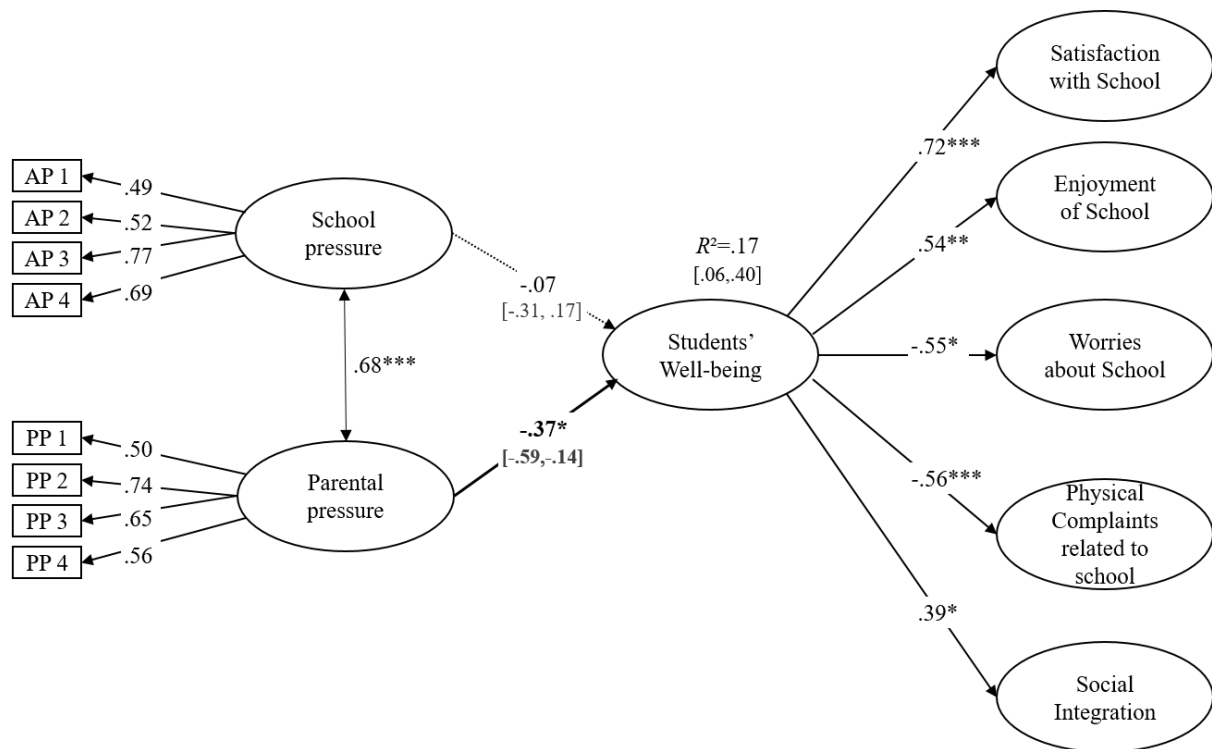
Notes. $N = 342$. $\chi^2(220) = 350.76$, $p < .001$, AIC = 16529.77, BIC = 16832.72, CFI = .938, RMSEA = .042. Indicators of the individual well-being components are not included in the figure for purposes of clarity. Model identification was achieved by fixing the variances of the latent well-being variables to 1. Lines that are solid and bold indicate significant paths. Significance codes: $^+ p < .10$, $* p < .05$, $** p < .01$, $*** p < .001$.

Figure C.6

Regression of Students' Well-Being on School and Parental Pressure Controlling for Gender
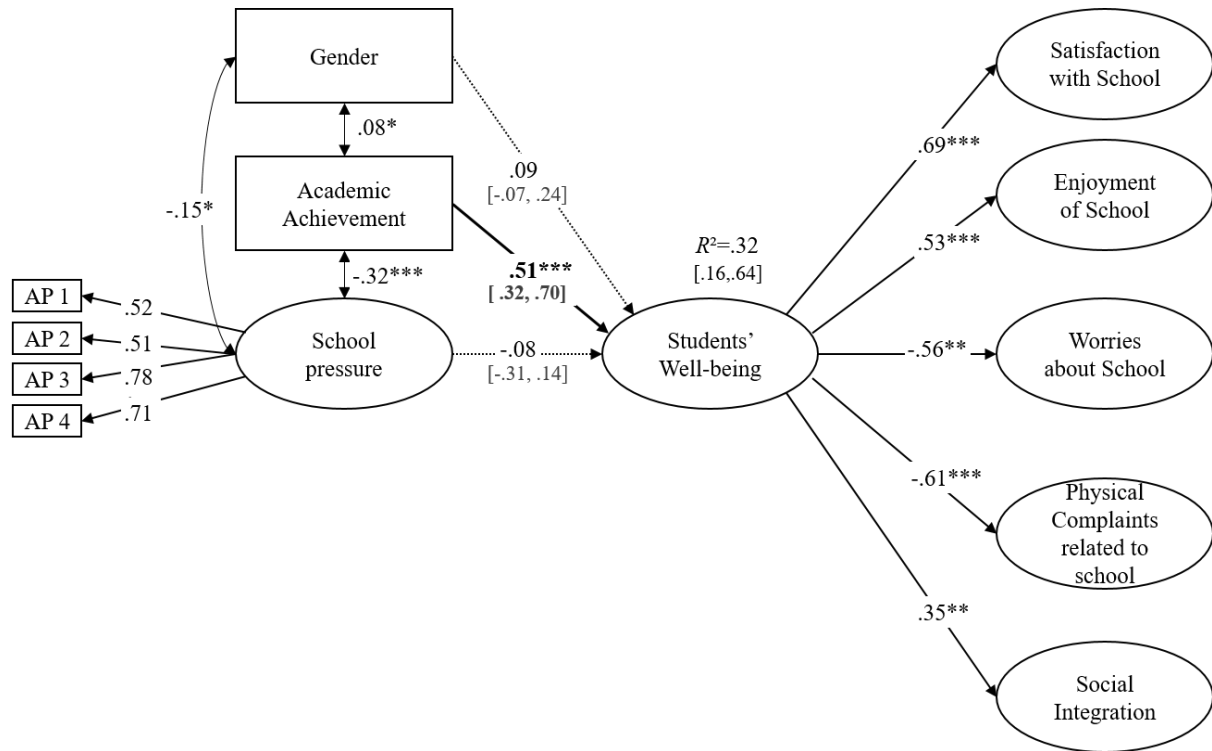
and Academic Achievement
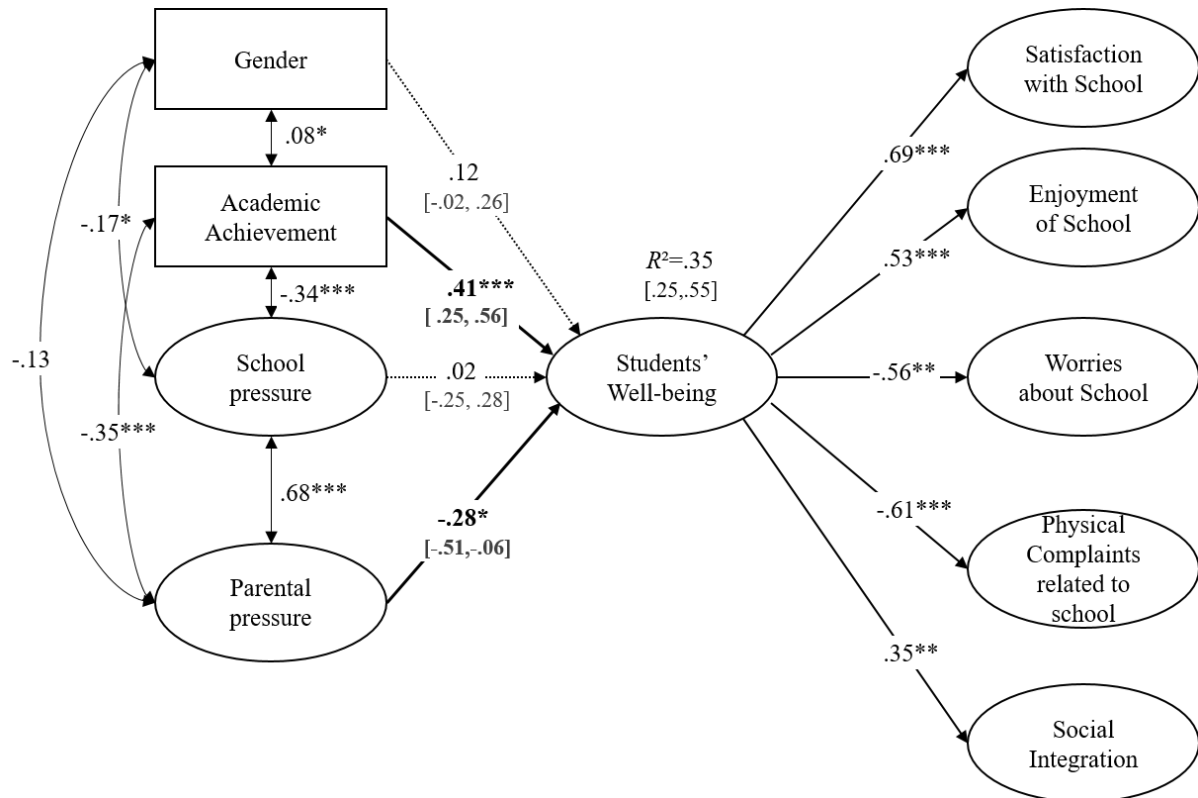
Notes. $N = 342$. $\chi^2(260) = 426.94$, $p < .001$, AIC = 17916.87, BIC = 18262.00, CFI = .924,

RMSEA = .044. Indicators of the individual well-being components are not included in the

figure for purposes of clarity. Model identification was achieved by fixing the variances of

the latent well-being variables to 1. Lines that are solid and bold indicate significant paths.

Significance codes: [+] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

4. General Discussion

This dissertation focused on the study of students' well-being in the school context as it represents a key educational goal (Hascher, 2004; Kanonire et al., 2020; OECD, 2017) whose circumstances and conditional factors still need to be better understood. In order to draw a differentiated picture of its state, its development over time, and its relations with other school-related variables, multiple components were considered that address the multifaceted nature of students' well-being. The knowledge interest of the two empirical studies that are part of the dissertation cumulus (Study I and Study II) and the further analyses (Study III) was guided by several overarching research questions. In the following section (Chapter 4.1), I will briefly summarize the main findings of each study. In Chapter 4.2, I will take these findings and discuss them in light of the overarching research questions. Subsequently, limitations and strengths across the studies will be discussed (Chapter 4.3). Finally, implications for future research and educational practice will be addressed in Chapter 4.4.

4.1 Summary of the Main Results of the Three Empirical Studies

Study I (*A Longitudinal Analysis of Reciprocal Relations Between Students' Well-Being and Academic Achievement*) sought to shed more light on the association between students' well-being and their academic achievement. To this end, the reciprocal relations between the two variables were analyzed over two and three measurement points, respectively, two years apart during the first four years of secondary school. This was done for the entire sample as well as separately for different genders and types of school. Cross-lagged panel models showed that mathematical competence was related to several facets of physical well-being at a later measurement point and that both mathematical competence and reading comprehension were reciprocally associated with helplessness in the school subjects mathematics and German. More specifically, academic achievement in both domains showed negative associations with later helplessness in the corresponding domain, whereas they showed a positive association

with later helplessness in the other domain. Regarding cognitive well-being, random intercept cross-lagged panel models showed mainly positive paths from satisfaction with life and satisfaction with school on later academic achievement, but not vice versa. Furthermore, life satisfaction in Grade 5 was positively related to reading comprehension in Grade 7, but there were also negative associations between life satisfaction in Grade 7 and both measures of academic achievement in Grade 9. The analysis of moderating effects by school type and gender revealed some minor changes in the pattern of associations. However, the multi-group models did not show improved model fit when the parameter estimates of different subgroups were estimated freely. The results suggest that especially students' mathematical competence is important for their later well-being, while particularly cognitive aspects of well-being seem to be important for later academic achievement, implying that both variables influence each other.

Study II (*The Longitudinal Development of Students' Well-Being in Adolescence: The Role of Perceived Teacher Autonomy Support*) examined the longitudinal development of several facets of students' well-being and whether they were related to changes in students' perceptions of the autonomy support they receive from their teacher, controlling for age and gender. As in Study I, the period of early adolescence was focused on and students were surveyed over a four-year period in early secondary school, with annual assessments over three to five measurement points included in the analyses. Latent growth curve models showed that students' satisfaction with school, enjoyment of school, and self-rated health decreased over time. Thereby, results suggested that only female students' self-rated health decreased, while male students' self-rated health remained stable. Perceived teacher autonomy support also showed a decreasing trend. In contrast, social integration remained stable. In addition, parallel process growth models showed that baseline levels of perceived teacher autonomy support were positively related to baseline levels of all the different facets of students' well-being and

that changes in perceived teacher autonomy support were positively associated with changes in satisfaction with school, enjoyment of school, and self-rated health. The study's findings underscore that students' well-being is at risk in early adolescence, and teacher autonomy support appears to play a critical role in this context.

The aim of the further analyses in Study III (*Comparing Parental and School Pressure in terms of their Relations with Students' Well-Being*) was to shed light on the relation between academic pressure and well-being among elementary school children. More specifically, it was examined whether pressure from individuals within the school (e.g., teachers) or from parents was more threatening to students' well-being, controlling for gender and academic achievement. Structural equation models, each focusing on an individual source of academic pressure, found that school-induced academic pressure was related to worries about school while academic pressure exerted by parents was related to satisfaction with school, physical complaints related to school, worries about school, and social integration when controlling for gender and academic achievement. The structural equation model, which contrasted both sources of academic pressure in terms of their relation to students' well-being, showed that academic pressure exerted by parents was more strongly related to satisfaction with school and social integration. When controlling for gender and academic achievement, the pattern of results remained similar, but the results were no longer statistically significant. Overall, the study findings suggest that academic pressure is negatively related to several aspects of students' well-being, with parental academic pressure appearing to be somewhat more critical to students' well-being.

4.2 Discussion of the Main Results

In the following sections, I will discuss the results in terms of the three overarching research questions of this dissertation, which were as follows:

1. How are students' academic achievement and their cognitive, affective, physical, and social well-being interrelated in elementary and secondary school? (Study I and further analyses in Study III)

2. How are students' perceptions of autonomy-supportive and autonomy-threatening behaviors of their parents and teachers related to different components of their well-being? (Study II and further analyses in Study III)

3. How do different components of students' well-being develop in early adolescence and how are factors that promote self-determination related to this development? (Study I and Study II)

4.2.1 *Relations Between Academic Achievement and Students' Well-Being*

In this section, the interplay between students' well-being and their academic achievement will be discussed. With regard to the elementary school context, Study III (further analyses) revealed significant relations between students' cognitive, affective, physical, and social well-being and academic achievement, which is consistent with prior research (Berger et al., 2011; Bo et al., 2016; Yang et al., 2019). More precisely, academic achievement was positively associated with positive indicators of students' well-being (e.g., satisfaction with school) and negatively to its negative indicators (e.g., worries about school). In the course of this, Study III extends the current literature in that it provides results on elementary school children from Germany and examines the differential relations between a large number of components of students' well-being and academic achievement in the same model simultaneously. The associations were low to moderately strong, which aligns with previous studies. Furthermore, Study I found positive relations between secondary school students' cognitive, affective, and physical well-being and academic achievement that were also small to moderate in magnitude which is in line with previous research as well (Bücker et al., 2018; Crede et al., 2015; Gumora & Arsenio, 2002; Kaya & Erdem, 2021; Obermeier et al., 2021;

Pietarinen et al., 2014; Steinmayr et al., 2019). Therefore, the present dissertation was able to substantiate existing research on the relation between students' well-being and academic achievement by replicating findings for both elementary and secondary school context. Due to the mainly cross-sectional evidence concerning the relation between students' well-being and academic achievement (for exceptions see Steinmayr et al., 2016; Suldo et al., 2011), one major contribution of the present dissertation was to longitudinally examine this relation in adolescence. Furthermore, several components of students' well-being were considered to gain a detailed picture of the interplay between both variables. The longitudinal findings on the associations with academic achievement for each of these components are discussed in detail in the following paragraph.

The results from Study I suggested that students' cognitive well-being (i.e. satisfaction with school) was positively related to later academic achievement (reading comprehension, mathematical competence) which is consistent with earlier longitudinal findings reported by Suldo et al. (2011) and recent longitudinal findings on these relations among female students at the transition to upper secondary school (Bortes et al., 2021). It is conceivable that students with more positive school-related cognitions are more willing to invest time in learning for school, show higher school engagement, and perform better as a result (Chase et al., 2014; Dotterer & Lowe, 2011; Fredricks et al., 2004). Another explanation could be that students with more positive school-related cognitions also have more positive emotions towards school, which broaden their thought-action repertoires (Fredrickson, 2001, 2013), leading to higher academic achievement. Satisfaction with life, as a general aspect of students' cognitive well-being, was also positively related to later academic achievement in mathematics in the first time interval, which could be interpreted in the same way as the results on satisfaction with school. However, satisfaction with life in Grade 7 was negatively related to academic achievement in Grade 9. These opposing effects occurring in two different time intervals

represent a surprising finding that should be further explored. With regard to students' affective well-being, Study I showed negative reciprocal relations between helplessness in the school subjects German and mathematics and academic achievement in the respective domains. The negative effects of helplessness on later academic achievement are consistent with previous findings on the relation between negative emotions and later academic achievement (Steinmayr et al., 2016) and could be explained by Eysenck's Attentional Control Theory (Eysenck et al., 2007). According to this theory, the results could be interpreted in that way that feelings of helplessness in a school subject are associated with increased anxiety in a domain-specific testing situation, leading to lower academic achievement because attention is directed to distracting rather than task-relevant aspects. The result that mathematical competence and reading comprehension are negatively associated with later helplessness could be explained in that way that the need for competence is more satisfied in those individuals with higher test scores resulting in a higher well-being and less negative emotions (Ryan & Deci, 2000, 2020). Regarding students' physical well-being, the results from Study I implied positive associations between mathematical competence and later physical well-being. These results could be also explained by SDT (Ryan & Deci, 2000, 2020) in that way that higher achievement in mathematics satisfies a student's need for competence, which results in higher well-being.

In summary, the findings on the relation between academic achievement and students' well-being provide support for different theoretical assumptions. While the associations between well-being and later academic achievement could be explained by Fredrickson's broaden-and-build theory (Fredrickson, 2001, 2013) and by Eysenck's Attentional Control Theory (Eysenck et al., 2007), the associations between students' academic achievement and later well-being could be explained by SDT (Ryan & Deci, 2000, 2020). Thus, the results of this dissertation suggest that the relation between academic achievement and students' well-being is characterized by a reciprocal influence. Because the findings from Study I are based

on cross-lagged panel models in which the measurement points are two years apart, future studies should substantiate and extend the results of this dissertation using smaller time intervals and multiple measurement points. I will discuss further implications, such as those related to the measurement of academic achievement when examining its relation with students' well-being, in Chapter 4.4.

4.2.2 Significance of Autonomy-Supportive and Autonomy-Threatening Behaviors for Students' Well-Being

The second overarching research question revolved around how students' perceptions of autonomy-supportive and autonomy-threatening behaviors of reference persons around them (i.e., parents, teachers) relate to their well-being. Autonomy represents a central psychological need (Ryan & Deci, 2000, 2020) and the adolescence marks a key phase in this context: This period is associated with physical, cognitive and socio-emotional changes (Eccles et al., 1993; Phillips, 2017; Sawyer et al., 2012) and children develop an increasing need for autonomy as they grow older.

With regard to autonomy-supportive behavior, the focus of this dissertation was on autonomy support provided by students' teachers. In line with previous research (Ferguson et al., 2011; Hagenauer & Hascher, 2010; Tilga et al., 2021), Study II revealed positive associations between teacher autonomy support and different facets of students' well-being. This finding could be explained by the fact that students' need for autonomy is satisfied though teacher autonomy support which leads to a higher sense of well-being (Reeve, 2015; Ryan & Deci, 2000, 2020). A major contribution of Study II was that it examined not only cross-sectional associations between these variables, but also associations among their longitudinal trends. The positive relations that have been found between trends in perceived teacher autonomy support and students' cognitive, affective, and physical well-being strengthen the assumption that teacher autonomy support is important for the development of students' well-

being. More precisely, this finding suggests that both constructs are especially closely bounded during early adolescence, which is in line with stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993) and the notion that the need for autonomy becomes particularly important in this life stage.

With regard to autonomy-threatening behaviors of individuals in the students' environment, the focus in this dissertation was on academic pressure. Consistent with prior research (Deb et al., 2015; Liu & Lu, 2012; Murberg & Bru, 2007; Obermeier, Schlesier & Gläser-Zikuda, 2022; Stang-Rabrig et al., 2022; Torsheim & Wold, 2001), it was found in Study III (further analyses) that academic pressure was negatively associated with several facets of students' well-being. By including multiple facets of students' well-being, a nuanced picture of the pattern of associations with academic pressure could be drawn. Because previous research examined this relation primarily with older students (for exceptions see Choi et al., 2019; Hirvonen et al., 2019) and for a small number of facets of well-being, focusing on elementary school children represented another important extension to the literature, as findings based on secondary school students cannot be easily generalized to this age group. One reason for this is that elementary school children have little experience with school and the grading system, and the end of the elementary school years represents the first major stress test, since their further school careers, especially in Germany, depend largely on their performance achieved at this time point. Another reason is that children at a young age are more dependent on the authorities around them and can therefore be particularly sensitive to pressure exerted on them. Another contribution of this dissertation was that different sources of academic pressure were examined simultaneously with regard to their relation with students' well-being. The results implied that academic pressure from parents is somewhat more strongly related to elementary school children's well-being, which may be due to the fact that parents are the most important socialization agents in the early life of children (Grusec & Hastings,

2007; Parsons & Bales, 1955), so it seems particularly threatening to children when these trusted figures put pressure on them. However, for a better understanding of the mechanisms behind this, it is needed to contrast academic pressure by individuals within the school context and parents at different stages of students' school careers. As has been discussed in Study III (further analyses), it is conceivable that the pressure by teachers becomes more threatening to students' well-being towards the end of their school careers and there is evidence that pressure from teachers was more detrimental to students' well-being than parental pressure in a sample of older students (Deb et al., 2015), so it would be helpful to examine the relation between academic pressure by different socialization agents and students' well-being by means of longitudinal data.

In summary, the results from Study II and Study III (further analyses) suggest that autonomy-supportive and autonomy-threatening behaviors by teachers and parents are relevant for students' well-being at the onset of adolescence. While autonomy-threatening behaviors (i.e., academic pressure) by teachers and parents showed negative associations with well-being immediately before the transition to secondary school, autonomy-supportive behaviors (i.e., teacher autonomy support) by teachers were positively related to students' well-being and its development in the early years of secondary school. These findings are consistent with the notion that students' well-being increases when the need for autonomy is met, but suffers when that need is thwarted (Reeve, 2015; Ryan & Deci, 2000, 2020). In this dissertation, the variables that support and thwart the need for autonomy were considered separately. However, because there is empirical evidence of bright (need satisfaction) and dark (need frustration) pathways that influence motivation individually (Haerens et al., 2015), considering these variables simultaneously in relation to students' well-being may be informative for understanding the function of the need for autonomy in relation to students' well-being in more detail.

4.2.3 Development of Students' Well-Being over Time

In this section, the findings on the longitudinal development of students' well-being in early adolescence will be discussed. In line with previous findings (Casas & González-Carrasco, 2019; González-Carrasco et al., 2017; Schütz et al., 2019; Wade & Vingilis, 1999), Study I and Study II showed that general aspects of students' well-being (Study I: satisfaction with life; Study II: self-rated-health) decline during adolescence. Thereby, the results suggested that only female students' self-rated health decreased between Grades 5 and 9, while male students' self-rated health remained stable. Recent findings on the trajectory of well-being in fifth grade suggest a similar result with respect to physical complaints related to school (Obermeier & Gläser-Zikuda, 2022). Taken together with the findings from Study I and Study II that female students reported a poorer assessment of their health than male students at several measurement points, this finding could be interpreted to mean that female students are more responsive to their bodies and may experience symptoms of illness more intensely than male students (Haugland et al., 2001; Wool & Barsky, 1994). In addition, a decline in school-related aspects of students' well-being (satisfaction with school, enjoyment of school) was shown for the period of early adolescence, which is also consistent with previous research (Hagenauer & Hascher, 2010; Liu et al., 2016; Tian et al., 2013). An important contribution of this dissertation is the longitudinal approach to studying such trends. In particular, the use of latent growth curve models in Study II represents an extension of the literature, as such models have rarely been used to examine longitudinal trends in students' well-being (for an exception see Way et al., 2007). Furthermore, the simultaneous inclusion of perceived teacher autonomy support as a time-varying covariate provided deeper insights into the mechanisms behind the reported declines. Results revealed a negative trend in perceived teacher autonomy support, which is consistent with the assumptions of stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993) that the school environment is becoming increasingly less congruent with

students' need for autonomy in early adolescence. Furthermore, as discussed in Study II, given the positive correlations between slopes, it is conceivable that the decline in perceived teacher autonomy support contributes to the declines in students' cognitive, affective, and physical well-being. Nevertheless, further research is needed regarding the determinants of the decline in students' well-being. For example, it would be interesting to use experimental designs (e.g., randomized controlled trials) to examine whether interventions that focus on teachers' autonomy-supportive skills can counteract declines in students' well-being.

Another finding worth mentioning in the context of the development of students' well-being is that the social component of students' well-being was the only one that did not decline during the investigated period. Possible reasons for this could be that it was studies only over a two-year period (Grade 6 to Grade 8), or that it was collected only on the basis of third-party assessments by parents who may not have accurate information about their children's social life. However, it is also conceivable that this finding is due to the fact that students' social relationships with peers become increasingly important during adolescence (Steinberg, 2010), so that their need for relatedness is less dependent on relationships with authority figures in their environment but is satisfied by close relationships with peers, leading to a stable social well-being (Morinaj et al., 2019).

Another important finding was that growth curves with a positive quadratic term showed the best fit when modeling longitudinal trends of satisfaction with school and self-rated health. This result suggests a mitigation of the decline on the corresponding variables at the end of the time interval and could imply that students' cognitive and physical well-being reach their nadir in eighth or ninth grade. This result is not implausible in light of previous research showing an increase in aspects of general well-being such as life satisfaction in late adolescence (Salmela-Aro & Tuominen-Soini, 2010; Steinmayr et al., 2019). Although there may be differences in the development of general and school-specific components of well-being, it

would be interesting to examine this finding in more detail in future research. I will revisit this issue in the section on implications for future research (Chapter 4.4).

4.3 Limitations and Strengths

In the following sections, I will address overarching limitations and strengths. These can be categorized into those of a conceptual and those of a methodological nature. In each of the following subsections, I will first discuss the conceptual aspects and then turn to the methodological aspects.

4.3.1 Limitations

Despite this dissertation makes an important contribution to the current literature, the findings have to be interpreted in light of several limitations. One conceptual shortcoming of the present dissertation concerns the operationalization of students' well-being (Study I, Study II, and further analyses in Study III). More specifically, there are two limitations in this regard. First, although the multifaceted nature of students' well-being could be accounted for in each study by using different indicators to measure the overarching components, it was not always possible, to fully align the operationalization of students' well-being with the theoretical framework used in the studies. This was particularly true for Study I and is primarily due to the fact that only variables measured at the same measurement points where students' academic achievement was assessed were included. As indicators of students' social well-being had not been assessed on at least two of the measurement points academic achievement scores were available for, this component could not be considered in this study. Second, the operationalization of the overarching components using the indicators at hand was not always satisfying. For example, some constructs capturing the cognitive and physical components of students' well-being in Study I and Study II were just measured by single items, which may lead to random and nonrandom errors (Bollen, 1989), especially when the underlying constructs are heterogeneous and complex (Fuchs & Diamantopoulos, 2009; Loo, 2002). This

limitation was addressed by modeling these variables as single indicators of latent variables to avoid treating them as perfectly reliable constructs (Jöreskog & Sörbom, 1982; Petrescu, 2013). Nevertheless, a comprehensive measurement of the constructs used in the studies of this dissertation would have been desirable in order to correctly determine reliability and measurement invariance.

Another conceptual limitation of this dissertation is that not all basic needs considered central to well-being in terms of SDT (Ryan & Deci, 2000, 2020) were equally considered. While the needs for autonomy (teacher autonomy support, academic pressure) and competence (reading comprehension, mathematical competence) were addressed by multiple indicators in the studies of this dissertation, the need for relatedness was only addressed by means of teacher autonomy support. Although it can be theoretically argued that teacher autonomy support can satisfy the need for relatedness, as has been described in Study II (cf. Ryan & Solky, 1996), it would have been preferable to examine further factors that satisfy the need for relatedness in terms of their association with students' well-being. High-quality social relationships are particularly important in this regard because they can also satisfy the other basic psychological needs (Deci & Ryan, 2014). I will discuss possible variables that future studies could focus on in the section on implications for future research (see Chapter 4.4.1).

A further limitation, which is methodological in nature, concerns the characteristics of the data used in Study I and Study II. In this context, three specific limitations should be considered. First, the data used in these studies were not suitable for comprehensively modeling the hierarchical structure of the German education system. The German education system is build up on multiple levels (students are clustered in classes, which are clustered in schools which are clustered in federal states). The class level could only be considered in one of the studies (further analyses in Study III). In the other two studies included in this dissertation, there was no usable information concerning the class level as the corresponding identification

number was changed as soon as little changes in the class composition occurred (e.g., a student left the class). Therefore, only the school level could be considered in these studies. Second, the proportions of the three secondary school types (*Hauptschule*, *Realschule*, *Gymnasium*) were not equally represented in the data used for Study I and Study II. In the samples, students from the Gymnasium (more academic secondary school track in Germany) were mainly represented, whereas students from the Hauptschule (secondary general school track in Germany) were the least represented. As described in Study I, different types of schools represent different learning environments that exhibit differences in the average and variance of important school-related outcomes such as academic achievement and motivational characteristics (Baumert et al., 2009). In this study in particular, which examined a moderating effect of school type on the relation between students' well-being and academic achievement, it would have been desirable to have a larger subsample of students attending Hauptschule. A third limitation with regard to the data used in Study I and Study II is that it has been administered between 2010 and 2015. Although this does not mean that the data is exceptionally old, there are some notable events that have taken place in the interim. For example, there were migration movements after the Syrian war, which led to an increasing proportion of immigrants in Germany (Bundesinstitut für Bevölkerungsforschung, 2023). Accordingly, recent representative studies have shown that the proportion of students with an immigration background has increased in the last years (Ludewig et al., 2022; Stanat et al., 2022). Although most previous studies did not find a relation between well-being and immigration background (Berry et al., 2006; Schotte et al., 2018; for an exception see Mood et al., 2016) so that the relations are likely to be still robust, it is important to note that the samples used in Study I and Study II are not representative of the current student population in Germany in terms of immigration background (for a comparison of the proportion of fourth graders with an immigration background in 2021 with 2011 and 2016, see Stanat et al., 2022). Furthermore,

a current study by Pagel and Edele (2022) found differences between recently arrived refugees and students without an immigration background when comparing their sense of belonging to the school and emotional as well as behavioral problems. Therefore, replication of the results with samples representative of the current student population is needed. Another event that has taken place in the meantime and must be mentioned in this context is the COVID-19 pandemic. Recent studies have shown that students' well-being deteriorated during the COVID-19 pandemic (Hawke et al., 2020; Ravens-Sieberer et al., 2021; Steinmayr et al., 2022), and that satisfaction with the family declined also during this time (Steinmayr et al., 2022). It is possible that this exceptional situation has ongoing effects on the interpersonal relationships between students and their parents and teachers. Further research on students' well-being and its relation with variables paired with these individuals (academic pressure, autonomy support, teacher–student relationship) is therefore needed to determine whether there are any lasting effects of the COVID-19 pandemic in this regard and whether the findings of this dissertation can be generalized to the post-pandemic situation.

A last limitation that has to be mentioned concerns the fact that despite all studies included in this dissertation used data from either the period before or after the transition from elementary to secondary school and, therefore, examined two important periods of the school career, the effect of the transition itself could not explicitly be investigated. According to stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993; Gutman & Eccles, 2007) school transition is associated with decreasing qualities in teacher–student relationships (Valdebenito et al., 2022) and restricted opportunities in decision-making and participation. Therefore, especially with regard to students' increasing need for autonomy it would have been interesting to directly examine how students' perceptions of autonomy supportive behavior by their teachers change during the transition.

4.3.2 Strengths

Now that the key limitations of this dissertation have been addressed, the main strengths of this work are described. A clear conceptual strength of all studies included in this dissertation is that students' well-being was operationalized through a variety of aspects to account for its multifaceted nature. This approach made it possible to provide both differentiated results regarding the development of students' well-being during adolescence and a nuanced picture of the relations with other relevant variables in the school context (Heffner & Antaramian, 2016; Kern et al., 2015). The fact that we found differences in the development of each aspect of students' well-being and its relation to the other outcomes considered reinforced the use of this approach.

Another critical contribution of this dissertation that is of methodological nature is that mainly longitudinal data (Study I and Study II) were used to explore important questions that arise with regard to students' well-being. Although the use of longitudinal data does not allow definitive conclusions about causality, it helps to better understand the relations between different variables. Specifically, with respect to what is known about the relation between students' well-being and academic achievement, the longitudinal approach had great potential to expand knowledge, as two influential theories (SDT: Ryan & Deci, 2000, 2020; Broaden-and-build theory: Fredrickson, 2001, 2013) provide bases upon which opposing directions regarding this relation can be hypothesized. Although there was no clear evidence for either theory, the approach provided detailed insights into the relations between students' well-being and academic achievement. This was also due to the aforementioned strength of considering different facets of well-being, as different patterns of relations with academic achievement emerged depending on the considered component of well-being. The use of longitudinal data to track trends in various school-related facets of students' well-being was another important addition to the literature, providing deeper insights into the period following the transition from

elementary to secondary school with up to five measurement points. In addition, the longitudinal design allowed for the simultaneous consideration of the development of a time-varying covariate, teacher autonomy support, over time.

Another methodological strength of this dissertation is that state-of-the art statistical approaches were used to answer the specific research questions. For example, the reciprocal relations between students' cognitive well-being and their academic achievement in Study I were analyzed using random intercept cross-lagged panel models. The use of this statistical approach allowed distinguishing between-person and within-person variance (Hamaker et al., 2015). More precisely, the stability of individual students with respect to the variables was controlled for in terms of trait-like individual differences that endure over time, which is more accurate than simply accounting for temporal stability through autoregressive paths between measurement points. Accordingly, the parameters calculated with these models usually lead to less biased results than those calculated with classical cross-lagged panel models (Hamaker et al., 2015). Furthermore, the longitudinal trends of students' well-being and perceived teacher autonomy support investigated in Study II, as well as the relations between these trends, were analyzed by means of parallel process growth models (also known as multivariate growth curve models, see Bollen & Curran, 2006; Curran et al., 2010). This approach made it possible to model the latent change in two variables simultaneously and also determine the relations between the intercept and slope parameters. Such modeling of the development of two constructs and their relations has been rarely used in research on students' well-being (for an exception see Way et al., 2007).

Finally, the use of data from large-scale assessment studies allowed the research desiderata addressed in the studies of the present dissertation to be examined on the basis of large samples, especially in Study I and Study II. As a result, the findings promise high external validity. Moreover, conducting secondary analyses is itself a strength, as research questions

can be answered that were not originally intended to be addressed in large-scale assessment reports (Beaton & Barone, 2017; Chow & Kennedy, 2014). Furthermore, the reuse of large-scale assessment data justifies the great effort involved in collecting the data.

4.4 Implications for Future Research and Educational Practice

4.4.1 Implications for Future Research

The present dissertation makes an important contribution to the research areas of education and educational psychology and, in particular, to research on students' well-being. However, as has become clear, the included studies have some shortcomings and further research is needed to substantiate and expand the findings of the present dissertation. One conceptual limitation that has been pointed out is the partly unsatisfying operationalization of students' well-being in the studies included in this dissertation. While this issue could be addressed by replicating the studies with instruments measuring students' well-being more comprehensively, it also points to an implication regarding the measurement of students' well-being in large-scale assessment studies. In addition to the advantages associated with using data from large-scale assessment studies (large sample sizes, representativeness), a major problem with many of these studies is that socioemotional variables such as well-being are inadequately operationalized. Most large-scale assessment studies that exist to date focus on academic performance as the central outcome (Govorova et al., 2020). However, due to the increasing importance of socio-emotional variables in the school context (Govorova et al., 2020; Kanonire et al., 2020; Organisation for Economic Cooperation Development [OECD], 2017), it is important that future large-scale assessment studies include a stronger focus on these variables so that a theory-based and more comprehensive measurement of these variables is possible.

Another implication for future analyses related to the operationalization of students' well-being concerns the domain-specificity of its measurement. Based on assumptions from

the internal/external frame of reference model (Marsh, 1986; Möller et al., 2009) and dimensional comparison theory (Möller & Marsh, 2013), dimensional comparisons lead to negative effects of academic achievement in one domain (e.g., mathematics) on self-concept in another domain (e.g., verbal) and vice versa. The results from Study I showed a similar effect regarding affective well-being in the domains of mathematics and German and their interaction with mathematical competence and reading comprehension. In addition, as has been discussed in Study II, there is evidence that teacher support in one subject is positively related to students' intrinsic value and effort in the same subject, while it is negatively related to the same variables in another subject (Dietrich et al., 2015). The authors argued that this could be explained by the fact that students compare their teachers in terms of their supportive behavior. Based on these findings, an implication for future research is to consider subject-specific indicators of students' well-being and examine their relations with other subject-specific school-related variables to obtain more detailed results and identify effects across subjects. Furthermore, measures of students' well-being with varying degrees of specificity (subject-specific, school specific, general) could be considered simultaneously to assess differences in the strength of the association between school-related variables and well-being as a function of the specificity of the measure. In this regard, Maechel et al. (2022) recently showed that well-being in mathematics (measured by satisfaction and mood) is more strongly related to academic achievement in mathematics than general and school-overarching indicators of well-being.

Another desideratum for future studies stems from the conceptual limitation of this dissertation that the basic psychological need for relatedness was not adequately addressed as a factor influencing students' well-being. Accordingly, there is a need to examine school-related variables associated with the satisfaction of students' need for relatedness in terms of their longitudinal relation to well-being. One factor that should be further explored in this regard is the relationship between teachers and students. The teacher–student relationship has

been repeatedly shown to be a factor relevant to various important outcomes in the school context, such as students' academic achievement, positive work behavior, and school adjustment (Baker, 2006; Hamre & Pianta, 2001; Longobardi et al., 2016; Sabol & Pianta, 2012). Given that higher quality teacher–student relationships are thought to play a central role in satisfying students' need for relatedness in the school context (Wentzel, 2010), it seems plausible that a positive teacher–student relationship can enhance students' school-related well-being. Consistent with this notion, there is already some cross-sectional evidence that the quality of the teacher-student relationship is positively related to overall well-being (Zhou et al., 2022) and negatively related to internalizing and externalizing symptoms (Lin et al., 2022). Another desideratum related to the consideration of other important factors associated with student need satisfaction is to consider these factors simultaneously in order to compare their relations to students' well-being. Study III (further analyses) of the present dissertation already compared different sources of academic pressure and also included academic performance as a control variable that is representative of the satisfaction of students' need for competence. However, the focus of Study III was not on comparing factors that satisfy different basic psychological needs (autonomy vs. competence). Future analyses, for example, could consider teacher autonomy support and teacher–student relationships along with measures of academic achievement in the same study. This could help to better assess the extent to which students' well-being is influenced by academic assessments compared to interpersonal relationships with significant others in the school context and, in particular, the extent to which positive interpersonal relationships can buffer negative feelings that arise from poor academic achievement and vice versa. In this context, it would also be interesting to include various measures of academic performance, which I will discuss in the next paragraph.

A further implication for future studies concerns the measurement of academic achievement when examining its relation with students' well-being. In all studies that have

been included in this dissertation students' academic achievement was measured in terms of their results on standardized achievement tests. This is a clear strength of these studies as such assessments are less biased by teachers' subjective judgements, but it would also be interesting to examine the relations between students' well-being and their academic achievement in terms of their school grades obtained in different subjects. Especially in light of SDT (Ryan & Deci, 2000, 2020) a comparison of academic achievement measured by standardized tests and school grades, respectively, in terms of their relations with students' well-being would be interesting. As school grades represent direct and regular feedback students receive from their teachers they might have a stronger impact on students' sense of competence than standardized tests as feedback through such evaluations of academic achievement is rare (Lauermann et al., 2020; Niepel et al., 2014; Weidinger et al., 2018). Furthermore, there is evidence that school grades are more strongly related to students' academic self-concept than results from standardized tests (Lauermann et al., 2020) and, therefore, these are potentially also more important for students' well-being. Consistent with this consideration, there are some studies that suggest that well-being is more strongly related to school grades than to academic achievement as measured by standardized tests (Lettau, 2021; Maechel et al., 2022). However, these studies did not include separate variables for school grades in different domains (e.g., mathematics and reading), and the evidence on the relation between school-related well-being and different indicators of academic achievement is cross-sectional in nature (Maechel et al., 2022). Therefore, a longitudinal analysis examining the interactions between the various components of students' school-related well-being and academic achievement in different academic domains measured by standardized tests and school grades would provide more detailed information about the relation between students' well-being and academic achievement. Based on SDT and the findings from the aforementioned studies (Lettau, 2021; Maechel et al., 2022), it would be reasonable to assume that grades are more strongly related to later well-being.

Likewise, it would be interesting to examine how well-being in turn affects the various criteria of academic achievement. For example, it is conceivable that students who frequently feel uncomfortable in school are less likely to participate verbally in class, which could have a negative impact on their grades but is not necessarily negatively related to their academic achievement as measured by standardized tests.

An important strength of Study I was to separate within- and between-person variance in the cross-lagged panel model with cognitive well-being and academic achievement to control for students' trait-like stability with respect to the different variables. A desideratum for future analyses would be the more regular use of random intercept cross-lagged panel models (Hamaker et al., 2015) to provide more powerful evidence with regard to the relation between academic achievement and various components of students' well-being. Because the random intercept cross-lagged panel model could only be applied in Study I when examining the relation between cognitive well-being and academic achievement (the indicators of cognitive well-being were the only ones measured in parallel with academic achievement at three measurement points), it is relevant to conduct such analyses for the other components of well-being (affective, physical, social) as well.

A final desideratum for future research, which should be pointed out here, is a more comprehensive examination of the development of students' well-being across the school career. As mentioned in the Limitations section (Chapter 3.3.1), the present work did not analyze longitudinal data covering both elementary and secondary school, so the direct effect of school transition could not be examined. Accordingly, future studies are needed to examine how students' well-being evolves from elementary school through secondary school. In addition, it would be reasonable to examine how students' well-being evolves from lower to upper secondary school. This seems to be particularly interesting in that Study II indicates a weakening of the negative trend in school satisfaction toward the end of the period under

consideration, which ends in Grade 9. Furthermore, some studies suggest that students' well-being increases as they progress through upper secondary school (Salmela-Aro & Tuominen-Soini, 2010; Steinmayr et al., 2019) at least in terms of general indicators of well-being (life satisfaction, mood). Another study by Stang-Rabrig et al. (2022) suggests a stable trend in students' well-being with respect to satisfaction with school in upper secondary school. Accordingly, studies examining several components of students' well-being across the whole secondary school period are needed to provide a comprehensive picture of its development. In general, it would be interesting to investigate how students' school-related well-being develops from elementary school to the end of secondary school and which factors contribute to this development, with a focus on school transitions. Here, in addition to variables related to students' need for autonomy, such as teacher autonomy support, other factors should be examined that are related to need satisfaction or might be relevant to the development of students' well-being for other reasons. In this context, recent research points to several other variables that seem to influence the development of students' well-being. Obermeier, Schlesier, Meyer, et al. (2022) were able show that the decline of students' well-being from the beginning of fifth grade to the beginning of sixth grade could be explained by achievement emotions and factors related to instructional quality. Furthermore, a study by Wu and Becker (2023) could show that school-level achievement had a negative impact on the trend in students' life satisfaction from Grade 6 to Grade 10. Therefore, to gain a deeper understanding of the development of well-being throughout the school career, future studies could also examine the parallel development of these factors over a longer period of time.

4.4.2 Implications for Educational Practice

In addition to the numerous implications of this dissertation for future research, there are also several implications for educational practice. Based on the findings presented in this dissertation on autonomy-promoting and autonomy-thwarting behaviors in relation to their

association with students' well-being (Study II and further analyses in Study III), it is important to make teachers and parents aware of the consequences of their behaviors. In addition, findings from Study II suggest that it is particularly meaningful to provide opportunities for teachers to improve their skills in supporting autonomy. In their meta-analysis on the effectiveness of interventions designed to improve autonomy support, Su and Reeve (2011) could show that such programs were effective in helping teachers to become more autonomy supportive. Furthermore, their results suggested that inexperienced individuals in particular benefit from these interventions, so it seems reasonable to target student teachers, teachers in teacher training, or those in their first years of employment. With regard to experienced teachers, it may be helpful to address the beliefs, expectations, and values they hold about effective motivational strategies prior to training that may prevent them from benefiting to the same extent as inexperienced teachers (Su & Reeve, 2011). The meta-analysis by Su and Reeve (2011) also showed effects of interventions concerning autonomy support when applied to parents. Therefore, it seems reasonable to offer corresponding workshops for them as well.

Apart from the fact that children and adolescents spend a large proportion of their time in school (see OECD, 2016), which provides an inherent argument that students should feel well in school, Study I additionally underscored the relevance of students' well-being by showing that school-related cognitive aspects of well-being in particular are positively associated with later academic achievement. In addition, the present dissertation supported results on gender differences (e.g., Liu et al., 2016; Palsdottir et al., 2012; Wiklund et al., 2012) by finding that female students show higher scores on satisfaction with school (Study I and Study II and further analyses in Study III) and enjoyment of school (Study II and further analyses in Study III), while showing lower scores on self-rated health (Study I and Study II). Moreover, the results of Study II indicate that only female students' self-rated health declined in early adolescence, while it remained stable among male students. Paired with the finding of

declines in other facets of students' well-being during adolescence, these results argue for a promotion of students' well-being, especially in early secondary school. Besides the aforementioned strategy to implement interventions fostering teachers' and parents' autonomy supportive skills, programs that directly address students' school-related well-being could be more regularly applied, whereby it is thinkable to individually address male and female students. In this regard, Seligman et al. (2009) reported that a program designed for use in the educational context to improve student enjoyment and engagement resulted in sustained higher scores on these variables, as determined by self-reports and teacher ratings. Such interventions could be particularly useful for male students, who appear to have lower cognitive and affective school-related well-being. Female students, on the other hand, could be supported by interventions that target their physical health and psychosomatic symptoms.

Based on the findings of Study III (further analysis), which further reinforce that academic pressure can negatively affect students' well-being, another implication for educational practice is to provide interventions that teach students strategies to cope with stress (OECD, 2015; Pascoe et al., 2020). As previous studies have shown, teaching students techniques to manage stressful situations can improve their mental and physical health (Bothe et al., 2014; Perry et al., 2017; van Loon et al., 2020). Although it will also be necessary to make teachers and parents aware of the negative effects that exerting pressure can have on students, such programs could be of fundamental benefit to students by helping them develop resilience strategies to deal with difficult situations later in life as well (Pascoe et al., 2020).

4.5 Conclusion

There is widespread agreement that students' well-being needs special attention in school (Hascher, 2004; Kanonire et al., 2020; OECD, 2017; Seligman et al., 2009). The fact that children spend a great deal of their time in school, and that the emotions and cognitions associated with this context have an impact on their attitudes toward learning later in life, are just two of several reasons that can be given for this assertion. Understanding under which conditions students are able to flourish and which conditions cause the opposite is therefore of great importance. In order to obtain a detailed picture of its state, its development, and its relations with other variables, particularly the factors that influence it, students' well-being was operationalized through several components and, when possible, this work used data with longitudinal designs in order to substantiate and extend the current literature. Drawing on theoretical considerations from self-determination theory (Ryan & Deci, 2000, 2020), stage-environment fit theory (Eccles & Midgley, 1989; Eccles et al., 1993), broaden-and-build theory (Fredrickson, 2001, 2013), and theories of socialization (Grusec & Hastings, 2007; Parsons & Bales, 1955), it was examined (1) how students' academic achievement and their well-being are interrelated, (2) how students' perceptions of autonomy-supportive and autonomy-threatening behaviors of their parents and teachers are related to their well-being, and (3) how students' well-being develops in early adolescence and how factors that promote self-determination are related to this development. In general, the dissertation highlights that school-related factors that satisfy the needs for competence (academic achievement) and autonomy (autonomy support from teachers), thereby promoting a sense of self-determination (Ryan & Deci, 2000, 2020), lead to higher well-being, whereas factors that counteract the need for autonomy (academic pressure) are detrimental to it. An important finding of this dissertation is that students' well-being and academic achievement are reciprocally related longitudinally, such that academic achievement, particularly in mathematics, is related to later

physical well-being, while cognitive well-being is related to later academic achievement. Another important finding is that students' cognitive, affective, and physical well-being decline during adolescence, and that these trends appear to be related to their perceptions of autonomy-supportive behaviors from their teachers. These findings point to the need for interventions that promote autonomy-supportive skills in teachers and parents and improve students' enjoyment, engagement, and resilience at school.

4.6 References II

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