Facilitating the Understanding of Personality: The Usefulness of Unifying Two Existing Approaches

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ABSTRACT

Economists and educational researchers discovered that noncognitive factors such as interests, self-concepts, and conscientiousness are both interesting and relevant because of the evidence that these types of constructs can be used to predict important human-capital outcomes (e.g., school functioning; see Kautz, Heckman, Diris, ter Weel, & Borghans, 2014). Given the importance of these factors, the discussion quickly turned to how these factors can be enhanced and fostered. It was recently claimed that a construct's malleability is one precondition for changing or enhancing it (e.g., through an intervention; Bailey, Duncan, Odgers, & Yu, 2017). However, the group of noncognitive factors reflects an inclusive conglomerate of variables, including personality traits and motivational resources. The inclusive grouping of concepts belies the often stark theoretical and conceptual distinctions that divide these constructs when they are used in research. For instance, the Big Five personality traits originate from trait theories, whereas constructs such as self-concepts and interests come from theoretical models that take a social cognitive perspective. Whereas traits are often defined as stable and cross-situationally consistent (McCrae & Costa, 2008b), social cognitive constructs are conceptualized as less stable, relevant to very specific contexts, and derived almost exclusively from experience (Bandura, 2001b; Eccles & Wigfield, 2002). In addition, because of their different origins, it is uncommon to find both types of constructs included in the same study (Roberts, 2009). This has created an asymmetry in the understanding of how changeable and malleable (e.g., stable or context-sensitive) the two classes of constructs are and has also impeded the ability to explore synergies when considering them together.

The current dissertation has two superordinate aims. The first aim was to test two basic assumptions about the malleability (i.e., time-consistency and context-sensitivity) of traits and social cognitive constructs. For this purpose, the Big Five personality traits (conscientiousness, neuroticism, extraversion, openness, and agreeableness) were contrasted against several social cognitive variables (i.e., interest, self-concept, and effort) with regard to their temporal stability (Study 1) and their context-sensitivity (Study 2). The second aim of the dissertation was to examine potential synergies when considering variables from both perspectives (conscientiousness as a trait and interest as a social cognitive construct) in predicting an achievement-related outcome, namely academic effort (Study 3).

This dissertation benefited from a large-scale longitudinal study called "*Tradition and Innovation in Educational Systems"* (TRAIN; Jonkmann, Rose, & Trautwein, 2013), which is hosted at the Hector Research Institute of Education Sciences and Psychology at the University of Tübingen, Germany. TRAIN is a school achievement study that encompasses four time points (from Grades 5 to 8). The study comprises N = 3,876 students in 136 classes in 99 schools from two federal states (Baden-Württemberg and Saxony) of Germany. Among other variables, the TRAIN study includes the Big Five personality traits and a variety of social cognitive variables (e.g., interest, self-concept), which provided the opportunity to test assumptions about the malleability of the different classes of constructs in the same study and moreover, it meant that potential synergies between the classes of constructs could be explored in a longitudinal setting.

In the first study (*Social Cognitive Constructs are Just as Stable as the Big Five Between Grades 5 and 8*), several social cognitive variables (i.e., self-concept, interest, and academic effort) and personality traits (i.e., the Big Five personality traits) were contrasted with respect to their temporal continuity and change over time. Three research questions were of particular interest. First, how stable are the constructs over time? Second, to what degree can the stability of each class of constructs be attributed to unchanging components, and how much of the instability can be attributed to state components? Third, to get a better idea of whether individuals change more or less on each class of variables, the average level of individual differences in change (i.e., to what extent students show increases or decreases in the constructs) were compared between the classes of constructs. The results indicated that there were no marked differences between personality traits and social cognitive constructs across multiple indicators of stability or changeability.

The second study (*The Effects of Getting a New Teacher on the Consistency of Personality*) focused on examining the effect of getting a new teacher on consistency in students' psychological functioning (i.e., personality traits and social cognitive variables) in two longitudinal studies (TRAIN and PISA-E; for the description of the PISA-E study, see Study 2 in Chapter 4). By using quasi-experimental designs, two indices of consistency (i.e., test-retest correlations and changes in variance components over time) were compared between students who got a new teacher and those who did not on a variety of social cognitive and personality constructs. The results showed no differences in the test-retest correlations for the math-related social cognitive constructs of interest, effort, self-concept, anxiety, and the Big Five personality traits (except extraversion). Significantly lower test-retest correlations were

found for some of the German- and English-related social cognitive constructs and for self-regulation in math for the group of students who got a new teacher. Finally, regarding the changes in variance (over time), there were found no systematic differences between groups in the TRAIN and PISA-E study.

The third study (*The Development of Students' Academic Effort: The Unique and Combined Effects of Conscientiousness and Individual Interest*) tested the unique and combined effects of conscientiousness and individual interest (as representatives of each perspective) on the development of academic effort in the school subjects of math, German, and English in the TRAIN study. Three research questions were of particular interest. First, the development of academic effort across three school subjects was examined. In a second step, the unique effects of conscientiousness and individual interest in predicting changes in academic effort over time were tested. Third, to test the interactive relation between conscientiousness and individual interest in a longitudinal setting, the proposed interaction between conscientiousness and individual interest was included in the analyses. Results showed that academic effort significantly decreased over time across the three school subjects. However, both conscientiousness and individual interest significantly and positively predicted change in academic effort such that when conscientiousness and individual interest were higher, the decrease in academic effort was smaller. In addition, conscientiousness and individual interest interacted in a compensatory manner such that individual interest was less important for the academic effort of students who were high on conscientiousness. The results held for most prospective paths across three waves of longitudinal data.

The findings of the three studies are summarized and discussed in light of a broader research context. Implications for practice and future research are derived.

ZUSAMMENFASSUNG

Nicht-kognitive Merkmale wie beispielsweise Gewissenhaftigkeit, Interessen, und Selbstkonzepte haben sich als wichtige Determinanten für humankapital-bezogene Variablen wie beispielsweise den Schulerfolg erwiesen (Kautz, Heckman, Diris, ter Weel, & Borghans, 2014). Aufgrund dieser Befunde ist es naheliegend diese Merkmale und Eigenschaften zu fördern. Um jedoch zur Förderung in Betracht gezogen zu werden, sollten Konstrukte beeinflussbar und veränderbar sein (Bailey, Duncan, Odgers, & Yu, 2017). Unter dem Begriff „*nicht-kognitive Merkmale"* sind eine Vielzahl an unterschiedlichen Konstrukten wie beispielsweise Persönlichkeitseigenschaften und motivationale Faktoren zusammengefasst. Diese Konstrukte stammen aus verschiedenen Forschungsbereichen und die gemeinsame Betrachtung dieser Konstrukte ignoriert, dass einhergehend mit der Herkunft der Variablen, unterschiedlich Annahmen über die jeweiligen Konstrukte postuliert werden. Die Big Five Persönlichkeitseigenschaften haben ihre Wurzeln in den sogenannten Traittheorien und werden häufig als stabil, transsituativ und nicht veränderbar definiert (McCrae & Costa, 2008b). Konstrukte wie Selbstkonzept, Interesse und Anstrengungsbereitschaft hingegen sind in Modellen, die eine sozial kognitive Perspektive einnehmen, eingebettet und werden als weniger stabil, kontext-spezifisch und leicht veränderbar konzipiert (Bandura, 2001b; Eccles & Wigfield, 2002). Des Weiteren wurden Persönlichkeitseigenschaften und sozial kognitive Konstrukte aufgrund ihrer unterschiedlichen Herkunft und Forschungsfelder bisher eher getrennt voneinander untersucht (Roberts, 2009). Die separate Untersuchung dieser Variablen führte zu einer zunehmenden Asymmetrie über das Verständnis der Veränderbarkeit der jeweiligen Konstrukt-Klassen und verhinderte darüber hinaus das Erforschen potentieller Synergien zwischen diesen.

Die vorliegende Dissertation hat zwei übergeordnete Ziele. Das erste Ziel war es zwei grundlegende Annahmen über die Veränderbarkeit (zeitliche Stabilität und Kontext-Sensitivität) von Persönlichkeitseigenschaften und sozial kognitiven Variablen zu untersuchen. Hierfür wurden die Big Five Persönlichkeitseigenschaften (Gewissenhaftigkeit, Neurotizismus, Extraversion, Offenheit und Verträglichkeit) mit mehreren sozial kognitiven Variablen (z.B. Interesse, Selbstkonzept und Anstrengungsbereitschaft) hinsichtlich der zeitlichen Stabilität (Studie 1) und ihrer Kontext-Sensitivität (Studie 2) verglichen. Das zweite Ziel war es potentielle Synergien zwischen zwei, für den Schulkontext besonders relevante, Variablen

aus den unterschiedlichen Forschungstraditionen (Gewissenhaftigkeit als Persönlichkeitseigenschaft und Interesse als sozial kognitive Variable) in der Prädiktion eines leistungsrelevanten Merkmals (die schulischen Anstrengungsbereitschaft) zu untersuchen (Studie 3).

Die Daten für die vorliegende Dissertation stammen aus der Studie „*Tradition und Innovation: Entwicklungsverläufe an Haupt- und Realschulen in Baden-Württemberg und Mittelschulen in Sachsen"* (TRAIN; Jonkmann, Rose, & Trautwein, 2013), welche am Hector-Institut für Empirische Bildungsforschung an der Universität Tübingen durchgeführt wurde. Die TRAIN Studie ist eine längsschnittlich angelegte Schulleistungsstudie mit vier Messzeitpunkten (Klassenstufe 5 bis 8). Die Studie umfasst Angaben von insgesamt $N = 3$ 876 Schülerinnen und Schülern in 136 Klassen in 99 Schulen aus zwei Bundesländern in Deutschland (Baden-Württemberg und Sachsen). Neben einer Vielzahl an Variablen, wurden in der TRAIN Studie die Big Five Persönlichkeitseigenschaften als auch mehrere sozial kognitive Variablen (z.B. Interesse, Selbstkonzept) erfasst. Dies eröffnete die Möglichkeit Annahmen der unterschiedlichen Konstrukt-Klassen hinsichtlich ihrer Veränderbarkeit (zeitliche Stabilität und Kontext-Sensitivität) zu testen und miteinander zu vergleichen. Des Weiteren konnten potentielle Synergien zwischen Konstrukten aus den unterschiedlichen Forschungstraditionen untersucht werden.

In Studie 1 (*Social Cognitive Constructs are Just as Stable as the Big Five Between Grades 5 and 8*) wurden die sozial kognitiven Variablen Selbstkonzept, Interesse und Anstrengungsbereitschaft mit den Big Five Persönlichkeitseigenschaften hinsichtlich mehrerer Indikatoren der zeitlichen Stabilität verglichen. Konkret wurden drei Forschungsfragen adressiert: Erstens, wie stabil sind die Konstrukte über die Zeit? Zweitens, wie viel Prozent der Varianz kann auf eher stabile Anteile (trait-Anteil) und wie viel Varianz kann auf messzeitpunkt-spezifischen Faktoren (state-Anteil) zurückgeführt werden? Drittens, unterscheiden sich die zwei Konstrukt-Klassen hinsichtlich der Varianz der durchschnittlichen Veränderung über eine Zeitspanne von 3 Jahren? Es konnten keine bedeutenden Unterschiede zwischen den zwei Konstrukt-Klassen hinsichtlich mehrerer Indikatoren der zeitlichen Stabilität festgestellt werden.

Studie 2 (*The Effects of Getting a New Teacher on the Consistency of Personality*) untersuchte den Einfluss eines Lehrkraftwechsels auf die Konsistenz mehrerer Persönlichkeitsvariablen in zwei längsschnittlich angelegten quasi-experimentellen Studien (TRAIN und PISA-E; für die Studienbeschreibung der PISA-E Studie, siehe Studie 2 in Kapitel 4). Hierfür wurden Schülerinnen und Schüler, die eine neue Lehrkraft bekamen, mit Schülerinnen und

Schülern, die dieselbe Lehrkraft über zwei Schuljahre hatten, auf den Big Five Persönlichkeitseigenschaften und mehreren sozial kognitiven Variablen hinsichtlich zweier Indikatoren der Konsistenz der Variablen (Test-Retest Korrelationen und Veränderung in den Varianzen über die Zeit) miteinander verglichen. Für die mathematik-bezogenen sozial kognitiven Variablen (Interesse, Anstrengungsbereitschaft, Selbstkonzept und Angst) und für die Big Five Persönlichkeitseigenschaften (mit Ausnahme von Extraversion) wurden keine Unterschiede hinsichtlich der Test-Retest Korrelationen zwischen den beiden Gruppen gefunden. Schülerinnen und Schüler, die eine neue Lehrkraft bekamen, zeigten signifikant niedrigere Test-Retest Korrelationen sowohl für mehrere Deutsch- und Englisch-bezogene sozial kognitiven Variablen als auch für die Selbstregulation hinsichtlich des Fachs Mathematik. Hinsichtlich der Veränderung in den Varianzen über die Zeit konnten sowohl in der TRAIN als auch in der PISA-E Studie keine systematischen Unterschiede zwischen den Gruppen festgestellt werden.

In Studie 3 (*The Development of Students' Academic Effort: The Unique and Combined Effects of Conscientiousness and Individual Interest*) wurden die prospektiven Effekte der Gewissenhaftigkeit und des Interesses auf die Entwicklung der Anstrengungsbereitschaft in der Schulfächern Mathematik, Deutsch und Englisch anhand der TRAIN Daten untersucht. Konkret wurden drei Forschungsfragen adressiert: Erstens, wie verändert sich die Anstrengungsbereitschaft in den Schulfächern Mathematik, English und Deutsch über die Zeit (Klasse 5 bis 8)? Zweitens, wird die Veränderung von Anstrengungsbereitschaft positiv durch Gewissenhaftigkeit und Interesse vorhergesagt? Drittens, interagieren Gewissenhaftigkeit und Interesse bei der Vorhersage der Veränderung von Anstrengungsbereitschaft miteinander? Die Ergebnisse zeigten, dass die Anstrengungsbereitschaft in den Fächern Mathematik, Deutsch und Englisch kontinuierlich über die Zeit abnimmt. Die negativen Veränderungskoeffizienten von Anstrengungsbereitschaft wurden, unter Kontrolle des Ausgangsniveaus der Anstrengungsbereitschaft, signifikant positiv von Interesse und Gewissenhaftigkeit vorhergesagt. Die negative Interaktion findet sich in zwei von drei Fällen. Konkret bedeutet dies, dass die Vorhersagekraft von Gewissenhaftigkeit auf die Anstrengungsbereitschaft stärker wird, wenn das Interesse niedrig ausgeprägt ist.

Die Ergebnisse der drei Studien werden zusammengefasst und im Hinblick auf einen breiteren Forschungskontext diskutiert. Implikationen für die Praxis und zukünftige Forschung werden abgeleitet.

CONTENTS

1 INTRODUCTION AND THEORETICAL BACKGROUND

Economists and educational researchers discovered that, in addition to cognitive ability, there are other personal qualities that are both interesting and relevant because there is evidence that these types of constructs are useful for predicting important human-capital outcomes such as school performance and school functioning (see e.g., Almlund, Duckworth, Heckman, & Kautz, 2011; Eccles & Wigfield, 2002; Kautz et al., 2014). For instance, self-controlled, hard-working, and responsible people—or taken together, conscientious people—perform well in almost all academic and work-related settings (Barrick & Mount, 1991; Poropat, 2009, 2014). Also, people who are interested in a specific domain tend to show higher achievement in this domain than their uninterested counterparts (Schiefele, Krapp, & Winteler, 1992). Such personal qualities can be summarized under the heading of "*noncognitive factors"*. As the name indicates, noncognitive factors[1] are constructs that are not considered to be indicators of cognitive ability or intellectual functioning.

Noncognitive variables include a variety of different constructs (e.g., interests, self-concepts, persistence, creativity, and conscientiousness) that have emerged from different influential research traditions such as personality and educational/motivational research. Recent reviews have shown that noncognitive qualities are critical for success in both educational and occupational settings and that interventions should focus on them, especially in childhood and adolescence (Cunha & Heckman, 2010; Kautz et al., 2014). Recently claimed to be a viable target of an intervention, personal qualities should be malleable (Bailey et al., 2017). But what is meant by malleable, and which constructs are malleable? According to the Oxford dictionary, something is malleable when it is *easily influenced* or when it can be *hammered or pressed into shape without breaking or cracking*. The question of which constructs are malleable and which are not is difficult to answer without a direct test (e.g., through an intervention). Nevertheless, passive observational studies can provide valuable information about consistency, continuity, and changes in concepts. These indices are assumptions (or characteristics) that lie behind each construct and can be used as indictors of malleability and changeability. However, prevailing beliefs about these assumptions are often aligned with the theoretical origins of the constructs. For instance, constructs that

[1] There is some debate about the use of the term of noncognitive factors (Borghans, Duckworth, Heckman, & Weel, 2008). Given that there are only a few aspects of human behavior that are without cognition, this term seems misleading. However, the use of the term is practical as it subsumes constructs that originated from different research traditions, and it is easy to communicate.

emerged from social cognitive frameworks (e.g., math self-efficacy or interest in social science) are often assumed to be more malleable (Bandura, 2001b; Eccles & Wigfield, 2002) than personality constructs, which are associated with the so-called "trait approach" (McCrae, 2004; McCrae & Costa, 2008b). Typical theoretical assumptions about traits are that they are broad, highly heritable, and highly stable and therefore not amenable to change. By contrast, social cognitive variables are conceptualized as narrow, less stable, relevant to very specific contexts, and derived almost exclusively from experience rather than genetics (Bandura, 2012; Eccles & Wigfield, 2002; Shavelson, Hubner, & Stanton, 1976). This distinction is supported by different theoretical models that conceptualize traits as core characteristics or basic tendencies and social cognitive variables as surface characteristics or characteristic adaptions (Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae & Costa, 2008b). However, because of the different origins and the separate examination of traits and social cognitive constructs in their respective research traditions, it is uncommon to find both types of constructs included in the same study (Roberts, 2009). This has created an imbalance in the understanding of how malleable and changeable the two classes of constructs may be, and moreover, it impedes the possibility of exploring synergies when considering them together.

The first aim of the current dissertation was to test two basic assumptions about the malleability (i.e., time-consistency and context-sensitivity) of traits and social cognitive constructs. For this purpose, the Big Five personality traits (conscientiousness, neuroticism, extraversion, openness, and agreeableness) were contrasted against several social cognitive variables (e.g., interests and self-concepts) with regard to their temporal stability (Study 1) and their context-sensitivity (Study 2). To be more specific, Study 1 compared multiple indices of stability (i.e., test-retest correlations, individual differences in change, and trait-state variance proportions) of these two classes of variables. Study 2 investigated whether personality traits and social cognitive variables responded differently to the same type of environmental experience (i.e., getting a new teacher). For this purpose, two indices of consistency (i.e., test-retest correlations and change in variance over time) were compared between students who got a new teacher and those who kept the same teacher for 2 years.

The second aim of the dissertation was to examine potential synergies when considering variables from both perspectives (traits and social cognitive constructs). Focusing on two prominent representatives of each class, Study 3 investigated the (interactive) relation of conscientiousness and individual interest in predicting the development of academic effort (i.e., the amount of time and energy that persons expend on academic tasks). A number of cross-

sectional studies (Di Domenico & Fournier, 2015; Sansone & Thoman, 2006; Trautwein et al., 2015) have shown that both conscientiousness and interest uniquely predict academic effort. However, a more interesting finding in these studies was that conscientiousness and interest also interacted with each other in a compensatory manner. This implies that high interest was able to compensate for low conscientiousness, and vice versa, high conscientiousness was able to compensate for low interest. The third study was designed to test these relations in a longitudinal setting.

The dissertation is structured in the following way: The introductory chapter presents the theoretical background of the three empirical studies and aims to locate the three studies within a broader research framework. The chapter is split into two parts. Chapter 1.1 contrasts the trait against the social cognitive perspective by describing the historical roots of both perspectives and juxtaposing them. The chapter closes with a depiction of why it might useful to integrate the two perspectives. By contrast, Chapter 1.2 introduces the Neo-Socioanalytic Model (NSM; see Roberts, 2006), which integrated the two perspectives with each other. Moreover, conscientiousness and interest as representatives of each perspective and their relation are described. Chapter 2 introduces the research questions of the three empirical studies in more detail. Chapters 3 to 5 present the three empirical studies. The final chapter (Chapter 6) summarizes and discusses the findings of the three studies and integrates them into a broader conceptual framework. Furthermore, the strengths and limitations of the studies are examined. The dissertation closes with implications for practice and future directions.

1.1 The Different Views: Trait and Social Cognitive Perspectives

Chapter 1.1 of the dissertation focuses on the juxtaposition of the trait and social cognitive perspectives and the need to integrate them. The two perspectives have fundamentally contributed to the understanding of psychological functioning but differ in their approaches and definitions and moreover, they often operate independently of each other (Fleeson, 2012; Fleeson & Jayawickreme, 2015; Roberts, 2009). There will be a brief introduction to both perspectives that covers several selected but prominent proponents and theories of the respective perspective. For the trait perspective (Chapter 1.1.1), the work of famous trait proponents and precursors such as Allport, Cattell, Norman, Goldberg, Eysenck, Costa, and McCrae is described. This is followed by the now instantiated Five Factor Model (John, Neumann, & Soto, 2008) and the Five Factor Theory (McCrae & Costa, 2008b). For the social cognitive perspective (Chapter 1.1.2), the impact of work by Mischel (e.g., 1968) and Bandura (e.g., 1986) on personality research is described. For this purpose, Mischel's (1968) critique of personality research is summarized, and Bandura's (1986, 2001b) social cognitive theory (SCT) is sketched. SCT is a grand theory in psychology and serves as the theoretical foundation of many theoretical models (see e.g., Bandura, 2001a; Lent, Brown, & Hackett, 1994; Schwarzer, 1999). In particular, theoretical models in educational and motivational research often take a social cognitive perspective on human behavior (see e.g., Eccles & Wigfield, 2002; Pekrun, 2000; Ryan & Deci, 2000). To exemplify how educational and motivational models present their constructs, (modern) Expectancy-Value Theory (Eccles & Wigfield, 2002) was selected as one prominent model that unifies many relevant educational constructs (e.g., self-concepts, values) within one framework. The chapter closes with a summary and a depiction of why it might useful to integrate the two perspectives.

1.1.1 Trait Perspective

What is the core of personality? What are personality traits? How many traits adequately describe the personality of people? These questions have concerned trait theorists for decades, and there are many different models of personality (John, Angleitner, & Ostendorf, 1988; John, Robins, & Pervin, 2008). The following chapter describes the "discovery" of the well-known Big Five personality traits and their instantiation within (and outside of) personality research. The Big Five have their origins in trait theories (John & Srivastava, 1999), which, however, primarily originated from analyses of the natural language (i.e., adjectives that describe people's behavior). The following description is guided by other work by Dig-

man (1990), John et al. (1988), John, Neumann et al. (2008), as well as Block (1995). It is structured into four phases: exploration, reduction, systemization, and manifestation, which, however, have fuzzy boundaries. The description is supported by a graphical overview (see Figure 1).

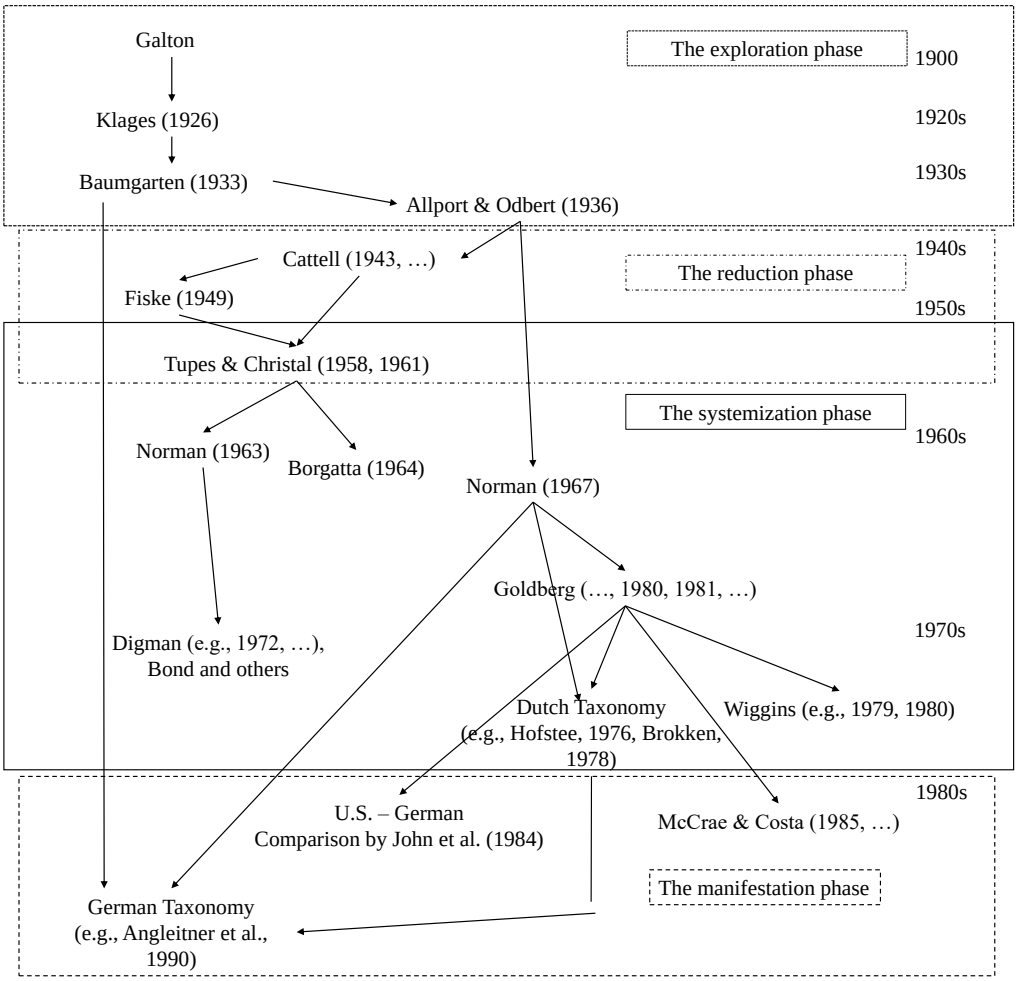

Figure 1. The history of lexical research on personality taxonomies (adapted; John et al., 1988).

The exploration phase

Starting more than half a century ago, various researchers began to investigate natural language regarding terms that describe (the most salient) personality characteristics (see Allport & Odbert, 1936; Baumgarten, 1933; Galton, 1884; Klages, 1926; McDougall, 1932). Inspired primarily by the work of Baumgarten (1933) in Germany, Allport and Odbert (1936) analyzed Webster's New International Dictionary (1925) and identified 17,953 (out of approximately 400,000) words that could be used to distinguish one behavior from another (p.

24). To organize these terms, the person descriptors were allocated to four categories: (1) *"real" traits of personality* (4,504 terms; 25.1%), (2) *temporary states of mind and moods* (4,541 terms; 25.3%), (3) *social or characterial judgments of personal conduct* (5,226; 29.1%), and (4) *miscellaneous (e.g., physical characteristics, capacities, and developmental conditions;* 3,682 terms*;* 20.5%). These four categories served as a starting point for many of the classification systems that followed. Moreover, Allport and Odbert (1936) provided one of the first definitions of traits: "*They designate generalized and personalized determining tendencies—consistent and stable modes of an individual's adjustment to his environment*" (p. 26). In particular, the first part of this definition, "*generalized and personalized determining tendencies,"* strongly influenced later trait theorists (John et al., 1988, p. 178).

The reduction phase

Allport and Odbert's (1936) classification system generated the first reference point for the structure of personality and guided many other research efforts. Cattell was one of the first to continue the work of Allport and Odbert. Primarily focusing on stable personality traits, Cattell was interested in building a systematic framework of personality. For this purpose, however, the list compiled by Allport and Odbert was too comprehensive and unmanageable. Using semantic and empirical clustering approaches, Cattell (e.g., 1943, 1945b, 1945a, 1947) successively reduced the 4,504 trait terms to 35 bipolar variables (for a more comprehensive description, see John et al., 1988). To further reduce this list, Cattell applied oblique factor analyses, which finally resulted in a 12-factor solution. On the basis of these 12 factors and four additional questionnaire-specific factors, he construed the *Sixteen Personality Factor Questionnaire (16PF;* Cattell, Eber, & Tatsuoka, 1970). Moreover, Cattell distinguished between surface and source traits (Cattell, 1946a).[2] The surface traits were seen as obvious characteristics that can easily be identified by other persons. By contrast, source traits lie behind the surface traits and are the "*real*" traits that cause behavior (see also Revelle, 2009). However, it should be noted that there were also some criticisms of Cattell's work. First, Cattell's procedure was accompanied by multiple arbitrary decisions that were based on his personal judgment (e.g., adding and removing terms; see e.g., Block, 1995). Second, reanalyses of Cattell's correlation matrices did not confirm the proposed number and structure of traits (see e.g., Digman & Takemoto-Chock, 1981; Tupes & Christal, 1958).

[2] In addition, to further organize the meaning of traits, Cattell (1946b) proposed three categories: abilities, dynamic traits, and stable temperamental traits.

Nevertheless, Cattell's work was seminal and inspired other researchers to continue working on the number of traits and the structure of personality in general.

The systemization phase

Fiske (1949) and Tupes and Christal (1958, 1961) can be mentioned as next on the list. Whereas Fiske adapted 22 of Cattell's variables and collected trait ratings of clinical psychology trainees, Tupes and Christal reanalyzed correlation matrices from eight samples (including samples from Cattell, 1945b, 1947 & Fiske, 1949). Both found that five rather than 12 factors were sufficient for describing personality (i.e., they accounted for most of the variance). Guided by work by French (1953), Tupes and Christal (1961) labeled the five recurrent factors as (a) Surgency (talkative, assertive, energetic), (b) Agreeableness (good-natured, cooperative, trustful), (c) Dependability or Conformity (conscientious, responsible, orderly), (d) Emotional Stability (calm, not neurotic, not easily upset), and (e) Culture (intellectual/cultured, polished, independent-minded; see also Borgatta, 1964).

Norman (1963) continued the work by Tupes and Christal (1958, 1961). Although he had taxonomic concerns and claimed a more theory-driven way to think about the development and structure of personality (see also Block, 1995), Norman first began by replicating the five factor solution that Tupes and Christal had identified. On the basis of these results, however, he concluded that "*it is time to return to the total pool of trait names in the natural language—there to search for additional personality indicators not easily subsumed under one or another of these five recurrent factors*" (Norman, 1963, p. 582). Consequently, Norman (1967) went back to Allport and Odbert's (1936) list and added 171 terms to the list. He had retrieved these terms from the 1961 version of Webster's Third New International Dictionary. Out of 18,125 terms, Norman (1967) identified 2,797 trait terms that described the "*relatively stable and specific 'biophysical' traits of individuals.*" The remaining terms were allocated to three additional categories: (a) *temporary states* (3,021 terms), (b) *social roles, relationships, and effects* (1,476 terms), and (c) *excluded* (10,831 terms). Semantic sorting was applied to reduce the trait list to a list of 1,566 terms (for a comprehensive summary, see again John et al., 1988, pp. 184–189). Another goal that Norman had was to create a hierarchical[3] classification. For this purpose, Norman first sorted the 1,566 terms into 10 broad classes (corresponding to the two poles of the previously identified five factors; Norman, 1963). Second, within each of the 10 poles, he constructed a mid-level category that con-

[3] In addition to the classical hierarchical classification, Wiggins (e.g., 1979, 1980) proposed a circumplex taxonomy of interpersonal traits.

tained 75 categories. In sum, Norman's efforts to organize the terms provided a valuable starting point in terms of a three-level hierarchical classification for subsequent work in trait and taxonomic research.[4]

Goldberg (1980, 1981, 1982) took over and subsequently tested the generalizability of Norman's (1967) list across methodological variations (e.g., different methods of factor extraction and rotations or the use of different sets of abbreviated trait terms) and data sources (see also Goldberg, 1990). In his 1981 work, Goldberg first chose the label the *Big Five* to name the five factors. Another key goal of Goldberg's was to empirically test Norman's (1967) preliminary classification. Constructing his own inventory of trait terms (e.g., adding and removing terms), Goldberg analyzed the correlations of the 75 category scale scores and found some deficiencies in Norman's 75 middle-level categories (i.e., primarily due to terms that were synonyms). Goldberg used a particular sorting algorithm (see e.g., Peabody, 1967) to consider the denotative and connotative properties of the adjectives and reduced the middle category to 42 bipolar categories.

Simultaneously, a second line of research ended up corroborating the status of the five factors. Researchers focused on developing questionnaires and emphasizing a more theoretically driven approach. Eysenck, another heavyweight in personality research, initially suggested two[5] superordinate personality dimensions, extraversion and neuroticism, which have a strong biological basis (see Eysenck, 1967). However, claiming that two factors do not exhaust the full range of personality characteristics, Costa and McCrae (1976), for instance, analyzed data from the 16PF. The results suggested three meaningful clusters: neuroticism and extraversion, which were comparable to Eysenck's dimensions, and a third cluster *openness to experience* (see also Tellegen & Atkinson, 1974). In a series of studies, Costa and McCrae developed the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1985) and subsequently added the agreeableness and conscientiousness scales (see e.g., McCrae & Costa, 1985a, 1989). In sum, the efforts of both lines of research resulted in what is known today as the Five Factor Model (Digman, 1972, 1990; McCrae & John, 1992).

The Five Factor Model (FFM) is now the most widely used framework for describing the structure of personality, and most researchers agree about the number of personality traits (John, Neumann et al., 2008; but see e.g., Lee & Ashton, 2008, for the HEXACO framework;

[4] During the 1970s to the mid-1980s, Mischel's book (1968) Personality and Assessment ignited the person-situation debate and led to a period of "disruption" in personality trait research (see also the next Chapter 1.1.2).
[5] Later, psychoticism was added to the model as a third dimension (Eysenck & Eysenck, 1976).

Saucier, 2003 for the Multi-Language Seven; or Boyle, 2008, for a general critique). In sum, according to the FFM framework, personality is hierarchically structured with five traits that are located at the top of the hierarchy. The Big Five personality traits are: *openness to experience, extraversion, agreeableness, neuroticism (or emotional stability), and conscientiousness* (for a graphical representation, see Figure 2). The personality traits can be sketched with the following sample descriptors: (a) *conscientiousness* (self-controlled, hard-working, responsible to others, rule abiding, goal- and task-directed, orderly, and planful), (b) *neuroticism* (shy, moody, worried, unstable, anxious, and tense), (c) *openness* (curious, creative, excitable, unconventional, open to new experiences, and having wide interests), (d) *agreeableness* (cooperative, sympathetic, forgiving, and warm), and (e) *extraversion* (outgoing, talkative, sociable, and energetic; Costa & McCrae, 1997; Goldberg, 1993; John & Srivastava, 1999; Shiner, 1998).

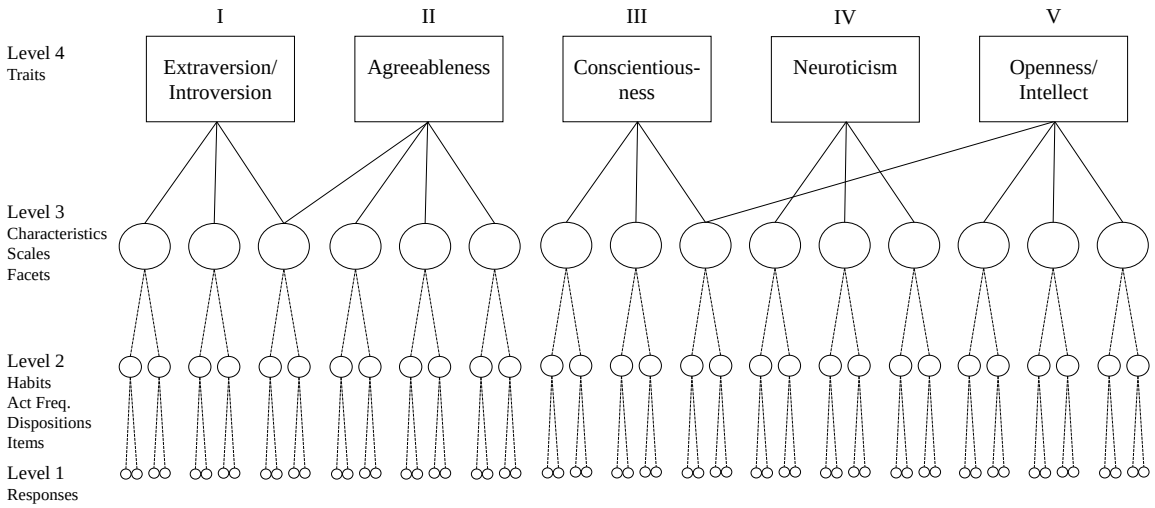

Figure 2. Structure of the FFM (Big Five) by Digman (1990).

The structure has been found across a variety of cultures (McCrae & Allik, 2002) and different age groups (Allemand, Zimprich, & Hendriks, 2008; Marsh, Nagengast, & Morin, 2013). Based on this broad framework, a wide range of instruments claim to reliably and validly measure the five personality traits. For example, the Revised NEO Personality Inventory (NEO-PI-R) and the NEO Five Factor Inventory (NEO-FFI; Costa & McCrae, 2008) as well as the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991) are widely used instruments and have received a lot of attention in recent years (for an overview, see Boyle, Matthews, & Saklofske, 2008).

Finally, the Big Five personality traits have gained more and more popularity also because they are useful for predicting a variety of important life outcomes such as academic performance (e.g., Noftle & Robins, 2007; Poropat, 2009, 2014), job performance (e.g., Barrick & Mount, 1991), mortality, and divorce (e.g., Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007) as well as better health conditions (e.g., Kotov, Gamez, Schmidt, & Watson, 2010; Weston, Hill, & Jackson, 2014; for an overview, see also Ozer & Benet-Martínez, 2006).

The manifestation phase

The research group surrounding Costa and McCrae has been particularly active in publishing an impressive number of studies (e.g., Costa & McCrae, 1985, 1997; McCrae et al., 1999; McCrae et al., 2000; McCrae & Allik, 2002; McCrae & Costa, 1985a, 1985b; McCrae & Terracciano, 2005) that have provided strong evidence for the replicability of the FFM[6], especially across different cultures. Because of the robust results and the minor differences between different cultures, they argue that the five factors might be universal across all humans and therefore a result of biological factors rather than environmental influences (but see Roberts, Wood, & Smith, 2005). On the basis of research efforts regarding the FFM, McCrae and Costa (2008b) formulated the Five Factor Theory (FFT), which embeds the Big Five personality traits (as basic tendencies) in a broader context. The FFT states how personality operates, how it affects life and behavior, and how it is influenced. Moreover, it locates the personality traits in relation to other classes of constructs such as self-related schemata, values, interests, and motives. The system is schematically depicted in Figure 3.

[6] Simultaneously, comprehensive taxonomies in other languages (e.g., Dutch and German; Brokken, 1978; Hofstee, 1976; Angleitner, Ostendorf, & John, 1990; see also John, Goldberg, & Angleitner, 1984) were constructed.

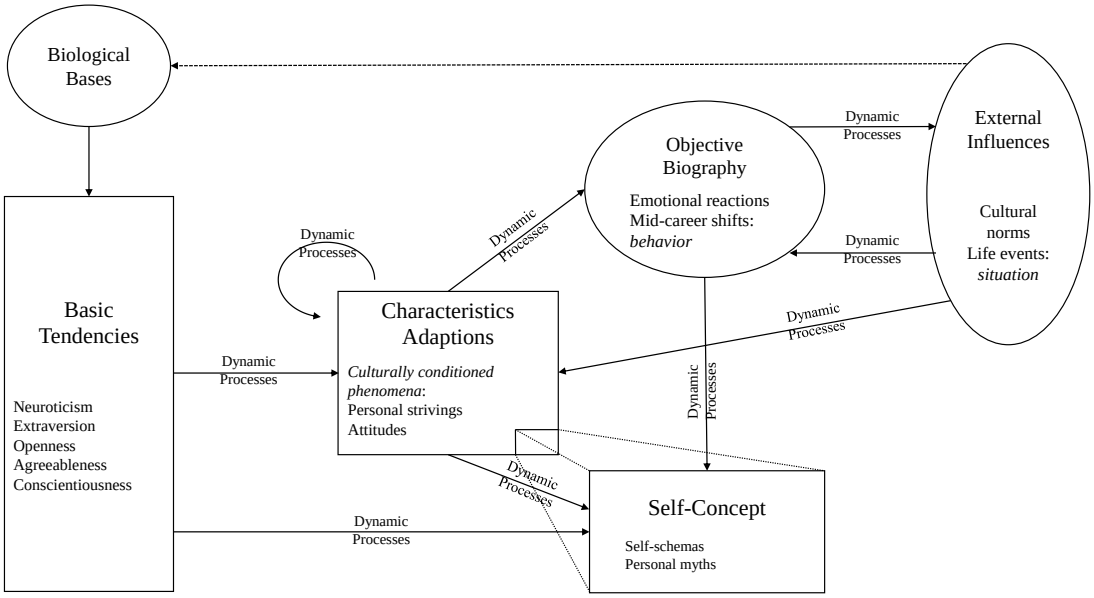

Figure 3. A schematic representation of the five factor theory personality system (McCrae & Costa, 2008b).

Central to the FFT are *basic tendencies* and *characteristic adaptations.* Basic tendencies (i.e., the Big Five personality traits) are biological in nature. However, they are unobserved neuropsychic structures that generate behavior. Qualitatively, they constitute the same time-consistent properties for all persons and differ only in the quantity of behavior generation. Basic tendencies influence the rest of the (personality) system but are not themselves influenced by external influences (e.g., different situations or contexts) or other constructs (McCrae & Costa, 2008b, pp. 162–163). By contrast, characteristic adaptations are understood as "all other" psychological constructs (e.g., habits, interests, values, knowledge, attitudes) that are manifested and shaped by the interactions between personality traits and the environment. They constitute two different layers of personality, which, however, cannot be empirically separated (see also Mõttus, 2017).

In sum, the FFT is a valuable starting point for understanding personality. However, certain processes and mechanisms remain unexplained (Mõttus, 2017). First, the underpinnings (e.g., genes, brain structures) of the basic tendencies and also the link between them remain unexplained (for an attempt, see e.g., De Young, 2015). Second, the theory is rather limited in what it says about personality development. For instance, earlier versions of the FFT claimed that personality traits change until adulthood is reached (e.g., by their intrinsi-

cally genetically driven program) and thereafter remain stable ("*set like plaster*"; Costa & McCrae, 1994). Environmental influences do not impact changes in personality traits (McCrae & Costa, 1996). Although a more recent version of the FFT softened this "set like plaster" position a bit, they still claimed that environmental influences do not cause changes in personality traits (McCrae & Costa, 2008b; Terracciano, McCrae, Brant, & Costa, 2005). However, this view contradicts recent research efforts regarding personality development and the relation of personality traits to social investments in personality research (Lodi-Smith & Roberts, 2007, 2012; Roberts, Walton, & Viechtbauer, 2006; Specht, 2017; see also Chapter 1.2).

Nevertheless, the FFT represents one grand theory of personality research and also reflects the great efforts put forth by trait theorists of the previous century. However, the overwhelming progress in trait research led to a somewhat unidimensional opinion about what personality is, how it is constituted, and the extent to which it is influenced by the environment. The progress has even been equated with a consensus on the structure and assumptions of personality (traits) in personality psychology as provokingly described by Pervin (1994):

> *What is striking concerning the statements of many trait enthusiasts is that progress in trait theory and research has come to be equated with a "consensus" concerning the "structure" of personality, thereby virtually equating a particular trait model with trait theory and trait theory with the field of personality.* (p. 103)

In fact, the assumptions about the Big Five personality traits made by the FFT (i.e., biologically based, very stable, consistent across situations and contexts) and the trait perspective in general manifested themselves both inside (see e.g., Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae, 2004; Mischel & Shoda, 2008; Pervin, 1994) and outside (see e.g., Bailey et al., 2017; Cobb-Clark & Schurer, 2012; Pintrich, 2003; Roberts & Hill, 2017, August 21; Whitehurst, 2016) the field of personality. This extreme position is often embraced in an effort to support the causal status of traits. If they are programmed in the genes, they must be stable (i.e., time-consistent) and the cause of human functioning rather than the consequences of environmental influences (see also Roberts, 2017). However, it is important to note that the extreme view of personality traits as causal, genotypic entities did not adequately reflect the status quo of the field of personality research. There have been multiple calls to broaden the view and integrate other approaches (e.g., the influence of situations and contexts) into the study of personality traits (Bandura, 1986; Block, 1995; Funder, 2009; Mischel & Shoda, 2008; Pervin, 1994; Roberts, 2009, 2017; Roberts & Nickel, 2017; Winter, John,

Stewart, Klohnen, & Duncan, 1998). These calls are best described by Mischel (e.g., 1968) and Bandura's (e.g., 1986) work, which rejected the unidirectional, biological explanation of behavior (see the next chapter).

1.1.2 Social Cognitive Perspective

The social cognitive perspective differs strikingly from the trait perspective regarding the view of the structure of personality, how personality is constituted, and especially, the extent to which personality is related to environmental influences (Bandura, 1986, 1999; Cervone, Shadel, & Jencius, 2001; Mischel, 1968, 2004). Social cognitive theories view persons and the environment as reciprocally interacting systems and emphasize that human behavior cannot be explained without considering environmental influences such as situations and contexts. Although social cognitive views date back to Dewey (e.g., 1922), Mead (e.g., 1934), and Baldwin (e.g., 1897), the impact of these early scholars on personality research was comparatively low (for a comprehensive overview of the history of social cognitive psychology, see Barone, Maddux, & Snyder, 1997). It was instead Mischel (e.g., 1968) and Bandura (e.g., 1986) who had a lasting impact on personality research. Both were influenced by the "cognitive revolution" movement (see e.g., Blake & Ramsey, 1951) in the late 1950s and early 1960s and used cognitive concepts to broaden personality theories (Barenbaum & Winter, 2008). Mischel (1968), strongly governed by the work of Kelly (1955) and Rotter (1954), reviewed the literature on personality (trait) research and questioned the key theoretical assumptions (i.e., time and situational consistency of internal characteristics; traits). Not surprisingly, the book evoked multiple different reactions, which ranged from ignoring traits to accepting that traits are stable and do not change to refuting the arguments completely. Bandura, on the other hand, inspired by the work of Miller and Dollard (1941) and also by Rotter (1954), developed social learning theory (SLT; Bandura, 1971), which he later relabeled social cognitive theory (SCT; Bandura, 1986; 2001b). Both Mischel and Bandura emphasized the interaction between the person and environment, which led to a more dynamic view on personality development and greatly facilitated the understanding of human functioning (Funder, 2008; Kenrick & Funder, 1988; Kihlstrom & Harackiewicz, 1990). SCT became a grand theory of psychology and formed the basis for most theoretical models that take a social cognitive view on human functioning. Educational and motivational research in particular are strongly influenced by social cognitive views (Pintrich, 2003). To illustrate how variables are presented in educational and motivational models, modern Expectancy-Value Theo-

ry (Eccles & Wigfield, 2002) was selected as one model that unifies many relevant educational constructs (e.g., self-concepts, values) within one framework.

The chapter is structured along three subchapters. First, the impact of Mischel's book (1968) on personality research is described and the different reactions that it evoked are summarized. Followed by this, the theoretical foundations of SCT (Bandura, 1986; 2001b) are sketched. The chapter closes with an outline of modern Expectancy-Value Theory (EVT; Eccles & Wigfield, 2002).

A more situationist view on personality

"*Mischel's book (1968) had the effect of a bombshell*" (Barenbaum & Winter, 2008, p. 16). Reviewing the existing research in the field of personality, Mischel had many criticisms of personality traits. Summarized in four statements, he claimed that, first, broad (!)[7] personality traits were not useful for predicting behavior above a correlation of .3 (i.e., "*the infamous personality coefficient"*[8]). Second, personality traits did not show time-consistency. Third, if they showed time-consistency, then it should be attributed to a similar situation or a stable environment. This led to the fourth point that personality traits did not show cross-situational[9] consistency (see also Roberts, 2009, pp. 138–139). Whereas the first three arguments were refuted (e.g., Block & Block, 2006; Funder, 2008; Ozer & Benet-Martínez, 2006; Roberts et al., 2007), the argument against the cross-situational consistency of personality traits was a little bit more knotty for the field of personality research. The argument was even used to question the existence of personality traits in general (Kenrick & Funder, 1988; Mischel & Shoda, 1995). Not surprisingly, this claim evoked multiple different reactions in the field, and the resulting controversy concerned personality researchers for (at least two) decades and is now known as the so-called "*person-situation debate"*.

Roberts (2009) organized the reactions to Mischel's book into three superordinate categories: (a) the "*Ignore It, and It Will Go Away*" approach, (b) the "*Howitzer*" approach, and (c) the "*Alice in Wonderland*" approach (pp. 139-140). The reactions simultaneously re-

[7] Mischel (1968) did not maintain a simplistic and pure situationist view. In fact, he questioned the usefulness of broad trait approaches and argued for a shift toward narrower conceptions of constructs (see e.g., Funder, 2009; Orom & Cervone, 2009). This view is also supported by the perspective of social cognitive theory (e.g., Bandura, 1997), which will be introduced in the next chapter.

[8] For the sake of completeness, Nisbett (1980) raised the putative limit for the predictive power of personality to .4. Moreover, it is now recognized that correlations in the range of .3 to .4 are comparable to the effect sizes of situational influences (Funder & Ozer, 1983; Funder, 2009).

[9] It is important to note that there is little agreement about how to define situations (Hogan, 2009; Reis, 2008), and consequently, there is no widely accepted taxonomy of situations (i.e., there is no standardized way of measuring them; but for a recent development of such a taxonomy, see Rauthmann et al., 2014; Rauthmann, Sherman, & Funder, 2015).

flected the future research directions of many researchers. Beginning with the *Alice in Wonderland* approach (i.e., every perspective has its entitlement), researchers began to propose different levels or layers of personality. One prominent example is McAdams' Levels Theory (McAdams & Pals, 2006). The model distinguishes between dispositional traits, characteristic adaptations (e.g., motives, goals, strivings, strategies, etc.) and life narratives (i.e., people construe their own lives as ongoing stories). Dispositional traits are seen as biologically based, decontextualized, and the most stable and recognizable aspect of personality. By contrast, the other units (i.e., characteristic adaptions and narratives) are defined as contextualized, intrinsically dynamic, and amenable to change (for an overview of these levels, see McAdams & Pals, 2006, p. 212). Similarly, Asendorpf and van Aken (2003) distinguished between core (more stable, higher, but not perfectly immune to environmental influences) and surface (less stable and not as high, but not totally susceptible to environmental influences) personality characteristics. In summary, every view is entitled and everybody can study what he or she believes in (or as "*in Alice in Wonderland, everyone gets a price*"; Roberts, 2009, p. 140). The *Howitzer* approach was characterized by invalidating ("*blowing a hole in the side of*") the arguments presented by Mischel (1968). The research group surrounding Costa and McCrae (see also Chapter 1.1.1) conducted a large number of empirical studies that demonstrated the utility, structure (e.g., McCrae & Terracciano, 2005), and consistency (e.g., Costa & McCrae, 1997; McCrae et al., 1999) of personality traits. In particular, cross-cultural studies (i.e., replications of the structure of personality across a variety of different environments) and the strong focus on temporal stability led to the belief that personality traits are stable across time and contexts/situations. In sum, proponents of this approach simply continued the work of previous trait theorists (see also McCrae, 2004; Mõttus, 2017). Finally, in the *Ignore It, and It Will Go Away* approach, the deterring effect of Mischel's book on trait research (especially research involving the term "trait") led many researchers to study different constructs (e.g., goals, self-esteem, achievement motivation) or to relabel their constructs as dispositions, resources, or reputations (e.g., Cantor, 1990; Dweck & Leggett, 1988; Pintrich, 2003). This approach was characterized by the hope that as long as they did not use the term "trait," they could go on studying the development of characteristics other than personality traits (see Roberts, 2009, p. 139).

In sum, Mischel's book had a huge impact on personality research because it challenged the basic assumptions behind broad personality traits (e.g., consistency across situations). This led many researchers to rethink their initial assumptions, but it also induced oth-

ers to study completely different constructs. Mischel emphasized the impact of situational and environmental influences on human behavior just as Bandura (1986) did. In the next subchapter, the theoretical foundations of social cognitive theory by Bandura (1986) are described.

Social cognitive theory by Bandura

Emerging out of social learning theory (SLT; Bandura, 1971), social cognitive theory (SCT; Bandura, 1986; 2001b) is an influential grand theory in psychology. Bandura wrote dozens of manuscripts and books to formulate a comprehensive theory of human functioning. As it would be well beyond the scope of this dissertation to describe all aspects of SCT, the following subchapter focuses on the aspects that sustainably influenced personality research as well the aspects that served as the fundament for educational theories (e.g., Expectancy-Value Theory; Eccles et al., 1983; Eccles & Wigfield, 2002; see also below).

Bandura criticized the unidirectional (i.e., controlled by environmental influences or driven by internal dispositions) explanation of behavior put forth by previous research and emphasized instead the dynamic interaction between persons and their environments. Consequently, Bandura (e.g., 1986) proposed a dynamic triadic reciprocal structure (also called "*reciprocal determinism*") as the core theoretical foundation of SCT (see Figure 4). In this model, internal personal qualities (i.e., cognitive, affective, and biological factors), behavioral patterns, and the environment dynamically interact with each other (influence one another bidirectionally). In doing this, Bandura integrated the views of cognitive, social, and personality psychology into one theoretical model (see also Kihlstrom & Harackiewicz, 1990).

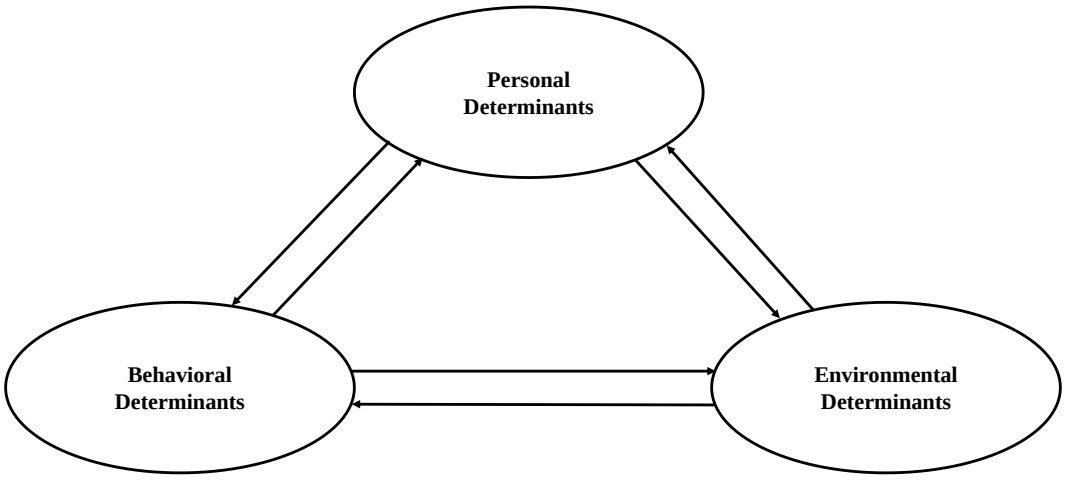

Figure 4. Schematization of triadic reciprocal determination in the causal model of social cognitive theory (Bandura, 2012).

SCT is based on an agentic perspective (Bandura, 1989, 2006). This indicates that people are able to influence their own functioning as well as to shape the course of the events in their lives. Human agency[10] has four core features: intentionality, forethought, self-reactiveness, and self-reflectiveness (Bandura, 2001b). All four core features are entangled with situational inducements and cannot be viewed without environmental determinants. First, *intentionality* refers to the idea that people act intentionally. They construe plans and actively decide to act or not to act. Second, *forethought* represents people's ability to set goals and to anticipate the likelihood of the outcomes of their behavior. Third, *self-reactiveness* reflects the ability to monitor the progress toward a specific goal and (if necessary) regulate behavior to shape the course of action in the right direction. Fourth, not only do people actively act or engage in specific situations/activities, but they also evaluate the results of their own functioning. The meta-cognitive capability of *self-reflectiveness* leads people to evaluate their motivation, values, and behavior and to judge whether their functioning was correct or not (for a more detailed description of the four core features, see e.g., Bandura, 2001b, pp. 6–10).

Obviously the environment plays a central role within the triadic reciprocal structure. In SCT, Bandura (2012) describes the environment not as a *monolithic force* (p. 11-12); instead, he distinguishes between three types of environmental structures: an imposed, a selected, and a constructed environment. First, the *imposed environment* reflects environmental settings (e.g., physical and socio-structural environments) that cannot be avoided. People act within those environments whether they like it or not. Although they have little control over these environments, they have some leeway to respond to the respective settings. Second, people *select* their *environments* and in turn are influenced by the environments they chose. Third, people actively *create environments* that offer them better control over achieving their (life) goals.

Finally, Bandura (e.g., 1986, 1997) argued that people's beliefs about their ability to execute a given action (i.e., perceived self-efficacy) is a central and pervasive mechanism of human agency. Efficacy beliefs are prospective (future-oriented) self-judgments. People evaluate whether they are capable of solving a specific (!) task and then decide whether or not

[10] In addition, human agency operates within three modes: personal, proxy, and collective. First, in personal agency, people directly influence the environment and shape the course of life. Second, in proxy agency, people influence other people, who have the required resources and knowledge to achieve their goals and secure the outcomes they desire. Third, in collective agency, by pooling their knowledge, skills, and resources, people work together (especially when they recognize they cannot afford to reach their goals without working together) to achieve common goals and benefits (Bandura, 2001b, 2012).

to engage or the extent to which they will engage. Perceived self-efficacy is domain-specific. Thus, people might have low self-efficacy beliefs in one domain (or task) but show high self-efficacy beliefs in another domain. As perceived self-efficacy is responsible for the decision to act or not to act, Bandura (e.g., 1989) further argued that self-efficacy beliefs determine the level of motivation (e.g., how much effort is exerted to engage in activities). For instance, when people do not believe in their ability to solve a specific task or achieve a specific goal, they will reduce their efforts or completely abort their attempts prematurely (see also Bandura, 1997). Furthermore, efficacy beliefs are developed in four ways: *Enactive mastery experiences, vicarious experiences (and allied social influences), verbal persuasion,* and *physiological and affective states* (for a detailed description, see Bandura, 1997, pp. 78–115).

In sum, in a socio cognitive view, people are self-organizing, proactive, self-reflecting, and self-regulating agents that dynamically interact with their environment. Whether or to what extent they act or engage in situations is strongly dependent on their efficacy beliefs (which are developed through past experience and interactions in the social environment). In the next subchapter, the influence of SCT on educational and motivational theories is outlined. Furthermore, modern Expectancy-Value Theory (EVT; Eccles & Wigfield, 2002) is briefly sketched. EVT serves as one example of how theoretical models of motivation present their variables.

Social cognitive models in educational and motivational research

In general, motivational theories are concerned with explaining why individuals energize and direct their behavior (Pintrich & Schunk, 2002). Although motivation theories emerged from different intellectual traditions such as *basic needs* and *motives* research (see e.g., Kruglanski & Higgins, 2007; Pintrich & Schunk, 2002; Weiner, 1992), most theoretical models in educational and motivational research take a social cognitive perspective on human behavior, and consequently, they present their constructs as social cognitive variables (see e.g., Eccles & Wigfield, 2002; Pekrun, 2000; Pintrich, 2003; Ryan & Deci, 2000). This seems reasonable because social cognitive theory (Bandura, 2001b) emphasizes the dynamic interactions of the environment, personal qualities, and the behavior of people, and this automatically leads to the conclusion that it must be possible to influence people's behavior and qualities by changing the environment. Fittingly, the following quote by Pintrich (2003) elucidates the view on the characteristics of social cognitive constructs:

> *In addition, if the social–cognitive constructs are assumed to be more situated and malleable, not stable personality traits, then it is more productive from an educational perspective to focus on constructs that offer the potential to be changed or more strongly influenced by the context.* (p. 670-671)

In the following, the (modern) Expectancy-Value Theory (EVT) of Eccles and colleagues (see Eccles et al., 1983; Eccles & Wigfield, 2002) is described. The description of the theoretical model should primarily serve as a prototypical example of how educational and motivational theories present their constructs and specify relations to environmental influences. EVT is one of the most influential theoretical models in educational research and unifies a variety of social cognitive constructs in one theoretical model. It is depicted in Figure 5.

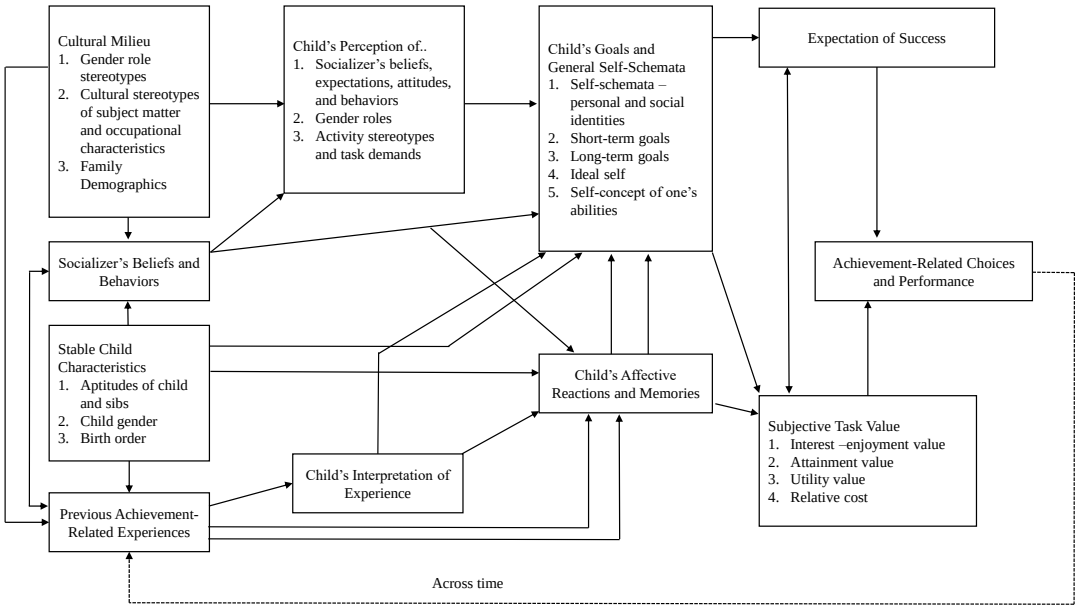

Figure 5. Eccles et al. expectancy-value theory of achievement-related choices (Eccles & Wigfield, 2002).

EVT links individuals' expectancy-related ("Can I do this task?") and task value beliefs ("Why should I do this task?") directly to performance as well as performance-related choices (e.g., persistence and task choice; see the right part of the model). It has been proposed that expectancy and task value beliefs are positively related to each other and are known to be strongly domain-specific (e.g., in the verbal domain or in the domain of math). The dissertation focuses primarily on expectancy-related and task value beliefs, which are briefly described in the following:

The modern EVT defines *expectations of success* as the belief in the feasibility of experiencing current or future success in a specific task (i.e., typically measured by personal efficacy expectations; Bandura, 1997; see also above). These beliefs, however, are assumed to primarily be influenced by a person's beliefs about her or his ability in a specific domain (i.e., ability self-concept; Marsh, 2007). In fact, Eccles (2009) stated recently, "*Empirically, we have found that ability self-concepts are so directly linked to expectations for success that it is quite difficult to distinguish between these two constructs"* (p. 82). Consequently, in recent EVT studies, expectations of success have often been measured by academic self-concept (e.g., Guo et al., 2016; Musu-Gillette, Wigfield, Harring, & Eccles, 2015; Wang & Eccles, 2013). Besides the evaluation of one's own ability, self-concepts[11] are primarily formed through interactions with other people (e.g., social comparison; Festinger, 1954) and past experiences (see Marsh, 2007; Suls & Mullen, 1982).

Subjective task beliefs consist of four value components: intrinsic value, attainment value, utility value, and cost (see again Figure 5), which can be further differentiated into several facets (for a detailed description, see Gaspard et al., 2014). First, *cost (or perceived cost)* refers to the decision to engage in a specific task (e.g., What does the person have to give up to perform an exercise?) as well as the expected effort one will need to finish the task. Second, a*ttainment value* is defined as the person's evaluation of the subjective importance of doing well on a particular task. Third, *utility value* is related to an individual's perception of the usefulness of engagement and achievement in a certain domain (e.g., an individual's short- and long-term plans or objectives). Finally, *intrinsic value (or interest value)* refers to the enjoyment a person obtains from doing an activity. This concept is related to the concept of intrinsic motivation by Ryan and Deci (2000) as well as to the construct of individual interest, which is described in more detail in Chapter 1.2.3 (see also Renninger & Hidi, 2011; Schiefele, 2009).

In sum, the central constructs of EVT are presented as beliefs (i.e., expectancy-related and task value beliefs). These beliefs are domain-specific (narrow, relevant to very specific contexts) and strongly entwined with past experiences (e.g., affective reactions, memories, and previous achievement-related experiences) from the social environment. Moreover, such beliefs are directly or indirectly influenced by short- and long-term goals as well as perceptions of stereotypes and gender roles (see Figure 5). EVT presents some details on how sta-

[11] Further, it is defined as a multifaceted and hierarchically organized construct (Shavelson, Hubner, & Stanton, 1976; Marsh & Shavelson, 2010). Academic self-concept has been shown to be a strong predictor of academic achievement (Valentine, DuBois, & Cooper, 2004).

ble these beliefs are and the extent to which these constructs are easy to change. It is interesting, that although theoretical models in motivational and educational research (e.g., EVT or interest theories; Schiefele, 1991) present some of their constructs as "*relatively stable dispositions*" or "*more stable self-schemata*," there is little doubt that the constructs are malleable and, moreover, that the environment has a central impact on the development of these constructs (see e.g., Eccles et al., 1993; Pintrich, 2003; Schiefele, 1991; Schiefele, 2009; Wigfield & Cambria, 2010). Whether these constructs have a biological basis was almost completely neglected (but see Greven, Harlaar, Kovas, Chamorro-Premuzic, & Plomin, 2009; Kovas et al., 2015; Malanchini et al., 2017).

1.1.3 A Summing-Up

The two previous chapters (1.1.1 Trait Perspective and 1.1.2 Social Cognitive Perspective) briefly reviewed the historical roots of both the trait and social cognitive perspectives and described the fundamentally different approaches that these two perspectives used to explain human behavior. Cervone et al. (2001) described the two approaches as Aristotelian top-down and Galilean bottom-up (for a more thorough description, see also Lewin, 1935). For instance, the Five Factor Theory (FFT; McCrae & Costa, 2008b) is a prototypical Aristotelian top-down approach because it defines personality traits as unobserved neuropsychic internal structures that are stable and directly cause overt behavior, independent of environmental influences. All people have the same properties on a qualitative level. It is only the degree of behavior generation that is different. By contrast, the social cognitive approach is a Galilean bottom-up approach because it explains human behavior in terms of a dynamic reciprocally related system (Bandura, 1986). The personal qualities dynamically develop into a coherent psychological system over time. Moreover, the development of personality cannot be viewed without considering environmental influences (Bandura, 2001b; Mischel & Shoda, 2008).

Until the 1960s, personality research was primarily guided by the trait perspective. Focusing primarily on the structure of personality (e.g., number of traits), personality traits were seen as biological based, very stable, and generalized patterns of behavior across time and various situations. The trait era was disrupted by Mischel's book *Personality and Assessment* (1968), which claimed that the cross-situational consistency of behavior (assessed through broad traits) is surprisingly low. This elicited the *person-situation debate*, which

busied personality researchers for (at least two) decades and aroused heated discussions about the structure of personality and the relevance of situations and personal qualities for human functioning (Funder, 2009; Kenrick & Funder, 1988). Simultaneously, Bandura (1971, 1986) formulated social cognitive theory (SCT), which emphasized the strong entanglement of a person's behavior, a person's qualities, and the environment (i.e., *reciprocal determinism*). However, the critique by Mischel (1968) evoked certain reactions that led researchers to separate into several different "*camps"* (see Chapter 1.1.2). Trait enthusiasts continued studying personality traits as biologically based, stable factors that are assumed to be unaffected by the environment. Another camp developed theoretical models in which they distinguished between different levels or layers of personality (Asendorpf & van Aken, 2003; McAdams & Pals, 2006). In these models, traits constitute the core of personality and are stable, and there is no or only a little development. The other layers, labeled as characteristics adaptions, surface characteristics, or narratives, are viewed as dynamic, less stable, and amenable to environmental influences. Another completely different reaction was to move on and study different concepts such as goals, self-concepts, or achievement motivation (Dweck & Leggett, 1988; Pintrich, 2003) or simply to relabel the constructs as dispositions or resources. These researchers have tended to use SCT (Bandura, 2001b) as the theoretical foundation and to study their concepts relatively independently of trait research (Roberts, 2009).

In recent years, however, these conceptually distinct constructs have been brought together into one group. Educational researchers and economists discovered that both personality traits (e.g., the Big Five) and social cognitive constructs (e.g., interests and self-concepts), summarized under the umbrella of noncognitive factors, appear to be useful for predicting important educational and human-capital outcomes (Almlund et al., 2011; Heckman, Stixrud, & Urzua, 2006; Kautz et al., 2014). Given their importance to policy-relevant outcomes (e.g., educational attainment), the discussion has quickly turned to how these qualities can be fostered, influenced, or enhanced (e.g., through interventions or appropriate feedback). In addition, to be a suitable target of an intervention, the constructs should be malleable (Bailey et al., 2017). The prevailing beliefs about the malleability of the constructs, however, are perfectly aligned with the origins of the different constructs (see Chapters 1.1.1 and 1.1.2). Trait theorists often present personality traits (e.g., Big Five) as heritable, very stable, and unaffected by the environment (McCrae & Costa, 2008b). On the other side, social cognitive variables (e.g., self-efficacy, interest) are viewed as narrow, less stable, relevant to very specific contexts, and derived almost exclusively from experience rather than genetics (Ban-

dura, 2012; Eccles & Wigfield, 2002). Moreover, because of the different origins and the separate examination of traits and social cognitive constructs in their respective research traditions, it is uncommon to find the two types of constructs included in the same study (Roberts, 2009). This has created an asymmetry in the understanding of how changeable or malleable constructs such as social cognitive variables and personality traits really are. Indicators of malleability and changeability could be consistency (i.e., temporal stability) and context-sensitivity (i.e., the degree to which variables respond to a new environmental setting) as they reflect the degree of change in the constructs. Studies 1 and 2 of this dissertation were designed to test these basic assumptions (i.e., time-consistency and context-sensitivity) of traits and social cognitive constructs in the same study. The next chapter depicts why it might be useful to integrate the trait and the social cognitive approaches with each other.

1.1.4 The Need to Integrate the Trait and Social Cognitive Perspectives

To move forward in understanding what personality is, what it constitutes, and how it develops, it seems that it would be fruitful to merge the trait and social cognitive perspectives. In fact, Roberts (2009) invoked the need to "*marry*" the traditional trait and social cognitive approaches and claimed this with rather vivid words: "*I will get out my metaphorical shotgun and attempt to force a marriage*" (p. 4). Although the two perspectives differ in their approaches to explain human functioning, they are not incompatible. The two approaches show different strengths and weaknesses, which, however, can compensate for each other (Fleeson & Jayawickreme, 2015). The strong pursuit to build a coherent model of personality in trait research led to the Five Factor Model (FFM; John, Neumann et al., 2008). The FFM is a good working framework for comprehensively describing a majority of personality variables (for a critique, see Kandler, Zimmermann, & McAdams, 2014). However, the strong focus on the structure of personality neglected the need for a theory that is able to explain trait genesis and development (De Young & Gray, 2009; Fleeson & Jayawickreme, 2015; McAdams & Pals, 2006). This, however, is the corresponding strength of social cognitive approaches. They focus to a large extent on the explanation of variable genesis and development (e.g., past experiences, social learning; Bandura, 1997; Eccles & Wigfield, 2002), although they thereby focus primarily on environmental influences. Whether there is a biological basis of social cognitive constructs was almost completely neglected (but see Greven et al., 2009; Kovas et al., 2015; Malanchini et al., 2017). Moreover, social cognitive approaches lack a descriptive and coherent framework of variables. This can be exemplified,

for instance, by the interest construct (see also Chapters 1.1.2 and 1.2.3). The interest concept has its roots in several different lines of theorizing (e.g., Eccles & Wigfield, 2002; Renninger & Hidi, 2011; Schiefele, 2009). Although there is consensus regarding the central characteristics of the concept, the labels of interest range from intrinsic motivation (Ryan & Deci, 2000) to intrinsic value (Eccles & Wigfield, 2002) to (individual) interest (Schiefele, 2009).

To achieve a successful integration of the two approaches, there are multiple steps to take. First, both camps have to acknowledge the perspective of the other and broaden their view. Trait researchers should move forward and open their view regarding situational and environmental influences on personality traits. Multiple studies have shown that personality traits are partially susceptible to environmental influences (e.g., life experiences, social roles; Lodi-Smith & Roberts, 2012), a finding that contradicts the concept of causal, genotypic entities that are unaffected by the environment. Thus, the conceptualization of personality traits as pure biological entities needs to be revised (Roberts, 2017). Conversely, social cognitive advocates should admit that their concepts might have a genetic basis (see Kovas et al., 2015; Malanchini et al., 2017). This leads to the next step. If one is willing to accept that personality traits change and are amenable to being influenced by environmental settings, and social cognitive variables (e.g., interest) also comprise genetic parts, it becomes apparent that no class of constructs constitutes the so-called core of personality. They stand side by side, equally weighted. This view was supported by a recent review. Kandler et al. (2014) reviewed the empirical evidence for the distinction between core (i.e., Big Five) and surface characteristics (e.g., self-related schemata, values and beliefs, etc.) using four criteria: stability, heritability, direction of causation, and shared genetic variance. In sum, they found only a little support for the distinction between basic traits as core characteristics and other characteristics as characteristic adaptions or surface characteristics.

The next chapters are structured in the following way: First, the Neo-Socioanalytic Model (Chapter 1.2), which merged the traidtional trait and social cogntive views, is introduced. Followed by this, there is an overview of one representative of each perspective, namely, conscientiousness as a personality trait (Chapter 1.2.1) and individual interest as a social cognitive variable (Chapter 1.2.2). The chapter closes with a description of the relation between conscientiousness and individual interest in predicting an important learning outcome (i.e., academic effort; Chapter 1.2.3).

1.2 The Neo-Socioanalytic Model

The Neo-Socioanalytic Model (NSM) was introduced by Roberts (2006) and Roberts and Wood (2006). This model represents an integrative model of personality in which several prominent personality theories were combined and extended such as Hogan's socioanalytic theory (Hogan & Blickle, 2013), McAdams' Levels Theory or "New Big Five" (McAdams & Pals, 2006), as well as the Five Factor Theory (FFT; McCrae & Costa, 2008b). The NSM is depicted in Figure 6.

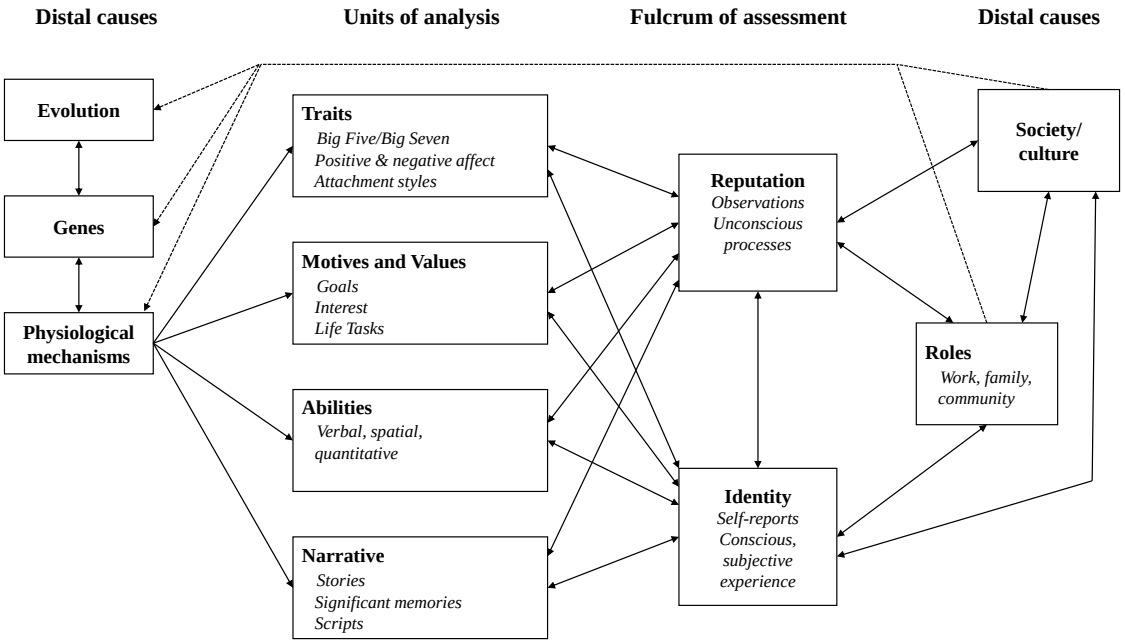

Figure 6. The neo-socioanalytic model of personality (Roberts & Nickel, 2017).

Central to the NSM are four primary and distinct units of analyses (also called domains of personality): traits, motives and values, abilities, and narratives. These four units are supposed to incorporate the most important categories of individual differences (Roberts, 2006, p. 5). In the first domain, *traits* are defined as "*relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances"* (Roberts, 2009, p. 140). This first domain reflects constructs such as the Big Five/Big Seven personality traits, affect, and attachment styles. *Values and motives* constitute the second domain and are best represented by goals, interests, and life tasks (e.g., What would you like to do? What do you want to achieve?). The third domain focuses on people's *abilities* ("What is a person capable of doing?"), broadly defined. Thus, the term abilities refers to not only cognitive abilities (e.g., for the hierarchical model of general intel-

ligence; *g;* see e.g., Gray & Thompson, 2004; Neisser et al., 1996) but also emotional and physical abilities (see e.g., Lubinski, 2000). *Narratives*, as the fourth domain, are represented by stories, significant memories, and scripts. People use these devices to understand themselves, the history of their lives, as well as their environment (McAdams, 1993; McAdams & Pals, 2006). In contrast to other models of personality (e.g., FFT; McCrae & Costa, 2008b), the four domains stand side by side and do not follow a prioritized hierarchical order. There is ample evidence that the other domains (i.e., motives and values, narratives) are distinct enough from that of personality traits and can consequently be considered separate domains with their own causal status (e.g., Bleidorn et al., 2010; Damian, Su, Shanahan, Trautwein, & Roberts, 2015; Roberts et al., 2007; for a recent review, see Kandler et al., 2014). All four domain are assumed to be biologically based (i.e., through physiological mechanisms). For instance, Roberts (2017) proposed the (revised) sociogenomic model of personality traits (see also Roberts & Jackson, 2008), which can be housed within the NSM. Considering also environmental influences (see also below), the model describes biological pathways that can provide mechanistic explanations for the patterns of growth and change in personality traits.

In addition to the four domains, the fulcrum of assessment and the primary contexts (distal causes) play significant roles in the NSM (see Figure 6). The fulcrum of assessment comprises *identity* (self-reports) and *reputation* (observer reports) and manifests the four domains of personality. The assessment simultaneously reflects a psychological component and a methodological component. From the methodological viewpoint, self-reports (in which persons are asked about their own behavior) and observer reports (in which other persons [e.g., friends, parents, teachers, etc.] are asked about the behavior of a particular person) are obviously two (very) different methods of measuring (the four domains of) personality. The type of method, however, is strongly entwined with the psychological components of identity and reputation. Identity represents a person's cognitively available views (self-perceptions in terms of "How am I?") about his or her personality (i.e., the four domains). Thus, identity also refers to a metacognitive perception of those self-perceptions (see Roberts, 2006, p. 10). On the other hand, reputation is based on others' perspectives on a particular person's personality. In line with the concept of the "*looking glass self*" (Cooley, 1902), the perceptions of others can influence a person's identity (e.g., people may see themselves differently as a function how others define them). However, because people often (but not always) actively

frame their reputation, identity might also influence their reputation (see Roberts & Nickel, 2017, pp. 158–159).

Finally, the NSM explicitly states that personality (including personality traits) changes over the life course and is moreover affected or even caused by environmental factors (e.g., experiences, social roles). To explain the mechanisms behind the development of personality, the NSM has provided eight principles: (a) *Cumulative Continuity Principle,* (b) *Maturity Principle,* (c) *Social Investment Principle,* (d) *Corresponsive Principle,* (e) *Plasticity Principle,* (f) *Role Continuity Principle,* (g) *Identity Development Principle,* and (h) *Niche-Picking Principle* (for descriptions and evaluations of the principles, see Roberts & Damian, in press; Roberts & Nickel, 2017). This is in stark contrast to previous theoretical models of personality research (e.g., McCrae & Costa, 2008b), which have asserted that personality traits change only due to an intrinsic genetically driven program (i.e., maturation) and are completely unaffected by the environment. The evidence speaks in favor of the developmental perspective. Multiple studies have shown that personality traits change over the life course. For instance, adults tend to become more conscientious, agreeable, and less neurotic (following the "*Maturity Principle"*[12]*;* Roberts & Wood, 2006; for meta-analyses, see Lodi-Smith & Roberts, 2007; Roberts et al., 2006). It is interesting, however, that there is less empirical evidence about personality development in childhood and adolescence. It can be assumed that, with maturation, the development of personality changes toward a broad and complex formation of psychological constructs (Caspi, Roberts, & Shiner, 2005; Shiner & De Young, 2013). The results of the existing longitudinal studies with regard to personality trait change in childhood and adolescence often show slight declines; however, there are no congruent patterns (Branje, van Lieshout, & Gerris, 2007; Durbin et al., 2016; Göllner et al., 2016; Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2009; Van den Akker, Deković, Asscher, & Prinzie, 2014).

In sum, the NSM represents an integrative model that gives equal weight to four units of analysis (i.e., traits, motives and values, abilities, and narratives). In formulating eight principles (see above) that describe and explain personality development in relation to environmental influences, the NSM merged social cognitive views with the trait approach (or to say it with different words: it "forced a marriage" between the two approaches). The follow-

[12] It has been argued that persons invest in and commit to adult social roles and, hence, adapt their behaviors in terms of certain life domains such as work and family (see also Roberts, Wood, & Smith, 2005).

ing chapters take a closer look at conscientiousness as a personality trait, and (individual) interest as a social cognitive construct, and their proposed relation.

1.2.1 A closer look at conscientiousness

This dissertation focuses on conscientiousness as one representative of the Big Five personality traits, which have their roots in the (long) history of trait theories (see John & Srivastava, 1999; see also Chapter 1.1.1: Trait Perspective). Conscientious individuals can generally be described as self-controlled, hard-working, responsible to others, and rule-abiding. They tend to be rather goal- and task-directed, and they like to plan and are orderly (John & Srivastava, 1999; Roberts, Jackson, Fayard, Edmonds, & Meints, 2009). Thus, it is not surprising that conscientiousness is linked with success in nearly all life domains (e.g., school, work, and health; Barrick & Mount, 1991; Noftle & Robins, 2007; Poropat, 2009; Roberts, Lejuez, Krueger, Richards, & Hill, 2014). Noftle and Robins (2007), for instance, examined relations between the Big Five personality traits and academic outcomes, and conscientiousness turned out to be the strongest predictor of both high school and college GPA (the mean effect size was .26). Moreover, Poropat's (2009) meta-analysis showed that conscientiousness predicted academic performance largely independently of cognitive ability. This evidence makes conscientiousness one of the most relevant noncognitive predictors in achievement settings. In the following, the characteristics of conscientiousness are reviewed.

First, conscientiousness is a trait. A variety of characteristics are associated with this label. Traits are (often) defined as biologically based, (very) stable, and consistent across situations and contexts (McCrae & Costa, 2008b). Whereas there is conceptual agreement and empirical evidence of the (at least partial) biological basis (De Young & Gray, 2009; Roberts, 2017) and the moderate to high stability (Ferguson, 2010; Roberts & Del Vecchio, 2000) of personality traits in general, the conceptualization of cross-situational consistency has evoked long-lasting discussions (see Johnson, 1999, and for a summary, see Chapter 1.1.3). Researchers have recently argued that all Big Five personality traits are operationalized within relevant contexts and arise in response to certain situations (Funder & Colvin, 1991; Roberts, 2009). Therefore, the current dissertation follows Roberts' (2009) definition: "*Personality traits are relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances"* (p. 140). Succinctly, conscientiousness is a default tendency to be self-controlled, responsible to others, hardworking, orderly, and rule-abiding in many situations (Roberts et al., 2014).

Second, according to the definition, conscientiousness is a (relatively) enduring personality trait; but what does "relatively enduring" mean? As stability is often quantified by means of test-retest correlations[13] (or rank-order correlations), a trait would be perfectly stable when $r = 1$ and entirely changing when $r = 0$ (see Ferguson, 2010). In their meta-analyses, Roberts and Del Vecchio (2000) reported test-retest correlations ranging from .35 to .75 for the Big Five personality traits. Whereas the stability in (young) adulthood tends to be relatively high (.57 to .72), the stability in childhood and adolescence tends to be considerably lower (.35 to .52). In addition, there is strong evidence that conscientiousness changes over the life course. Following the *maturity principle*, adults tend to become more conscientious (Roberts et al., 2006) because they invest in and commit to social roles. By contrast, there is less empirical evidence on the development of conscientiousness in childhood and adolescence. The results of existing longitudinal studies have shown incongruent patterns (Branje et al., 2007; Göllner et al., 2016; Klimstra et al., 2009; Van den Akker et al., 2014). However, in contrast to (young) adulthood, conscientiousness increases in childhood (i.e., children become more able to exert self-control during the preschool and elementary school years; Wigfield et al., 2015), but then it tends to decrease during the transition into adolescence and thereafter begins to increase again. To explain the temporary decrease in conscientiousness, Denissen, van Aken, Penke, and Wood (2013), for instance, emphasized the significance of regulatory processes for explaining personality development in childhood and adolescence. They argued that learning these regulative strategies might take some practice. However, thus far, it has been difficult to draw final conclusions because the sample characteristics and types of assessment methods have varied across the existing studies (see also Göllner et al., 2016).

Finally, conscientiousness is a (broad) higher order construct (Digman, 1990; Goldberg, 1993). Lexical and questionnaire studies have identified several facets that constitute conscientiousness (see e.g., Jackson et al., 2009). The number of facets, however, has varied from two to 10 (for an overview, see Roberts et al., 2014), and there is consensus only (if at all) about the facets of responsibility, orderliness, self-control, and industriousness (p. 4). Other facets (e.g., traditionalism, punctuality, decisiveness) have been identified but have yet to be replicated. Moreover, the facets can be organized into a proactive and inhibitive behavior factor (Jackson et al., 2010). Whereas the inhibitive behavior factor is best represented in

[13] It should be noted that there is also criticism of the use of test-retest correlations as stability measures (Anusic & Schimmack, 2016; Fraley & Roberts, 2005).

the facet of self-control (i.e., the tendency to inhibit impulses), the proactive dimensions are best reflected by the facet of industriousness (i.e., the tendency to work hard and pursue goals even in the face of challenge).

1.2.2 A closer look at (individual) interest

The representative of the social cognitive perspective is interest. Interest is a key variable in many theoretical models of educational research (Eccles & Wigfield, 2002; Pintrich, 2003; Renninger & Hidi, 2011; Renninger, Hidi, & Krapp, 1992; Ryan & Deci, 2000; Schiefele, 1991). It is closely linked to school achievement and a variety of other learning outcomes such as academic effort (Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Schiefele et al., 1992; Trautwein, Lüdtke, Schnyder, & Niggli, 2006). In fact, Pintrich (2003) concluded in his review that interest was one of the five most important social cognitive constructs in motivation science (p. 672).

The current state of research differentiates between situational and individual interest (Schiefele, 2009). Situational (or activated) interest is described as a certain condition that is caused by a stimulus in the environment (e.g., exciting lessons in school). By contrast, individual interest (also called personal interest) is conceptualized as "*a relatively stable motivational orientation or personal disposition that develops over time in relation to a particular topic or domain*" (Hidi & Harackiewicz, 2000, p. 152). The current dissertation focuses exclusively on individual interest. In the following, paralleling the description of conscientiousness, the characteristics of individual interest are portrayed.

First, individual interest emerged from theoretical models (e.g., Renninger et al., 1992) with a social cognitive perspective (Bandura, 2001b; Pintrich, 2003). Thus, by definition, individual interest is narrow, relevant to very specific contexts (e.g., school subjects), and derived almost exclusively from (past) experience (Renninger, 1992; Schiefele, 1991) rather than genetics (but see Kovas et al., 2015). Furthermore, individual interest is strongly domain-specific, and there is empirical evidence that the domain-specificity of interest increases when students get older (Denissen, Zarrett, & Eccles, 2007). These characteristics are in stark contrast to the proposed characteristics of conscientiousness or traits in general (i.e., biologically based and independent of a domain).

Second, individual interest is supposed to be "*a relatively stable personal disposition*," which indicates that individual interest is (relatively) stable and changes over time.

Test-retest correlations increase from .18 at school entry to .65 at the end of secondary school (Frenzel, Goetz, Pekrun, & Watt, 2010; Marsh et al., 2005; Wigfield et al., 1997). Furthermore, children's interests in most academic subjects decline continuously during the school years (Frenzel et al., 2010; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Wigfield et al., 1997) but with substantial variation (Musu-Gillette et al., 2015). One explanation is that, when young children enter school, they have quite a universal (or general) interest (i.e., they engage in many different activities) that becomes more and more specific as they mature. This differentiation process leads to declines across all subjects (Wigfield et al., 2015). Also, the interests of young people shift during adolescence to nonacademic domains (e.g., video games; Sharif, Wills, & Sargent, 2010), and this shift may offer an additional explanation for why students show lower interests in school subjects as they get older. It is surprising that these developmental patterns fit with the developmental patterns of conscientiousness, which also shows slight declines and is moderately stable during childhood and adolescence (see above).

Finally, (individual) interest comprises affective and cognitive aspects. For instance, Schiefele (2009) distinguished between feeling-related and value-related valences. Correspondingly, Eccles and Wigfield (2002) differentiated between attainment value and intrinsic value. Whereas attainment value is defined as a person's view of the subjective importance of doing well on a particular task, intrinsic value (or interest value) refers to the enjoyment a person obtains from doing an activity (see also Renninger & Hidi, 2011).

1.2.3 The (hypothesized) relation between conscientiousness and individual interest

It is undisputed that both conscientiousness and (individual) interest are central constructs in their research fields and predict achievement and learning outcomes. However, the relation between conscientiousness and interest in predicting these outcomes has not been the subject of much research. Notable exceptions are Di Domenico and Fournier (2015), Sansone and Thoman (2006), and Trautwein et al. (2015). In each of these articles, conscientiousness and interest were used to predict learning outcomes such as academic effort or achievement (e.g., GPA). The studies[14] found consistent support for a compensatory mechanism (Di Domenico & Fournier, 2015; Sansone, Thoman, & Smith, 2010; Trautwein et al., 2015), which implies that high levels on one of the predictors can (at least in part) compen-

[14] The studies differed in their study design (e.g., lab and classroom-based research) and interest measures (situational vs. stable). They also investigated between- and within-person effects, respectively.

sate for low levels on the other predictor in terms of an "either/or" pattern (Cohen, Cohen, West, & Aiken, 2003, p. 285). On the basis of these studies, Trautwein, Roberts, Nagengast, and Lüdtke (in press) suggested the CONscientiousness × Interest Compensation (CONIC) model to describe the interactive relation[15] between conscientiousness and interest in predicting academic effort. The CONIC model postulates that individual interest will be less relevant for the academic effort of students who are high in conscientiousness, and vice versa, conscientiousness is less relevant for academic effort when students have strong interests (see also Trautwein et al., 2015). Translated into regression language, this would indicate that academic effort is positively predicted by conscientiousness and interest but negatively predicted by their product term (see Figure 7 for a graphical representation).

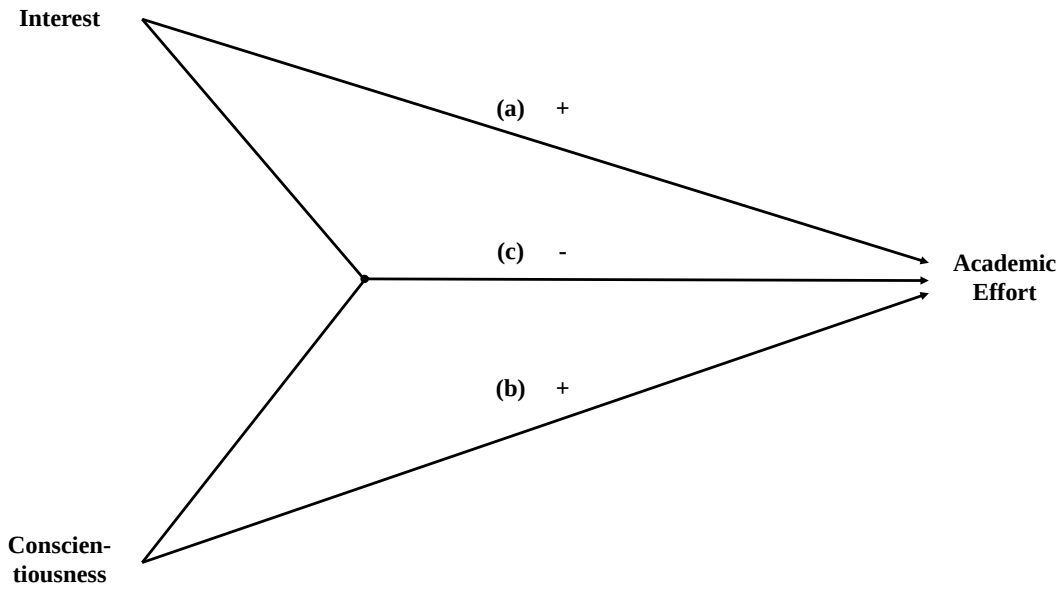

Figure 7. *Graphical representation of the CONIC model (Trautwein et al., in press).*

What can explain the interactive relation between these two constructs? Conscientiousness and interest are both forces that drive individuals to engage in activities. The driving elements of both constructs lead conscientiousness and individual interest to be positively associated with a construct such as academic effort ("*I do my best when it comes to …*"; see e.g., Trautwein & Lüdtke, 2007). However, as described above, conscientiousness and indi-

[15] Trautwein et al. (2015) originally hypothesized three models for how individual interest and conscientiousness could be related to achievement and other achievement-related behaviors (e.g., academic effort): *an additive effects model*, *a synergistic effects model*, and *a compensatory effects model* (p. 144). These three models correspond to the three possible statistical relations between two variables (no interaction, positive interaction, and negative interaction; for a statistical description, see Cohen, Cohen, West, & Aiken, 2003).

vidual interest differ in their conceptual level and also in how they initiate activity. Conscientiousness is a broad personality trait, which is less context driven and reflects a default tendency[16] to work hard in almost any achievement setting (see Chapter 1.2.1). Consequently, conscientiousness can be described as a domain-independent "*built-in push factor*". By contrast, individual interest is narrow and specific to a certain domain (see also Chapter 1.2.2). Because people are interested in this particular domain, they voluntarily spend additional time engaging in activities linked to this domain (i.e., interest draws people toward activities). Moreover, interested persons expect to experience positive emotions when they engage in these activities. Thus, individual interest can be described as a powerful emotional "*pull factor*" (Sansone et al., 2010; Sansone, Wiebe, & Morgan, 1999; Trautwein et al., 2015). On the other hand, if a student is not interested in a task but is conscientious, he or she will usually complete the required school task anyway. The "*built-in push factor*" of conscientiousness steps in and compensates for the lack of interest.

Previous work on the CONIC model was exclusively cross-sectional, and it is therefore still unclear whether the combination of conscientiousness and interest also plays a role in predicting the development of effort over time. The third study in this dissertation was designed to address the lack of prospective, longitudinal tests of the relation between conscientiousness and interest in predicting the development of effort.

[16] In particular, the industriousness facet (i.e., the tendency to work hard, to aspire to excellence, and to persist in the face of challenge) of conscientiousness can be mentioned as the relevant driving force (Trautwein, Roberts, Nagengast, & Lüdtke, in press).

2 RESEARCH QUESTIONS

The dissertation aimed to achieve two objectives. The first aim was to test two basic assumptions of the malleability (i.e., time-consistency and context-sensitivity) of personality and social cognitive constructs. Both construct classes have emerged in multiple reviews as critical predictors of important human capital outcomes such as school performance and school functioning (e.g., see Almlund et al., 2011; Eccles & Wigfield, 2002; Kautz et al., 2014; Poropat, 2009). This is why it was concluded that interventions should focus on them, especially in childhood and adolescence. The focus on young people is key because the investments made by these populations will reap larger gains throughout life (Cunha & Heckman, 2010). But, to be a viable target of an intervention, malleability is considered to be a necessary precondition (Bailey et al., 2017), and prevailing beliefs about the malleability of personality and social cognitive variables is strongly aligned with their origins. Constructs such as self-concept, interest, and effort emerged from theoretical models (Eccles & Wigfield, 2002; Pintrich, 2003) that are based on a social cognitive perspective (Bandura, 2001b). Social cognitive models present their constructs as malleable by default and entwined with the (social) context. By contrast, personality traits such as the Big Five originated from trait theories (John, Neumann et al., 2008), which often define their constructs as heritable, stable, and consistent across time and contexts (McCrae & Costa, 2008b). Moreover, because of their different intellectual heritage, it is rather uncommon to find both types of constructs (i.e., social cognitive and trait-like constructs) included in the same study (Roberts, 2009). This has created an asymmetry in the understanding of how malleable the respective constructs are. Consequently, Studies 1 and 2 were designed to test two basic assumptions of the malleability (i.e., time-consistency and context-sensitivity) of traits and social cognitive constructs in the same study (for the study description, see below). For this purpose, the Big Five personality traits (conscientiousness, neuroticism, extraversion, openness, and agreeableness) were contrasted against several social cognitive variables (e.g., interests, self-concepts, and academic effort) with regard to their temporal stability (Study 1) and their context-sensitivity (Study 2). To be more specific, Study 1 compared multiple indices of the stability (i.e., test-retest correlations, individual differences in change, and trait-state variance proportions) of these two classes of variables. Study 2 investigated whether the two construct classes responded differently to the same type of environmental experience (i.e., getting a new teacher).

The second aim was to examine potential synergies when considering variables from both perspectives (traits and social cognitive constructs). The focus, thereby, was on two prominent representatives of each perspective: conscientiousness (as a broad personality trait) and individual interest (as a topic-specific social cognitive variable). Previous studies have found support for a compensatory pattern (Di Domenico & Fournier, 2015; Sansone et al., 2010; Trautwein et al., 2015) between conscientiousness and individual interest in predicting important school outcomes such as academic effort and achievement. This compensatory pattern indicates that high levels on one of the predictors can (partly) compensate for low levels on the other predictor in terms of an "either/or" pattern. To be more specific, the effect of conscientiousness on academic effort is stronger when individual interest is low (and vice versa). The objective of Study 3 was to test this relation in a longitudinal setting.

The dissertation benefited from a large-scale longitudinal multicohort study called "*Tradition and Innovation in Educational Systems"* (TRAIN; Jonkmann et al., 2013), which is hosted by the Hector Research Institute of Education Sciences and Psychology at the University of Tübingen. TRAIN is a large-scale school achievement study that encompasses four time points (from Grades 5 to 8; T1, T2, T3, and T4). The study comprises 136 classes in 99 schools from two federal states (Baden-Württemberg and Saxony). Data were available for n = 2,894 (46% female) students at T1 (Grade 5; mean age M = 11.1 years, SD = 0.56), n = 2,936 (45% female) students at T2 (Grade 6), n = 2,993 (46% female) individuals at T3 (Grade 7), and n = 3,060 (46% female) students at T4 (Grade 8). The sample size of the pooled data set was N = 3,876. This data set contained all individuals who provided information at a minimum of one time point. In addition to achievement measures and demographic variables, the TRAIN study includes the Big Five personality traits and a variety of social cognitive variables (e.g., interests, self-concept). This provided the opportunity to test two basic assumptions of malleability (i.e., stability in Study 1, context-sensitivity in Study 2) of the different construct classes in one study. Moreover, it enabled to study potential synergies between the construct classes in a longitudinal setting (unique and combined effects of conscientiousness and individual interest on the development of academic effort; Study 3).

In the following, the research questions of the three empirical studies will be described in greater detail.

In the first study (*Social Cognitive Constructs Are Just as Stable as the Big Five Between Grades 5 and 8*), several social cognitive variables and personality traits were contrasted in terms of their temporal continuity and change over time. To this end, the Big Five per-

sonality traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness) were examined as well as social cognitive constructs such as subject-specific individual interest, self-concept, and academic effort. To determine whether the baseline consistency of these two classes of variables differed, multiple indices of continuity and change were examined over time (i.e., test-retest correlations, variance components, and trait-state variance proportions; Bishop, Geiser, & Cole, 2015; Fraley & Roberts, 2005; Roberts & Mroczek, 2008). Three research questions were of particular interest. First, how stable are the constructs over time? Second, to what extent can the stability of each class of constructs be attributed to unchanging components, and how much of the instability can be attributed to state components? Third, to get a better idea of whether individuals change more or less in each class of variables, the average level of individual differences in change (i.e., to what extent students show increases or decreases in the constructs) were compared between the classes of constructs. On the basis of the proposed characteristics of the two types of variables, social cognitive variables should show less stability on all indices than the Big Five personality traits (see Chapter 1.1).

The second study (*The Effects of Getting a New Teacher on the Consistency of Personality*) focused on examining the effect of getting a new teacher on consistency in students' psychological functioning in two independent, large, longitudinal German studies (TRAIN and PISA-E; for the description of the PISA-E study, see Study 2 in Chapter 4.). By using quasi-experimental designs, two indices of consistency (i.e., test-retest correlations and changes in variance components over time) were compared between students who got a new teacher and those who did not on a variety of student characteristics (including social cognitive and personality constructs). The German school system offered a unique setting in which the effect of getting a new teacher could be tested. In Germany, teachers typically change classes every 2 years, whereas the composition of these classes remains the same for several years. In Study 1, several math-related social cognitive variables (i.e., interest, academic effort, self-regulation, and anxiety) were examined. In Study 2, the same approach used in Study 1 was applied but with two extensions. First, the social cognitive constructs of interest and effort were complemented by self-concept. In addition, potential differences between the school subjects of math, German, and English were investigated. The second study also provided the opportunity to contrast the social cognitive constructs with the Big Five personality traits and asked whether social cognitive variables were more strongly influenced by getting a new teacher than the Big Five personality traits were. Again, based on the often-

proposed characteristics of both types of variables, social cognitive variables (strong context-sensitivity) should be more influenced by this uncertain transitional situation than the Big Five personality traits (low context-sensitivity; see again Chapter 1.1).

The third study tested the unique and combined effects of conscientiousness and individual interest (as representatives of each perspective) on the development of academic effort in the school subjects of math, German, and English in the TRAIN study. Academic effort is conceptualized as the amount of time and energy that persons expend on academic tasks (Corno, 1986; Trautwein & Lüdtke, 2007) and is a key variable in many theoretical models of academic learning (Fredricks, Blumenfeld, & Paris, 2004; Newmann, 1992; Pintrich & de Groot, 1990). Three research questions were of particular interest. First, the development of conscientiousness, individual interest, and academic effort (in three school subjects) in terms of temporal stability and mean-level change over time were examined. The main focus was on the development of academic effort because it was the target variable in which the variation was explained. In a second step, the unique effects of conscientiousness and individual interest in predicting the changes in academic effort over time were tested. Third, to test the CONscientiousness × Interest Compensation (CONIC; Trautwein et al., in press) model in a longitudinal setting, the proposed interaction between conscientiousness and individual interest was included in the analyses. On the basis of previous research (see e.g., Di Domenico & Fournier, 2015; Trautwein et al., 2015), support was expected to be found for the compensatory (negative) interaction between conscientiousness and individual interest in a longitudinal study as well (see also Chapter 1.2.3).

3 STUDY 1 SOCIAL COGNITIVE CONSTRUCTS ARE JUST AS STABLE AS THE BIG FIVE BETWEEN GRADES 5 AND 8

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Abstract

Personality traits and social cognitive variables are central constructs in psychological research. It is often assumed that personality traits are less changeable than social cognitive variables, and thus, interventions usually tend to focus on the latter. However, these assumptions about the mutability of personality and social cognitive variables have never been tested side-by-side in a longitudinal study. Using a large longitudinal study with four time points and N = 3,876 students in 136 classes (99 schools), we compared the mutability of the Big Five personality traits and social cognitive constructs more often described as socio-emotional skills or motivational variables (individual interest, self-concept and academic effort in the school subject's math, English, and German). The results indicated that there are no marked differences between personality traits and social cognitive constructs across multiple indicators of stability/changeability.

Keywords: Big Five, social cognitive constructs, stability, latent-state-trait models

Social Cognitive Constructs are Just as Stable as the Big Five Between Grades 5 and 8

Over the last decade there has been a groundswell of attention brought to bear on "non-cognitive" factors that contribute to school outcomes. Motivated in part by research emerging out of economics that showed that factors other than cognitive ability were important for human capital (Heckman et al., 2006), researchers and policy makers from multiple fields, but especially education, have been investigating the importance of non-cognitive factors. Multiple reviews have come to the same conclusion: non-cognitive factors are critical for success in both educational and occupational settings and that interventions should focus on them (Kautz et al., 2014; National Research Council, Pellegrino, & Hilton, 2012).

What are non-cognitive factors? As the name would indicate, non-cognitive factors are any construct that are not considered traditional indicators of cognitive ability or intellectual functioning. From the viewpoint of psychology, this broad category inevitably includes a mix of many different constructs that go by many different names and that emerge out of disparate theoretical orientations. Common terms used to describe non-cognitive factors are socio-emotional skills, character, personality, and 21st Century Skills. Prototypical constructs include factors such as self-concept of ability, self-efficacy, academic persistence, conscientiousness, stress tolerance, grit, and creativity (National Research Council et al., 2012).

The rather inclusive grouping of concepts belies the often stark theoretical and conceptual distinctions dividing these constructs when used in research. Some of these variables, represented best by conscientiousness, are considered "traits" and are often described as enduring, broad, and heritable (McCrae & Costa, 2008b). On the other side are social cognitive variables (e.g., self-efficacy), which are presumed to be narrow, relevant to very specific contexts, and derived almost exclusively from experience rather than genetics (Bandura, 2012). The distinction between these two groups of variables is supported by many different theoretical models that conceptualize traits as core characteristics and social cognitive variables as surface characteristics (Asendorpf & van Aken, 2003). The fact that these conceptually distinct constructs are brought together in one group reflects, in part, the pragmatism of many educational researchers and economists who have discovered that all of these constructs appear to be useful for predicting important educational and human capital outcomes (Almlund et al., 2011).

Given their importance to policy-relevant outcomes (e.g., educational attainment and occupational success), the discussion has quickly turned to how these qualities can be fos-

tered in students through interventions, especially in childhood and adolescence[17] (Heckman & Kautz, 2012). For a non-cognitive quality to be a viable target of an intervention, it is typically assumed that it should be malleable. Currently, the prevailing belief is that the malleability of a non-cognitive characteristic is perfectly aligned with the conceptual distinctions that have been drawn between the trait and social cognitive perspectives. Social cognitive variables (e.g., math self-efficacy or interest in social science) are often assumed to be more malleable than constructs associated with personality (e.g., grit and conscientiousness; Bailey, Duncan, Odgers, & Yu, 2015; Harter, 1998; Shavelson et al., 1976). Based on the prevailing theoretical systems in psychology, this assumption appears well-justified when considering that conceptually, social cognitive constructs emerged from a framework that by definition presents most of its affiliated constructs as malleable (Bandura, 2012). In particular, social cognitive variables are traditionally seen as more entwined with individuals' social contexts. For example, self-concept beliefs emerged as a result of social comparison processes and the evaluation of one's own ability (Suls & Mullen, 1982). Also, domain-specific interests were found to result from a student's interaction with a specific object or activity (Krapp, 2002) and are presumed not to be based on biological factors (but see Kovas et al., 2015). By virtue of their theoretical origins, social cognitive constructs are assumed to be amenable to change, and there is little doubt that they can be fostered through interventions (see e.g., Lazowski & Hulleman, 2016; O'Mara, Marsh, Craven, & Debus, 2006).

In contrast, there is some debate about the ratio of stability and change in personality traits (Anusic & Schimmack, 2016). Personality traits are often assumed to be highly heritable and highly stable and therefore not amenable to change. For instance, the Five Factor Theory (McCrae & Costa, 2013) asserts that personality traits are influenced primarily by biological factors such as genetic pre-dispositions, and trait change is attributed solely to intrinsic maturation and not to life experience or environmental effects. In contrast, research emerging from the Neo-socioanalytic framework of personality holds that personality traits are not perfectly stable and can be affected by experience (Roberts & Nickel, 2017). According to this perspective personality traits, in particular, are marked by relative stability *and* change (both mean level and individual differences) that are presumed to be caused by experiences and environmental factors (Caspi et al., 2005; Roberts et al., 2006).

[17] The periods of late childhood and early adolescence are defined by fundamental changes in youths' lives (e.g., rapid biological changes, shifting demands in school life, initiation of new relationships with peers, etc.; Soto and Tackett (2015) that are potential sources of instability and also mutability. These age periods are ideal for studying these issues as this is when non-cognitive factors are the most relevant to educational outcomes and are most often the targets of interventions.

Whereas the assumptions of the relative malleability of social cognitive and personality constructs appear reasonable, data that support these positions are surprisingly scarce. Although it is common to intervene or try to change social cognitive constructs such as socio-emotional skills (e.g., Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011), it is less common to focus on their test-retest stability or heritability. Conversely, while the idea that personality traits do develop with time and age is beginning to gain a foothold in the personality literature (e.g., Roberts & Mroczek, 2008), it is highly unusual to find research focused on intervening to change personality traits, and conversely much more common to find reports of their test-retest stability and heritability (e.g., Ferguson, 2010). When examined separately in various longitudinal studies, it is common to find that mean-level changes in both personality traits and social cognitive constructs in adolescence are surprisingly heterogeneous (Musu-Gillette et al., 2015; Soto, John, Gosling, & Potter, 2011; Van den Akker et al., 2014). Fittingly, a recent review of the conceptual and empirical basis of the distinction between these two classes of constructs found that the division between traits and social cognitive concepts was conceptually larger than the empirical data would justify (Kandler et al., 2014).

Nonetheless, because the intellectual heritage behind these two classes of variables is so stark, it is uncommon to find both types of non-cognitive constructs included in the same study (Roberts, 2009). This has created an asymmetry in the understanding of how changeable constructs like social cognitive variables and personality traits may be. In the absence of systematic interventions on both social cognitive variables and personality traits researchers are left with observational data as the basis to inferences about their relative consistency and mutability.

The Present Study

While not directly addressing whether a concept can be changed through intervention, passive observational studies can provide valuable information on their continuity and change over time and thus their potential for changeability. Presumably, if one class of variable would be more consistent, and in turn show less change over time in the same longitudinal study this would lend credence to the argument that constructs like conscientiousness are, or are not, good targets for intervention. The problem currently is that, to our knowledge, no study has explicitly examined the stability and mutability of both sets of constructs within the same longitudinal sample of students. A focus on students is key as these are the populations that are the focus of most interventions under the presumption that the investments made in

these populations will reap larger gains throughout life (Cunha & Heckman, 2010). In an effort to address this oversight, we contrast social cognitive variables and personality traits in terms of their temporal continuity and change over time within a large scale, longitudinal study of students with four time points (N = 3,876 in 136 classes; age range 11-14). To this end, Big Five personality traits of extraversion, agreeableness, conscientiousness, neuroticism, and openness were examined as well as social cognitive constructs such as subject-specific individual interest, self-concept and academic effort. Because continuity and mutability are not unitary constructs, we examined multiple indices of continuity and change over time in order to determine whether these two classes of variables differed in the baseline consistency/mutability. Based on test-retest correlations and parameters from Generalized Second Order Growth Models, three research questions were examined: First, how stable are the constructs over time? Second, to what degree is stability of each class of constructs attributable to unchanging components and how much of the instability is attributable to state components? Third, interventions are predicated on being able to move individuals or groups of individuals in one direction or another. One way to characterize the malleability of a non-cognitive characteristic is therefore to examine the extent to which people show increases or decreases in the constructs, which is typically examined as individual differences in change (Roberts & Mroczek, 2008). We examine the average level of individual differences in change across these two classes of constructs to get a better idea if individuals change more or less on each class of variables in a naturalistic longitudinal study.

Method

Sample

We used data from a large longitudinal German study ("*Tradition and Innovation in Educational Systems*"; TRAIN; Jonkmann et al., 2013), which is hosted by the Hector Research Institute of Education Sciences and Psychology. TRAIN is a large-scale school achievement study that encompasses four time points (from Grades 5 to 8; T1, T2, T3, and T4). The study comprises 136 classes in 99 schools from two federal states (Baden-Württemberg and Saxony). Data were available for n = 2,894 (46% female) individuals at T1 (Grade 5), n = 2,936 (45% female) individuals at T2 (Grade 6), n = 2,993 (46% female) individuals at T3 (Grade 7), and n = 3,060 (46% female) individuals at T4 (Grade 8). The sample

size of the pooled data set was N = 3,876. This data set contained all individuals who gave information at a minimum of one time point.[18].

Instruments

The social cognitive constructs (i.e., self-concept, interest, and academic effort) were assessed with four items per school subject (math, German, English). The items were rated on a 4-point Likert scale ranging from 1 (*I do not agree at all*) to 4 (*I agree entirely*). The self-concept items targeted the students' own evaluation of their ability in the respective school subjects. The domain-specific interest items focused on the intrinsic value of the respective school subject. The items from the academic effort scales were focused on the effort needed to meet subject-specific tasks. The Big Five were measured with the German version (Lang, Lüdtke, & Asendorpf, 2001) of the Big Five Inventory (John et al., 1991). The items were rated on a 5-point Likert scale[19] ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Unfortunately, the negatively worded items showed negative or low item-total correlations for all Big Five traits (all *rs* < .22). Therefore, we used only the positively worded items. We conducted several robustness checks in examining the item properties of all Big Five scales as a whole by means of confirmatory factor analyses. Following this, we re-ran all of our analyses with the complete set of items (for the results see SI Appendix C). The main results remained virtually unchanged. Sample items, the number of items, and the Cronbach's alpha values (ranging from .55 to .90) at all four time points are shown in Table S3 in the SI Appendix A2.

Statistical Analyses

All models were estimated in the framework of longitudinal confirmatory factor analyses in Mplus 7.31 (Muthén & Muthén, 1998-2012). Two-sided statistical tests were performed at the 5% level of significance.

The analytical procedure encompassed roughly three steps: First, we estimated manifest (rank-order) correlations between all constructs. From these models, means, standard deviations as well as the rank-order correlations of the adjacent time points were derived. Second, to properly interpret latent variable change in longitudinal models, at least strong measurement invariance has to be established (Meredith, 1993; Meredith & Teresi, 2006). Thus, we specified latent-state models in which we imposed strong measurement invariance

[18] Supporting information on the sample composition is reported in the SI Appendix A1.
[19] We applied a linear transformation (scale = 3/4 + 0.25) to convert the 5-point Likert scale to a scale with a minimum of 1 and a maximum of 4 so that we could compare it with the motivational constructs.

(same loadings and intercepts for each indicator over time), separately for each construct. Third, we estimated Generalized Second-Order Growth Models (GSGM) to model the function of mean-level change and, in addition, to separate the rather stable variance from the time-point-specific variance (Bishop et al., 2015). The GSGM is a combination of a latent-state-trait (LST) and a latent growth curve (LGC) model (Geiser et al., 2015). It is diagrammed in Figure S1 in the SI Appendix A3.

In LST models three coefficients are of particular interest: the consistency (CO), occasion specificity (OS), and reliability (REL) coefficients (Steyer, Schmitt, & Eid, 1999). The CO coefficients indicate the degree of stability across measurement points (trait part). The OS coefficients denote the degree to which differences in observed variables are influenced by the situation or by person × situation interactions (state part). The REL coefficients reveal the extent to which the measures are reliable and are not due to measurement error.

Missing data. Due to attrition or nonresponse at single time points, missing values occur in nearly all longitudinal studies. To deal with these, we used the full information maximum likelihood procedure (see, e.g., Enders, 2001)**.** Due to its ability to offer less biased parameter estimates, this procedure is believed to be superior to conventional methods such as listwise or pairwise deletion (Graham, 2009). Furthermore, to make the missing at random (MAR) assumption more plausible, we included several auxiliary variables (Collins, Schafer, & Kam, 2001) in all analyses (e.g., standardized achievement tests, grades, socioeconomic status, gender, etc.).

Nested data structure. In the present study, students were nested within classes, resulting in a multilevel structure in the data set. Therefore, students in a class are not independent from each other (students within classes tend to be more similar than students from different classes; Raudenbush & Bryk, 2002). Failing to consider this structure could lead to an underestimation of the standard errors (see e.g., Satorra & Muthén, 1995). However, we were not interested in contextual effects and thus relied on single-level analyses with cluster-robust standard errors (McNeish, Stapleton, & Silverman, 2016) as implemented in Mplus. In addition, it should be noted that the intraclass correlation coefficients were rather small for the Big Five and social cognitive constructs, ranging from .02 to .09.

Results

To contrast personality traits and social cognitive constructs in terms of their temporal stability over time, we began by computing simple descriptive statistics and rank-order correlations. Table S4 in the SI Appendix B1 presents the means and standard deviations of all constructs. The means of two Big Five measures (conscientiousness, openness) and all social cognitive constructs (except self-concept in the subject German) consistently decreased over time. Neuroticism, extraversion, and agreeableness as well as the self-concept in the subject German did not increase or decrease over time. The standard deviations were slightly smaller for the Big Five measures than for the social cognitive constructs. The rank-order correlations between adjacent time points for all constructs are depicted in Figure 1.

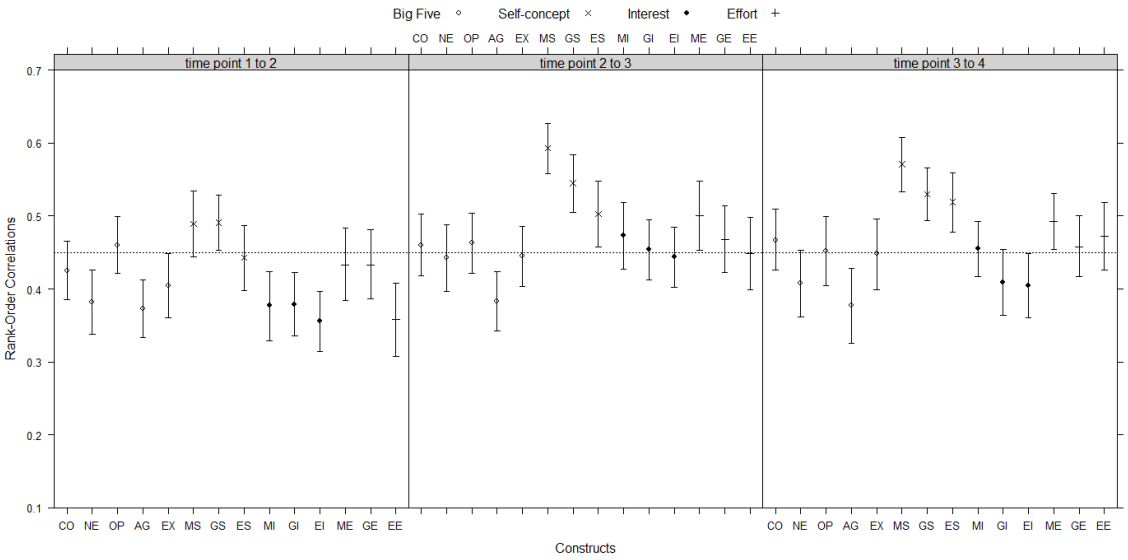

Figure 1. Manifest rank-order correlations with 95% confidence intervals. CO = Conscientiousness, NE = Neuroticism, AG = Agreeableness, EX = Extraversion, MS = Math Self-Concept, GS = German Self-Concept, ES = English Self-Concept, MI = Math Interest, GI = German Interest, EI = English Interest, ME = Math Effort, GE = German Effort, EE = English Effort. The dashed line indicates the mean rank-order correlation for all constructs ($\bar{r}$ = .45).

In addition, the average rank-order correlation ($\bar{r}$ = .45) of all constructs is depicted as a reference point. For the Big Five, the rank-order correlations ranged from .37 to .47 and were usually not statistically significantly different from the average rank-order correlation. The highest rank-order correlations were found for domain-specific self-concept measures ranging from .44 to .59. With the exception of the rank-order correlations from T1 to T2 for math and English, the rank-order correlations were statistically significantly higher than the average rank-order correlation. For subject-specific interest, the rank-order correlations

ranged from .36 to .47. For academic effort, they ranged from .36 to .50, and they were usually not statistically different from the average rank-order correlation (see also Table S5 in the SI Appendix B2). In addition, we compared the average rank-order correlation of the Big Five traits ($\bar{r}$ = .43) with the average rank-correlation of the social cognitive constructs ($\bar{r}$ = .46). The average rank-order correlation of the social cognitive constructs was statistically significant higher than the one for the Big Five traits (Z = 3.50, p = .000). However, the difference was rather small (Δ.037).

With reference to the second and third research questions (degree of stable and time-point-specific stability/change and average level of individual differences in change), we estimated Generalized Second-Order Growth Models (Bishop et al., 2015), separately for each construct. For these analyses, we assumed linear change. The assumption appeared to be reasonable, because the means decreased consistently over time (see again Table S4 in the SI Appendix B1), and all models demonstrated good fit (see Table S6 in the SI Appendix B3). Table 1 presents the intercepts, slopes, and their variances as well as the correlation between the intercepts and slopes. In addition, we again provide the average coefficients of all parameters as reference points. The statistically significant negative slope factors (except for self-concept in the subject German and extraversion) coincided with the decreasing means over time found in the manifest indicators.

Table 1
Results of the GSGM Models

Constructs	Intercept	Intercept variance	Slope	Slope variance	COR (I,S)
Big Five					
Conscientiousness	**2.93 [2.89, 2.96]**	**0.14 [0.12, 0.16]**	**-0.05 [-0.06, -0.04]**	**0.016 [0.012, 0.020]**	**-.52 [-.60, -.45]**
Neuroticism	**2.55 [2.51, 2.59]**	**0.20 [0.14, 0.25]**	**-0.02 [-0.03, -0.01]**	**0.017 [0.008, 0.027]**	**-.51 [-.63, -.40]**
Openness	**2.89 [2.86, 2.92]**	**0.18 [0.15, 0.21]**	**-0.04 [-0.05, -0.03]**	**0.018 [0.012, 0.023]**	**-.53 [-.61, -.45]**
Agreeableness	**2.80 [2.76, 2.83]**	**0.12 [0.08, 0.15]**	**-0.01 [-0.02, -0.00]**	**0.013 [0.008, 0.018]**	**-.56 [-.67, -.45]**
Extraversion	**2.92 [2.88, 2.95]**	**0.17 [0.11, 0.23]**	0.00 [-0.01, 0.02]	**0.020 [0.010, 0.030]**	**-.54 [-.63, -.44]**
Social cognitive constructs					
Self-concept in math	**3.03 [2.98, 3.07]**	**0.30 [0.25, 0.35]**	**-0.09 [-0.11, -0.07]**	**0.027 [0.018, 0.037]**	**-.25 [-.38, -.12]**
Self-concept in German	**3.01 [2.98, 3.04]**	**0.14 [0.10, 0.17]**	-0.01 [-0.02, 0.00]	**0.007 [0.003, 0.012]**	**-.36 [-.51, -.21]**
Self-concept in English	**3.05 [3.01, 3.08]**	**0.19 [0.16, 0.23]**	**-0.07 [-0.08, -0.06]**	**0.023 [0.016, 0.030]**	**-.31 [-.44, -.18]**
Interest in math	**3.11 [3.07, 3.14]**	**0.11 [0.08, 0.14]**	**-0.12 [-0.14, -0.11]**	**0.008 [0.003, 0.014]**	-.06 [-.36, .24]
Interest in German	**3.03 [2.98, 3.07]**	**0.18 [0.14, 0.22]**	**-0.12 [-0.13, -0.10]**	**0.011 [0.004, 0.019]**	**-.33 [-.53, -.13**]
Interest in English	**3.07 [3.03, 3.12]**	**0.15 [0.11, 0.18]**	**-0.12 [-0.14, -0.11]**	**0.010 [0.002, 0.017]**	-.18 [-.47, .11]

Table 1 (continued)
Results of the GSGM Models

Constructs	Intercept	Intercept variance	Slope	Slope variance	COR (I,S)
Effort in math	**3.27 [3.24, 3.30]**	**0.17 [0.13, 0.20]**	**-0.11 [-0.12, -0.09]**	**0.018 [0.011, 0.025]**	-.11 [-.29, .08]
Effort in German	**3.28 [3.24, 3.31]**	**0.16 [0.13, 0.19]**	**-0.08 [-0.09, -0.07]**	**0.016 [0.010, 0.023]**	**-.23 [-.38, -.09]**
Effort in English	**3.33 [3.29, 3.36]**	**0.13 [0.10, 0.16]**	**-0.09 [-0.11, -0.08]**	**0.017 [0.011, 0.024]**	-.12 [-.30, .06]
Average coefficients for the Big Five	2.82	0.16	-0.02	0.017	-.53
Average coefficients for the social cognitive constructs	3.13	0.17	-0.09	0.015	-.21
Overall average coefficients	3.02	0.17	-0.07	0.016	-.33

Note. N = 3,876. Coefficients in bold are statistically significantly different from 0 ($p < .05$, two-tailed). The values in brackets are 95% confidence intervals.

Furthermore, the GSGM models allowed us to distinguish between the stable variance components (CO), state variability (time-point-specific variance components; OS) and measurement error (ERR)[20]. The different variance proportions of the constructs are depicted in Figure 2[21].

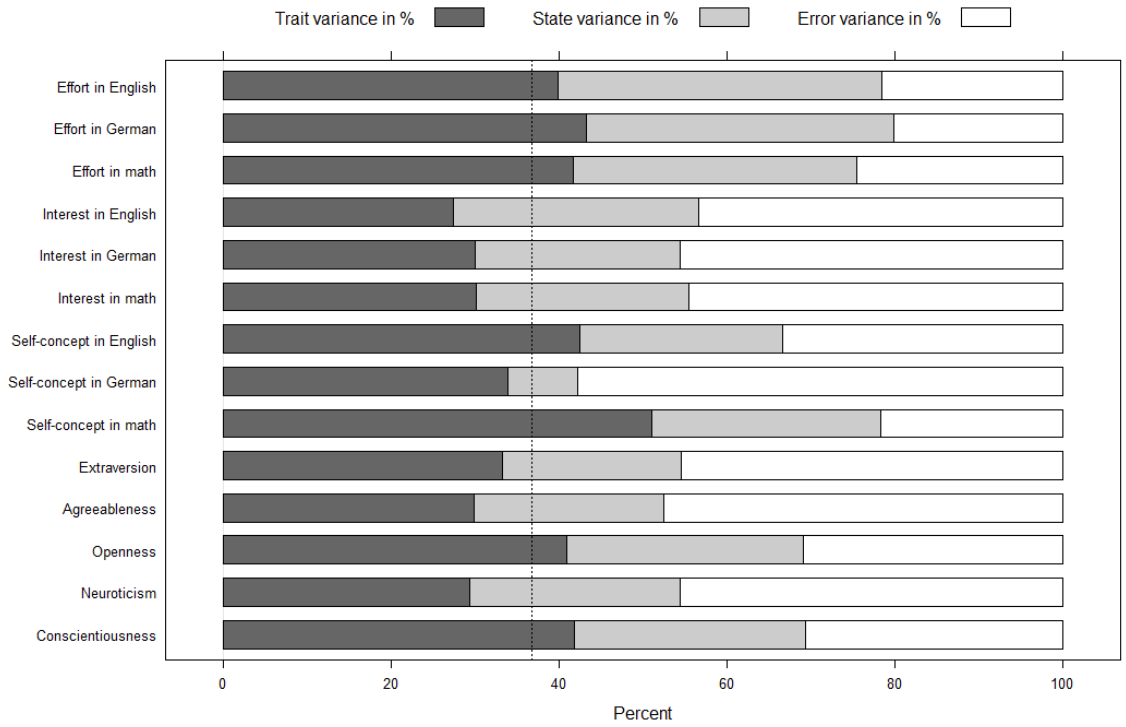

Figure 2. Proportions of variance in percentages for all constructs. The dashed line indicates the mean proportion of trait variance across all constructs (36.8%).

We again provide the mean coefficients as reference points (see Table S8 in SI Appendix B5). For the Big Five traits, the stable variance components captured 30% to 42% of the variance, whereas 21% to 28% of the variance was time-point-specific, and 30% to 47% was due to measurement error. For the social cognitive constructs, 27% to 51% of the variance was explained by the CO, whereas 8% to 39% was due to state variability, and 22% to 53% was due to measurement error. Attention should be drawn to the measure of German self-concept. In comparison with the other constructs, it showed a small amount of state variance and a large amount of measurement error. Examining the trait variance components for the Big Five, we see that conscientiousness (Δ5.0%, SE = 0.016, p = .002) and openness

[20] Detailed information on the CO, OS, and ERR coefficients is described in the SI Appendix A3.
[21] This is a simplified presentation of the results. In LST models, each indicator (parcel) has its own consistency, specificity, and reliability coefficient. To simplify matters, the consistency and specificity coefficients were aggregated across the item parcels and time points. The specific results for the item parcels as well as the averaged LST coefficients are reported in Tables S7 and S8 in the SI Appendices B4 and B5.

(Δ4.1%, *SE* = 0.014, *p* = .005) were statistically significantly above the average reference point (36.8%). For the social cognitive variables, self-concept in math (Δ14.2%, *SE* = 0.015, *p* < .000) and English (Δ5.7%, *SE* = 0.015, *p* < .000) as well as academic effort in math (Δ4.9%, *SE* = 0.015, *p* = .001) and German (Δ6.5%, *SE* = 0.020, *p* = .001) were statistically significantly above the average reference point. Statistically significantly below the average reference point were neuroticism (Δ-7.5%, *SE* = 0.017, *p* < .000), agreeableness (Δ-7.0%, *SE* = 0.022, *p* = .002) and extraversion (Δ-3.6%, *SE* = 0.016, *p* = .022) for the Big Five and the interest measures in math (Δ-6.7%, *SE* = 0.014, *p* < .000), German (Δ-6.8%, *SE* = 0.015, *p* < .000) and English (Δ-9.4%, *SE* = 0.013, *p* < .000) for the social cognitive variables. Self-concept in German and academic effort in English were not statistically significantly different from the reference point. In sum, the same number of scales were above and below the average amounts of stable, state, and error variance for both the Big Five and the social cognitive variables showing no evidence for differential stability or changeability across construct domains.

As a last step, we compared the variances in the slope parameters for each construct as this represents the average amount of individual differences in change across the social cognitive and personality trait indicators. The variances in the slopes provide an estimate of the average range of change that students exhibited in each class of variables over time. We compared all slope variances of the constructs against the average (.016). Except for the self-concept measures in math (Δ0.011, *SE* = 0.005, *p* = .016), German (Δ-0.007, *SE* = 0.004, *p* = .041) and English (Δ0.007, *SE* = 0.004, *p* = .041) as well as interest in math (Δ-0.008, *SE* = 0.003, *p* = .005), we found that no slope variance was statistically significantly different from the average slope variance across the Big Five or the social cognitive domains.

Discussion

In the present study, we examined the stability and mutability of the Big Five personality traits and social cognitive constructs such as subject-specific individual interest, self-concept, and academic effort in the same longitudinal sample of students. Our results showed no meaningful differences on (a) the stability of the constructs at the manifest level, (b) the percentage of stable variance for each construct, and (c) the amount of change that students showed on each construct over time in the form of the average variance in the slopes. Based on this study, we found no meaningful differences between the stability and mutability of social cognitive or personality trait variables in a longitudinal sample of adolescent students. However, it should be noted that there were heterogeneous results within each

construct class. For instance, within the Big Five traits conscientiousness and openness were more stable than extraversion, neuroticism and agreeableness. On the other hand, within the social cognitive constructs the self-concept measures were more stable than the interest measures.

The findings of this study are important for educational policy makers who are currently focused on how to best enhance non-cognitive skills (Heckman & Kautz, 2012) as an adjunct to focusing exclusively on cognitive skills. In this context, it is important to understand the nature of the various constructs that fall under the umbrella of non-cognitive constructs as their scope and variety are more diverse than those typically found in cognitive skills.

It is also the case that there are many assumptions behind the different classes of constructs within the non-cognitive set, with the most prevalent being that personality traits are not changeable and social cognitive constructs are changeable and therefore the latter should be the focus of interventions (Bailey et al., 2015). Whereas our study could not directly address whether either class of variable could be more easily changed through a direct intervention, our study tests basic assumptions behind the stability and mutability of these classes of constructs. Succinctly, many parties assume that personality traits, even in childhood, represent stable, unchangeable constructs (Bailey et al., 2015). By contrast, social cognitive and motivational constructs are typically considered to be less stable and more changeable. Up to this point, the relative stability and mutability of these constructs has never been tested simultaneously in a longitudinal study of students, the population most often considered for intervention. Our study provides valuable data on this comparison and shows that both classes of variables are equivalently stable and equivalently changeable in an observational longitudinal study. Whereas this does not prove that personality traits are changeable through intervention or that social cognitive variables are difficult to change, it does warrant a more open approach to considering which variables to include in future intervention studies.

Limitations and Future Directions

Although the current study used a large sample over a 3-year period of time and examined a variety of social cognitive and personality constructs, some noteworthy limitations should be kept in mind when interpreting the results. First, it should be noted that students from the highest school track in Germany (i.e., the Gymnasium) did not participate in the study. Rather, the students came from the other nonacademic tracks (lower and intermediate

track schools) in two states of Germany. Thus, it would be ideal for future studies to include students from all academic tracks. Second, we used only the positively worded items from the Big Five scales because the negatively worded items demonstrated low, zero, or even negative item-total correlations. These results had probably to do with response biases in terms of acquiescent tendencies, mid-point, or extreme responding and made it very challenging to analyze these measures. This issue is being discussed in the literature on using self-reports in young children and clearly needs further consideration (see e.g., Soto, John, Gosling, & Potter, 2008). Third, analyzing whether there are comparable stabilities and trait-state ratios for other instruments would be indispensable for obtaining a more thorough understanding of the relative stability of these two classes of constructs. Finally, there is a need to examine the trait-state proportions on the facet level of the personality traits as well as other classes of person characteristics (e.g., motives, abilities, etc.).

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Supporting Information

Supporting Information A: Method

Supporting Information A1: Sample[22]. The students were spread across the two federal states in the following way: In Baden-Württemberg, 43.2% of the students (n = 1,678) came from the lower track ("Hauptschule") and 22.7% (n = 881) from the intermediate track ("Realschule"). The remaining students (34.0%; n = 1,321) visited multitrack schools ("Mittelschule") in Saxony. Multitrack schools are a combination of lower and intermediate track schools.

Table S1 shows the complete sample composition, including students who dropped out or joined the study late.

Table S1
Overview of Sample Composition

	T1 (Grade 5)	T2 (Grade 6)	T3 (Grade 7)	T4 (Grade 8)	Pooled data
Complete sample all variables	2,894	2,936	2,993	3,060	3,880
Dropped out of the study	--	-226	-359	-235	
Changed classes		8 (3.5%)	28 (7.8%)	10 (4.3%)	
Moved		63 (27.9%)	72 (20.1%)	66 (28.1%)	
Repeated a grade		39 (17.3%)	50 (13.9%)	46 (19.6%)	
Other / no information		116 (51.3%)	209 (58.2%)	113 (48.1%)	
Joined the study later	--	+268	+416	+302	
Changed classes		18 (6.7%)	98 (23.6%)	8 (2.6%)	
Moved		107 (39.9%)	65 (15.6%)	93 (30.8%)	
Repeated a grade		50 (18.7%)	28 (6.7%)	74 (24.5%)	
Changed classes		93 (34.7%)	225 (54.0%)	127 (42.1%)	

To examine possible differences between students who dropped out or joined the study after it had begun, we contrasted the continuers with students who dropped out or joined the study late. First, we compared students who dropped out of the study after they

[22] Göllner et al. (2016) already published the mean level of change in the Big Five personality traits in the same data set, but with a different focus.

provided data at one time point with those who provided data at the next time point as well. This was done at all time points for the study variables and for several demographic variables (gender, SES) and achievement measures (grades, standardized achievement tests in German and math). Significant differences between these groups are displayed in Table S2.

Table S2
Differences (Cohen's d) between Students who Dropped Out or Joined the Study Late with the Continuers

	T1 » T2	T2 » T3	T3 » T4
Dropouts	*n* = 226	*n* = 359	*n* = 310
Gender (male = 1)	--	--	--
Socioeconomic status	--	-0.18	--
Math grade	0.20	0.48	0.69
German grade	--	0.58	0.70
English grade	--	0.31	0.61
Math achievement	-0.22	-0.34	-0.56
German achievement	-0.21	-0.23	-0.40
Big Five	--	--	--
Conscientiousness	0.17	--	-0.23
Neuroticism	0.17	0.20	0.32
Openness	0.25	--	-0.19
Agreeableness	--	--	-0.18
Extraversion	--	--	--
Social cognitive constructs	--	--	--
Self-concept in math	--	-0.15	-0.41
Self-concept in German	0.16	-0.13	--
Self-concept in English	--	--	-0.27
Interest in math	0.19	--	--
Interest in German	0.17	0.13	--
Interest in English	--	--	--
Effort in math	--	-0.23	-0.35
Effort in German	--	--	--
Effort in English	--	--	-0.29

Table S2 (continued)
Differences (Cohen's d) between Students who Dropped Out or Joined the Study Late with the Continuers

	T1 » T2	T2 » T3	T3 » T4
Joined the study late	*n* = 429	*n* = 424	*n* = 302
Gender (male = 1)	OR = 1.36	--	--
Socioeconomic status	--	0.14	--
Math grade	0.68	0.29	0.84
German grade	0.60	0.36	0.65
English grade	0.64	0.38	0.64
Math achievement	-0.22	--	--
German achievement	-0.18	--	--
Big Five			--
Conscientiousness	--	--	-0.25
Neuroticism	0.17	--	--
Openness	--	--	--
Agreeableness	--	--	-0.31
Extraversion	--	--	--
Social cognitive constructs			
Self-concept in math	--	--	-0.23
Self-concept in German	-0.15	-0.14	--
Self-concept in English	--	-0.17	--
Interest in math	--	--	--
Interest in German	--	--	-0.19
Interest in English	--	--	--
Effort in math	--	--	-0.35
Effort in German	-0.25	--	-0.32
Effort in English	--	-0.17	-0.18

Overall, the differences between continuers and dropouts ranged from d = -0.32 to 0.49 and between students who joined the study late and students who were already in the study from d = -0.35 to 0.84. Due to the fact that a considerable proportion (13.9% to 24.5%) of the students dropped out or joined the study late because of grade repetition, the moderate

to huge effect sizes were not unexpected. However, to reduce possible biases in the parameter estimates, we used the full information maximum likelihood procedure (see e.g., Enders, 2001).

Supporting Information A2: Instruments

Table S3
Example Items, Number of Items, and Cronbach's Alpha for the Scales

Construct	Subject	Number of Items	Sample items (wording)	Cronbach's alpha (T1, T2, T3, T4)
Big Five			**I see myself as someone who...**	
Conscientiousness	--	*5 of 9*	...does a thorough job.	*.77, .80, .80, .80*
Neuroticism	--	*5 of 8*	...worries a lot.	*.71, .68, .69, .71*
Openness	--	*8 of 11*	...is inventive.	*.80, .81, .83, .83*
Agreeableness	--	*4 of 8*	...is helpful and unselfish with others.	*.67, .67, .66, .67*
Extraversion	--	*5 of 8*	...is talkative.	*.71, .73, .76, .77*
Social cognitive constructs			**What applies to you?**	
Self-concept	*Math*			*.78, .85, .85, .86*
	German	*4*	*I am good at math [German, English].*"	*.63, .66, .64, .66*
	English			*.68, .78, .81, .83*
Interest	*Math*			*.56, .62, .68, .71*
	German	*4*	"*Working on math [German, English] tasks is fun for me.*"	*.55, .65, .72, .71*
	English			*.62, .70, .74, .75*
Effort	*Math*			*.79, .83, .85, .87*
	German	*4*	"*I do my best when it comes to math [German, English].*"	*.81, .85, .89, .89*
	English			*.83, .86, .89, .90*

Supporting Information A3: Statistical analyses

As mentioned in the main text, the GSGM is a combination of a latent state-trait (LST) model and a latent growth curve (LGC) model (Geiser et al., 2015). It is depicted in Figure S1.

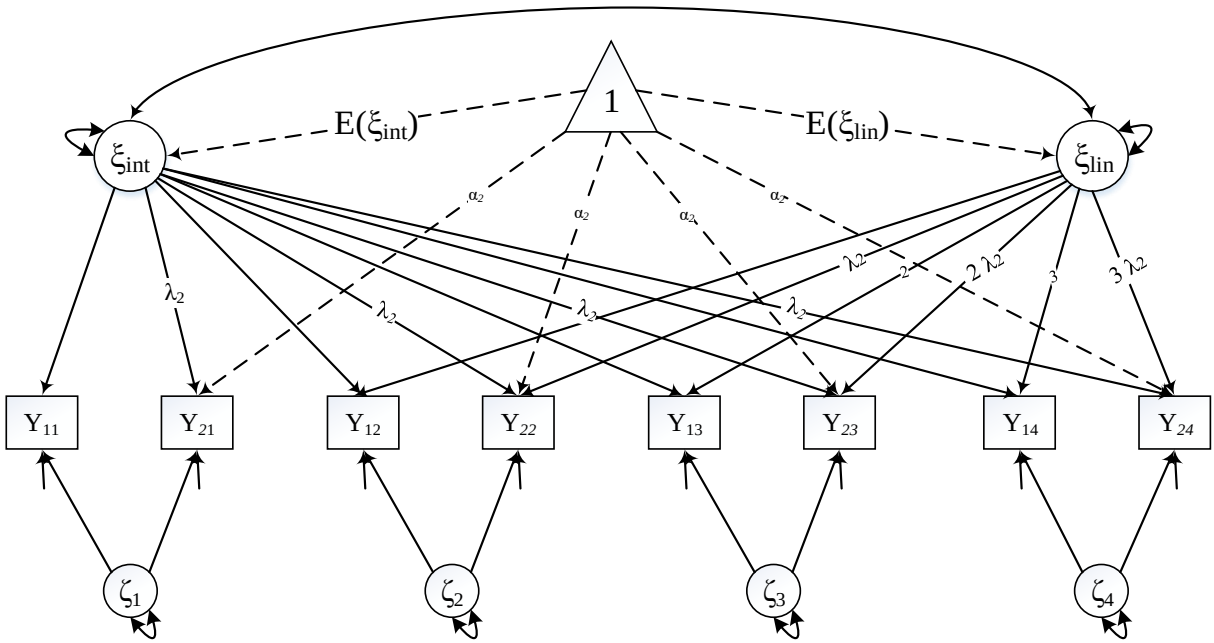

Figure S1. Conceptual GSGM model. All directional (single-headed) paths without a label are set to 1 in the model. Error covariances for the same item parcels (correlated uniquenesses) are not depicted.

In LST models, three coefficients are of particular interest, namely, consistency (CO), occasion specificity (OS), and reliability (REL) coefficients (Steyer et al., 1999). These coefficients are defined on the basis of the decomposition of the variances of the respective latent state-trait model. According to Bishop et al. (2015), the decomposition of the variances of the observed variables in a GSGM model is as follows (p. 26 in Appendix F):

$$var(Y_{it}) = \lambda_{it}^2 var(\xi_{int}) + (t-1)^2 \lambda_{it}^2 var(\xi_{lin}) + 2\,(t-1)\,\lambda_{it}^2 cov(\xi_{int}, \xi_{lin}) + \gamma_{it}^2 var(\zeta_{t)} + var(\varepsilon_{it}) \quad \text{(S1)}$$

As can be seen in Equation S1, the variance of the observed variables is partitioned into three variance components, that is, first, the trait and growth variance, second, the state variance, and third, the error variance. The CO, OS, and REL coefficients are defined on the basis of this variance decomposition. The CO coefficients indicate the degree of stability across measurement points for each indicator and are defined as follows:

$$CO(Y_{it}) = \frac{\lambda_{it}^2 var(\xi_{int}) + (t-1)^2 \lambda_{it}^2 var(\xi_{lin}) + 2\,(t-1)\,\lambda_{it}^2 cov(\xi_{int}, \xi_{lin})}{Var(Y_{it})} \quad \text{(S2)}$$

Both the intercept and the slope factor contribute to the CO coefficients in the GSGM (Geiser et al., 2015). These coefficients reflect the rather stable parts of the trait.

The OS coefficients denote the degree to which differences in observed variables are influenced by the situation or by the person × situation interactions and are defined as in classical latent state-trait models as:

$$OS(Y_{it}) = \frac{\gamma_{it}^2 var(\zeta_t)}{Var(Y_{it})} \quad \text{(S3)}$$

As can be seen in Equation S3, only the time-point-specific latent variables contribute to the OS coefficients (the latent variables ζ_t are uncorrelated with all other latent variables). Thus, the OS coefficients mirror the amount of variance that is time-point-specific and not explained by stable person characteristics (intercept and growth components).

$$Rel(Y_{it}) \quad \text{(S4)}$$
$$= \frac{\lambda_{it}^2 var(\xi_{int}) + (t-1)^2 \lambda_{it}^2 var(\xi_{lin}) + 2\,(t-1)\,\lambda_{it}^2 cov(\xi_{int}, \xi_{lin}) + \gamma_{it}^2 var(\zeta_t)}{Var(Y_{it})}$$
$$= CO(Y_{it}) + OS(Y_{it})$$

The REL coefficient reveals the amount of reliable variance in an indicator. To be more specific, the REL coefficient corresponds to the sum of the CO and OS coefficients.

In sum, the *CO*, *OS*, and *REL* coefficients are used to quantify the extent to which measurements are stable person characteristics (traits), occasion or time-point-specific effects (states), and measurement error (Geiser et al., 2015).

Parceling strategy. To reduce model complexity and to make the models more comparable to each other, we decided to build two item parcels per time point for each construct. To construct balanced item parcels, we followed the *Item-to-Construct Balance* parceling strategy (Little, Cunningham, Shahar, & Widaman, 2002). Thus, we built the item parcels by considering the relative balance between the loadings and intercepts. We began with the highest and then added the other items to the anchor item in an inverted order. To control for the specific item parcel variance over time, we used the correlated-uniqueness approach.[23]

[23] In addition, we conducted several robustness checks. We specified the models on the indicator level, changed the number of parcels for the Big Five scales, and used another approach to account for item specificity over time (method factor). The main results were virtually unaltered.

Assessing model fit. The evaluation of the model fit was based on the common fit indices for latent variable models: The comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR; Hu & Bentler, 1998) According to Hu and Bentler's (Hu & Bentler, 1999) recommendations, a good fit is indicated by values equal to or greater than .95 for the CFI and equal to or less than .05 for the RMSEA and SRMR.

Supporting Information B: Additional Results

Supporting Information B1: Means and Standard Deviations

Table S4
Means and Standard Deviations

Constructs	T1		T2		T3		T4	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Big Five								
Conscientiousness	2.96	0.62	2.90	0.60	2.87	0.60	2.80	0.58
	[2.92, 2.99]	[0.60, 0.64]	[2.87, 2.94]	[0.59, 0.62]	[2.84, 2.91]	[0.58, 0.63]	[2.76, 2.83]	[0.56, 0.60]
Neuroticism	2.40	0.67	2.36	0.62	2.32	0.61	2.35	0.61
	[2.36, 2.44]	[0.65, 0.69]	[2.33, 2.39]	[0.60, 0.64]	[2.28, 2.35]	[0.59, 0.63]	[2.32, 2.38]	[0.59, 0.63]
Openness	2.89	0.60	2.88	0.58	2.83	0.58	2.77	0.56
	[2.86, 2.92]	[0.58, 0.62]	[2.85, 2.91]	[0.56, 0.59]	[2.80, 2.86]	[0.56, 0.60]	[2.75, 2.80]	[0.54, 0.58]
Agreeableness	2.91	0.65	2.92	0.61	2.89	0.60	2.88	0.58
	[2.87, 2.95]	[0.63, 0.67]	[2.89, 2.96]	[0.59, 0.63]	[2.86, 2.92]	[0.57, 0.62]	[2.85, 2.92]	[0.55, 0.60]
Extraversion	2.84	0.63	2.85	0.59	2.86	0.60	2.84	0.59
	[2.81, 2.87]	[0.61, 0.65]	[2.82, 2.88]	[0.57, 0.61]	[2.83, 2.90]	[0.57, 0.62]	[2.81, 2.88]	[0.56, 0.61]
Social cognitive constructs								
Self-concept in math	2.97	0.76	2.89	0.80	2.81	0.79	2.69	0.82
	[2.93, 3.01]	[0.74, 0.78]	[2.84, 2.94]	[0.78, 0.83]	[2.77, 2.84]	[0.77, 0.81]	[2.65, 2.73]	[0.79, 0.84]
Self-concept in German	2.93	0.64	2.97	0.60	2.95	0.59	2.91	0.58
	[2.89, 2.96]	[0.62, 0.65]	[2.94, 3.00]	[0.58, 0.62]	[2.92, 3.00]	[0.57, 0.61]	[2.88, 2.94]	[0.56, 0.60]
Self-concept in English	3.04	0.71	2.95	0.75	2.90	0.77	2.83	0.77
	[3.00, 3.08]	[0.69, 0.73]	[2.91, 2.99]	[0.73, 0.77]	[2.86, 2.93]	[0.75, 0.79]	[2.79, 2.87]	[0.75, 0.79]

Table S4 (continued)
Means and Standard Deviations

Constructs	T1		T2		T3		T4	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Interest in math	3.05	0.64	2.86	0.67	2.74	0.70	2.63	0.70
	[3.01, 3.08]	[0.61, 0.66]	[2.82, 2.89]	[0.65, 0.69]	[2.70, 2.78]	[0.68, 0.72]	[2.59, 2.66]	[0.67, 0.72]
Interest in German	2.91	0.62	2.74	0.68	2.64	0.71	2.56	0.64
	[2.87, 2.95]	[0.602, 0.640]	[2.70, 2.78]	[0.66, 0.71]	[2.60, 2.69]	[0.68, 0.73]	[2.52, 2.60]	[0.62, 0.66]
Interest in English	2.98	0.67	2.81	0.70	2.66	0.731	2.60	0.69
	[2.93, 3.02]	[0.65, 0.70]	[2.77, 2.85]	[0.68, 0.72]	[2.62, 2.70]	[0.71, 0.75]	[2.557, 2.633]	[0.67, 0.71]
Effort in math	3.31	0.59	3.17	0.64	3.12	0.68	3.00	0.71
	[3.28, 3.34]	[0.56, 0.61]	[3.135, 3.203]	[0.62, 0.66]	[3.08, 3.15]	[0.65, 0.70]	[2.95, 3.02]	[0.69, 0.73]
Effort in German	3.31	0.58	3.20	0.63	3.15	0.70	3.04	0.69
	[3.28, 3.34]	[0.56, 0.60]	[3.15, 3.24]	[0.60, 0.66]	[3.11, 3.19]	[0.67, 0.73]	[3.00, 3.08]	[0.66, 0.71]
Effort in English	3.36	0.61	3.23	0.65	3.14	0.71	3.05	0.71
	[3.32, 3.40]	[0.58, 0.63]	[3.12, 3.27]	[0.63, 0.67]	[3.10, 3.18]	[0.68, 0.73]	[3.01, 3.09]	[0.68, 0.74]

Note. N = 3,876. The values in brackets are 95% confidence intervals.

Supporting Information B2: Manifest Rank-Order Correlations

Table S5
Manifest Rank-Order Correlations

Constructs	Rank-order correlations[a]		
	r_{12}	r_{23}	r_{34}
Big Five			
Conscientiousness	.43 [.39, .47]	.46 [.42, .50]	.47 [.43, .51]
Neuroticism	.38 [.34, .43]	.44 [.40, .49]	.41 [.36, .45]
Openness	.46 [.42, .50]	.46 [.42, .50]	.45 [.41, .50]
Agreeableness	.37 [.33, .41]	.38 [.34, .42]	.38 [.33, .43]
Extraversion	.41 [.36, .45]	.45 [.40, .49]	.45 [.40, .50]
Social cognitive constructs			
Self-concept in math	.49 [.44, .53]	.59 [.56, .63]	.57 [.53, .61]
Self-concept in German	.49 [.45, .53]	.55 [.51, .58]	.53 [.49, .57]
Self-concept in English	.44 [.40, .49]	.50 [.46, .55]	.52 [.48, .56]
Interest in math	.38 [.33, .42]	.47 [.43, .52]	.46 [.42, .49]
Interest in German	.38 [.34, .42]	.45 [.41, .50]	.41 [.36, .45]
Interest in English	.36 [.31, .40]	.44 [.40, .49]	.40 [.36, .45]
Effort in math	.43 [.38, .48]	.50 [.45, .55]	.49 [.45, .53]
Effort in German	.43 [.39, .48]	.47 [.42, .51]	.46 [.42, .50]
Effort in English	.36 [.31, .41]	.45 [.40, .50]	.47 [.43, .52]

Note. N = 3,876. [a]For reasons of simplicity, only the rank-order stabilities of adjacent time points are depicted. The average rank-order correlation of all constructs is $\bar{r}$ = .45. The values in brackets are 95% confidence intervals.

Supporting Information B3: Model Fit of the Models Tested

Table S6

Fit Indices for the Tested Models

Constructs	Model	χ^2	*df*	CFI	TLI	RMSEA	SRMR
Big Five							
Conscientiousness	SMIM	59.189	9	0.994	0.982	0.038	0.020
	GSGM	40.118	14[a]	0.997	0.994	0.022	0.031
Neuroticism	SMIM	20.509	9	0.997	0.992	0.018	0.015
	GSGM	49.500	13	0.992	0.982	0.027	0.032
Openness	SMIM	33.502	9	0.997	0.991	0.027	0.017
	GSGM	46.762	14[a]	0.996	0.993	0.025	0.025
Agreeableness	SMIM	23.566	9	0.996	0.988	0.020	0.016
	GSGM	31.045	14[a]	0.995	0.991	0.018	0.021
Extraversion	SMIM	24.561	9	0.996	0.987	0.021	0.016
	GSGM	39.603	14[a]	0.993	0.986	0.022	0.022
Social cognitive constructs							
Self-concept in	SMIM	20.932	9	0.999	0.997	0.018	0.009
math	GSGM	59.208	13	0.997	0.993	0.030	0.044
Self-concept in	SMIM	14.994	9	0.998	0.994	0.013	0.014
German	GSGM	33.611	14[a]	0.994	0,987	0.019	0.018
Self-concept in	SMIM	53.379	9	0.994	0.980	0.036	0.022
English	GSGM	53.902	14[a]	0.994	0.989	0.027	0.044
Interest in math	SMIM	52.347	9	0.993	0.978	0.035	0.019
	GSGM	71.144	13	0.991	0.980	0.034	0.041
Interest in German	SMIM	24.732	9	0.997	0.991	0.021	0.014
	GSGM	66.535	13	0.991	0.980	0.033	0.044
Interest in English	SMIM	27.042	9	0.997	0.991	0.023	0.018
	GSGM	77.870	13	0.990	0.978	0.036	0.044
Effort in math	SMIM	34.318	9	0.999	0.996	0.027	0.012
	GSGM	61.531	13	0.997	0.994	0.031	0.042
Effort in German	SMIM	16.820	9	0.999	0.999	0.015	0.015
	GSGM	27.274	13	0.999	0.999	0.017	0.033
Effort in English	SMIM	20.679	9	0.999	0.998	0.018	0.009
	GSGM	25.784	13	0.999	0.998	0.016	0.035

Note. N = 3,876; SMIM = Strong Measurement Invariance Models; GSGM = Generalized Second-Order Growth Model; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual. [a] One residual correlation was fixed to zero (T1 to T4).

Supporting Information B4: Item-Parcel-Specific Results

Table S7
Item-Parcel-Specific Results

Construct	Time point	Parcel specific LST coefficients					
		First parcel			Second parcel		
		CO	OS	REL[a]	CO	OS	REL[a]
Big Five							
Conscientiousness	1	0.306	0.244	0.550	0.552	0.200	0.752
	2	0.258	0.355	0.613	0.474	0.297	0.770
	3	0.272	0.385	0.657	0.461	0.297	0.758
	4	0.369	0.238	0.607	0.651	0.191	0.841
Neuroticism	1	0.388	0.319	0.708	0.213	0.241	0.454
	2	0.353	0.273	0.626	0.206	0.219	0.425
	3	0.336	0.259	0.595	0.200	0.213	0.412
	4	0.414	0.271	0.685	0.237	0.214	0.451
Openness	1	0.413	0.218	0.631	0.454	0.220	0.675
	2	0.365	0.323	0.688	0.385	0.312	0.697
	3	0.355	0.352	0.708	0.372	0.338	0.710
	4	0.466	0.261	0.727	0.458	0.236	0.694
Agreeableness	1	0.198	0.193	0.391	0.432	0.220	0.652
	2	0.170	0.235	0.406	0.355	0.255	0.610
	3	0.174	0.251	0.425	0.351	0.265	0.615
	4	0.234	0.192	0.426	0.469	0.201	0.670
Extraversion	1	0.393	0.219	0.612	0.297	0.156	0.453
	2	0.320	0.270	0.589	0.261	0.207	0.469
	3	0.314	0.270	0.584	0.287	0.232	0.520
	4	0.413	0.194	0.608	0.371	0.164	0.534

Table S7 (continued)
Item-Parcel-Specific Results

Construct	Time point	Parcel specific LST coefficients					
		First parcel			Second parcel		
		CO	OS	REL[a]	CO	OS	REL[a]
Social cognitive constructs							
Self-concept in math	1	0.442	0.260	0.702	0.511	0.256	0.767
	2	0.415	0.332	0.746	0.496	0.338	0.834
	3	0.476	0.276	0.752	0.564	0.278	0.842
	4	0.539	0.225	0.764	0.635	0.226	0.861
Self-concept in German	1	0.238	0.085	0.323	0.409	0.084	0.493
	2	0.237	0.115	0.352	0.408	0.115	0.523
	3	0.243	0.066	0.309	0.397	0.063	0.460
	4	0.271	0.064	0.335	0.508	0.07	0.578
Self-concept in English	1	0.284	0.174	0.458	0.524	0.191	0.715
	2	0.264	0.279	0.544	0.465	0.292	0.757
	3	0.299	0.282	0.581	0.515	0.288	0.803
	4	0.393	0.212	0.605	0.659	0.211	0.870
Interest in math	1	0.208	0.230	0.438	0.314	0.223	0.537
	2	0.209	0.263	0.472	0.330	0.266	0.596
	3	0.243	0.287	0.530	0.361	0.274	0.635
	4	0.313	0.261	0.574	0.431	0.231	0.661
Interest in German	1	0.341	0.169	0.510	0.285	0.150	0.435
	2	0.293	0.267	0.560	0.245	0.237	0.482
	3	0.299	0.340	0.639	0.240	0.291	0.531
	4	0.378	0.263	0.642	0.317	0.234	0.551
Interest in English	1	0.256	0.279	0.535	0.244	0.229	0.474
	2	0.247	0.333	0.580	0.246	0.286	0.532
	3	0.266	0.361	0.627	0.258	0.301	0.558
	4	0.349	0.303	0.652	0.327	0.245	0.572

Table S7 (continued)
Item-Parcel-Specific Results

Construct	Time point	Parcel specific LST coefficients					
		First parcel			Second parcel		
		CO	OS	REL[a]	CO	OS	REL[a]
Effort in math	1	0.400	0.301	0.701	0.397	0.318	0.715
	2	0.358	0.357	0.715	0.354	0.375	0.728
	3	0.416	0.352	0.768	0.400	0.361	0.761
	4	0.518	0.316	0.834	0.495	0.321	0.816
Effort in German	1	0.355	0.261	0.616	0.550	0.298	0.848
	2	0.310	0.388	0.698	0.452	0.417	0.869
	3	0.314	0.441	0.755	0.457	0.472	0.929
	4	0.422	0.319	0.741	0.604	0.336	0.940
Effort in English	1	0.293	0.370	0.664	0.432	0.404	0.835
	2	0.279	0.418	0.697	0.390	0.432	0.822
	3	0.315	0.415	0.730	0.447	0.436	0.883
	4	0.442	0.307	0.748	0.594	0.306	0.900

Note. CO = consistency, OS = occasion specificity, REL = reliability, [a] REL = CO + OS; [a]REL = CO + OS

Supporting Information B5: Averaged LST Coefficients

Table S8
Averaged LST Coefficients

Construct	CO	OS	REL[a]
Big Five			
Conscientiousness	0.418 [0.386, 0.450]	0.276 [0.247, 0.305]	0.694 [0.674, 0.713]
Neuroticism	0.293 [0.259, 0.327]	0.251 [0.223, 0.279]	0.545 [0.520, 0.569]
Openness	0.409 [0.380, 0.437]	0.282 [0.254, 0.311]	0.691 [0.676, 0.707]
Agreeableness	0.298 [0.254, 0.341]	0.227 [0.196, 0.258]	0.524 [0.492, 0.557]
Extraversion	0.332 [0.301, 0.363]	0.214 [0.186, 0.242]	0.546 [0.525, 0.567]
Social cognitive constructs			
Self-concept in math	0.510 [0.481, 0.539]	0.274 [0.247, 0.300]	0.783 [0.769, 0.798]
Self-concept in German	0.339 [0.304, 0.374]	0.083 [0.057, 0.108]	0.421 [0.392, 0.451]
Self-concept in English	0.425 [0.395, 0.455]	0.241 [0.216, 0.266]	0.666 [0.647, 0.686]
Interest in math	0.301 [0.274, 0.328]	0.254 [0.229, 0.280]	0.556 [0.537, 0.575]
Interest in German	0.300 [0.270, 0.329]	0.244 [0.214, 0.274]	0.544 [0.526, 0.562]
Interest in English	0.274 [0.248, 0.300]	0.292 [0.266, 0.318]	0.566 [0.550, 0.582]
Effort in math	0.417 [0.387, 0.447]	0.338 [0.308, 0.367]	0.755 [0.743, 0.767]
Effort in German	0.433 [0.395, 0.471]	0.366 [0.332, 0.401]	0.799 [0.783, 0.816]
Effort in English	0.399 [0.365, 0.433]	0.386 [0.354, 0.418]	0.785 [0.771, 0.799]

Table S8 (continued)
Averaged LST Coefficients

Construct	CO	OS	REL[a]
Average coefficients for the Big Five	0.350	0.250	0.600
Average coefficients for the social cognitive constructs	0.378	0.275	0.653
Overall average coefficients	0.368	0.266	0.634

Note. CO = consistency, OS = occasion specificity, REL = reliability, [a] REL = CO + OS

Supporting Information C: Results for the Big Five with all Items

We first examined the item properties of all Big Five scales as a whole by means of confirmatory factor analyses and then re-ran all of our analyses with the complete set of items. The results of these additional analyses are presented in the following. As expected, the Cronbach's alpha values dropped due to the low, zero, or negative item-total correlations. The results of the confirmatory factor analyses showed low, zero, or even negative factor loadings for the negatively worded items. However, most important in the context of the present study, the main results of the manifest rank-order correlations and GSGM models remained virtually unchanged. More specifically, the proportion shared between the trait and state variance components was largely the same, but the proportion of the error variances substantially increased. There was no reliable information offered by the negatively worded items. On the basis of these results, we decided to report the results on only the positive items.

Supporting Information C1: Instruments

Table S9.
Example Items, Number of Items, and Cronbach's Alpha for the Scales with all Items

Construct	Subject	Number of Items	Sample items (wording)	Cronbach's alpha (T1, T2, T3, T4)
Big Five			**I see myself as someone who...**	
Conscientiousness	--	*9 of 9*	...does a thorough job.	*.52, .61, .68, .67*
Neuroticism	--	*8 of 8*	...worries a lot.	*.36, .51, .57, .58*
Openness	--	*11 of 11*	...is inventive.	*.55, .62, .65, .63*
Agreeableness	--	*8 of 8*	...is helpful and unselfish with others.	*.44, .53, .60, .61*
Extraversion	--	*8 of 8*	...is talkative.	*.49, .63, .69, .73*

Supporting Information C2: Model Fit of the Models Tested

Table S10

Fit Indices for the Measurement Models of the Big Five with all Items

Constructs	Model	*n*	χ^2	*df*	CFI	TLI	RMSEA	SRMR
Big Five								
Conscientiousness	CMIM	3,473	4517,35	540	0.774	0.736	0.046	0.082
	SMIM	3,473	4436,469	582	0.781	0.763	0.044	0.085
	GSGM	3,473	2246,500	579	0.905	0.897	0.029	0.067
Neuroticism	CMIM	3,470	3623,550	410	0.728	0.671	0.048	0.075
	SMIM	3,470	3848,742	452	0.712	0.684	0.047	0.079
	GSGM	3,470	1832,491	450	0.883	0.871	0.030	0.065
Openness	CMIM	3,474	2875,890	830	0.914	0.902	0.027	0.043
	SMIM	3,474	3125,016	891	0.906	0.901	0.027	0.048
	GSGM	3,474	2867,919	885	0.917	0.911	0.025	0.046
Agreeableness	CMIM	3,472	5086,310	410	0.635	0.558	0.057	0.101
	SMIM	3,472	5444,564	452	0.610	0.572	0.056	0.105
	GSGM	3,472	2014,414	450	0.878	0.865	0.032	0.064
Extraversion	CMIM	3,472	5238,930	410	0.691	0.626	0.058	0.100
	SMIM	3,472	5798,965	452	0.658	0.625	0.058	0.106
	GSGM	3,472	2391,263	450	0.876	0.863	0.035	0.070

Note. CMIM = Configural Measurement Invariance Models; SMIM = Strong Measurement Invariance Models; GSGM = Generalized Second-Order Growth Model; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Supporting Information C3: Factorloadings of the Configural Invariance Models

Table S11
Factorloadings for the Big Five with all Items

Constructs	Model	Item	Factorloadings T1 (se)	Factorloadings T2 (se)	Factorloadings T3 (se)	Factorloadings T4 (se)
Big Five						
Conscientiousness	CMIM	sbfi03	0.51 (0.02)	0.54 (0.02)	0.56 (0.02)	0.55 (0.02)
		sbfi10r	-0.13 (0.04)	0.01 (0.03)	0.10 (0.03)	0.06 (0.03)
		sbfi13	0.54 (0.02)	0.57 (0.02)	0.59 (0.02)	0.58 (0.02)
		sbfi17r	-0.12 (0.04)	-0.04 (0.03)	0.08 (0.03)	0.04 (0.03)
		sbfi20	0.61 (0.02)	0.60 (0.02)	0.57 (0.02)	0.55 (0.02)
		sbfi28	0.61 (0.02)	0.58 (0.02)	0.57 (0.02)	0.54 (0.02)
		sbfi33	0.47 (0.03)	0.43 (0.02)	0.41 (0.02)	0.37 (0.02)
		sbfi36r	-0.36 (0.03)	-0.23 (0.03)	-0.11 (0.03)	-0.08 (0.04)
		sbfi42r	-0.02 (0.04)	0.08 (0.03)	0.17 (0.03)	0.12 (0.04)
Neuroticism	CMIM	sbfi05	0.55 (0.03)	0.50 (0.02)	0.48 (0.02)	0.52 (0.02)
		sbfi11r	-0.25 (0.03)	-0.13 (0.05)	-0.06 (0.04)	-0.06 (0.04)
		sbfi14	0.54 (0.02)	0.51 (0.03)	0.52 (0.02)	0.50 (0.02)
		sbfi18r	-0.37 (0.03)	-0.18 (0.04)	-0.13 (0.04)	-0.14 (0.04)

Table S11 (continued)
Factorloadings for the Big Five with all Items

Constructs	Model	Item	Factorloadings T1 (se)	Factorloadings T2 (se)	Factorloadings T3 (se)	Factorloadings T4 (se)
Neuroticism		sbfi25	0.63 (0.02)	0.57 (0.02)	0.58 (0.02)	0.54 (0.02)
		sbfi29	0.42 (0.02)	0.40 (0.02)	0.43 (0.02)	0.45 (0.02)
		sbfi34r	-0.30 (0.03)	-0.15 (0.04)	-0.06 (0.04)	-0.05 (0.04)
		sbfi39	0.59 (0.02)	0.51 (0.03)	0.48 (0.02)	0.49 (0.03)
Openness	CMIM	sbfi04	0.48 (0.02)	0.47 (0.02)	0.50 (0.02)	0.47 (0.02)
		sbfi06	0.59 (0.02)	0.60 (0.02)	0.60 (0.02)	0.58 (0.02)
		sbfi09r	-0.43 (0.02)	-0.40 (0.02)	-0.34 (0.03)	-0.33 (0.02)
		sbfi16	0.52 (0.02)	0.53 (0.02)	0.50 (0.02)	0.50 (0.02)
		sbfi19	0.55 (0.02)	0.56 (0.02)	0.54 (0.02)	0.59 (0.02)
		sbfi22	0.63 (0.02)	0.64 (0.02)	0.63 (0.02)	0.60 (0.02)
		sbfi24r	-0.47 (0.02)	-0.37 (0.02)	-0.33 (0.03)	-0.32 (0.02)
		sbfi30	0.52 (0.02)	0.43 (0.02)	0.43 (0.02)	0.40 (0.02)
		sbfi37	0.59 (0.02)	0.54 (0.02)	0.53 (0.02)	0.47 (0.02)
		sbfi40	0.45 (0.02)	0.44 (0.02)	0.42 (0.02)	0.40 (0.02)
		sbfi44r	-0.08 (0.03)	0.05 (0.03)	0.07 (0.03)	0.05 (0.03)

Table S11 (continued)
Factorloadings for the Big Five with all Items

Constructs	Model	Item	Factorloadings T1 (se)	Factorloadings T2 (se)	Factorloadings T3 (se)	Factorloadings T4 (se)
Agreeableness	CMIM	sbfi02r	-0.55 (0.03)	-0.46 (0.02)	-0.50 (0.03)	-0.48 (0.02)
		sbfi08	0.24 (0.04)	0.10 (0.04)	0.06 (0.04)	0.02 (0.04)
		sbfi12r	-0.53 (0.03)	-0.48 (0.03)	-0.55 (0.03)	-0.57 (0.02)
		sbfi21r	-0.66 (0.03)	-0.60 (0.02)	-0.61 (0.02)	-0.65 (0.02)
		sbfi27	0.37 (0.04)	0.16 (0.04)	0.07 (0.04)	0.08 (0.04)
		sbfi32r	-0.63 (0.03)	-0.51 (0.03)	-0.47 (0.03)	-0.51 (0.03)
		sbfi35	0.17 (0.04)	0.10 (0.04)	-0.03 (0.04)	-0.03 (0.04)
		sbfi38	0.27 (0.04)	0.11 (0.05)	-0.02 (0.04)	-0.04 (0.04)
Extraversion	CMIM	sbfi01	0.36 (0.02)	0.40 (0.02)	0.43 (0.02)	0.46 (0.02)
		sbfi07r	-0.23 (0.04)	-0.04 (0.04)	0.12 (0.04)	0.14 (0.04)
		sbfi15r	-0.25 (0.04)	-0.07 (0.04)	0.03 (0.04)	0.11 (0.05)
		sbfi23	0.52 (0.02)	0.52 (0.02)	0.49 (0.02)	0.46 (0.02)
		sbfi26r	-0.32 (0.04)	-0.08 (0.04)	0.00 (0.04)	0.07 (0.05)
		sbfi31	0.59 (0.02)	0.58 (0.02)	0.59 (0.02)	0.55 (0.02)
		sbfi41	0.59 (0.02)	0.52 (0.02)	0.53 (0.02)	0.56 (0.02)
		sbfi43	0.54 (0.02)	0.50 (0.02)	0.51 (0.02)	0.49 (0.02)

Note. CMIM = Configural Measurement Invariance Models. The models were identified by fixing the variance of the latent variables to 1.

Supporting Information C4: Means and Standard Deviations (Big Five with all Items)

Table S12
Means and Standard Deviations

Constructs	T1		T2		T3		T4	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Big Five								
Conscientiousness	2.82	0.42	2.79	0.44	2.77	0.45	2.71	0.44
	[2.80, 2.84]	[0.41, 0.43]	[2.76, 2.81]	[0.42, 0.45]	[2.75, 2.80]	[0.44, 0.47]	[2.684, 2.728]	[0.42, 0.45]
Neuroticism	2.37	0.43	2.33	0.44	2.32	0.45	2.35	0.44
	[2.35, 2.40]	[0.42, 0.44]	[2.31, 2.36]	[0.42, 0.45]	[2.30, 2.35]	[0.44, 0.47]	[2.33, 2.37]	[0.43, 0.46]
Openness	2.78	0.41	2.78	0.41	2.75	0.42	2.71	0.40
	[2.76, 2.80]	[0.39, 0.42]	[2.76, 2.80]	[0.40, 0.42]	[2.73, 2.77]	[0.40, 0.43]	[2.69, 2.73]	[0.39, 0.41]
Agreeableness	2.87	0.43	2.87	0.44	2.86	0.45	2.82	0.45
	[2.84, 2.89]	[0.42, 0.45]	[2.85, 2.89]	[0.42, 0.45]	[2.83, 2.88]	[0.44, 0.46]	[2.79, 2.85]	[0.44, 0.46]
Extraversion	2.77	0.46	2.80	0.48	2.84	0.49	2.82	0.50
	[2.74, 2.79]	[0.44, 0.47]	[2.78, 2.83]	[0.46, 0.49]	[2.81, 2.87]	[0.48, 0.51]	[2.79, 2.84]	[0.49, 0.51]

Note. N = 3,876. The values in brackets are 95% confidence intervals.

Supporting Information C5: Manifest Rank-Order Correlations for the Big Five with all Items

Table S13

Manifest Rank-Order Correlations for the Big Five (with all Items)

Constructs	Rank-order correlations[a]		
	r_{12}	r_{23}	r_{34}
Big Five			
Conscientiousness	.46 [.42, .51]	.52 [.48, .56]	.55 [.51, .59]
Neuroticism	.37 [.32, .42]	.47 [.43, .52]	.47 [.43, .51]
Openness	.45 [.41, .48]	.48 [.44, .52]	.48 [.44, .53]
Agreeableness	.43 [.39, .48]	.48 [.44, .52]	.52 [.48, .56]
Extraversion	.45 [.41, .49]	.53 [.49, .57]	.55 [.52, .59]

Note. N = 3,876. [a]For reasons of simplicity, only the rank-order stabilities of adjacent time points are depicted. The average rank-order correlation of all constructs is $\bar{r}$ = .48. The values in brackets are 95% confidence intervals.

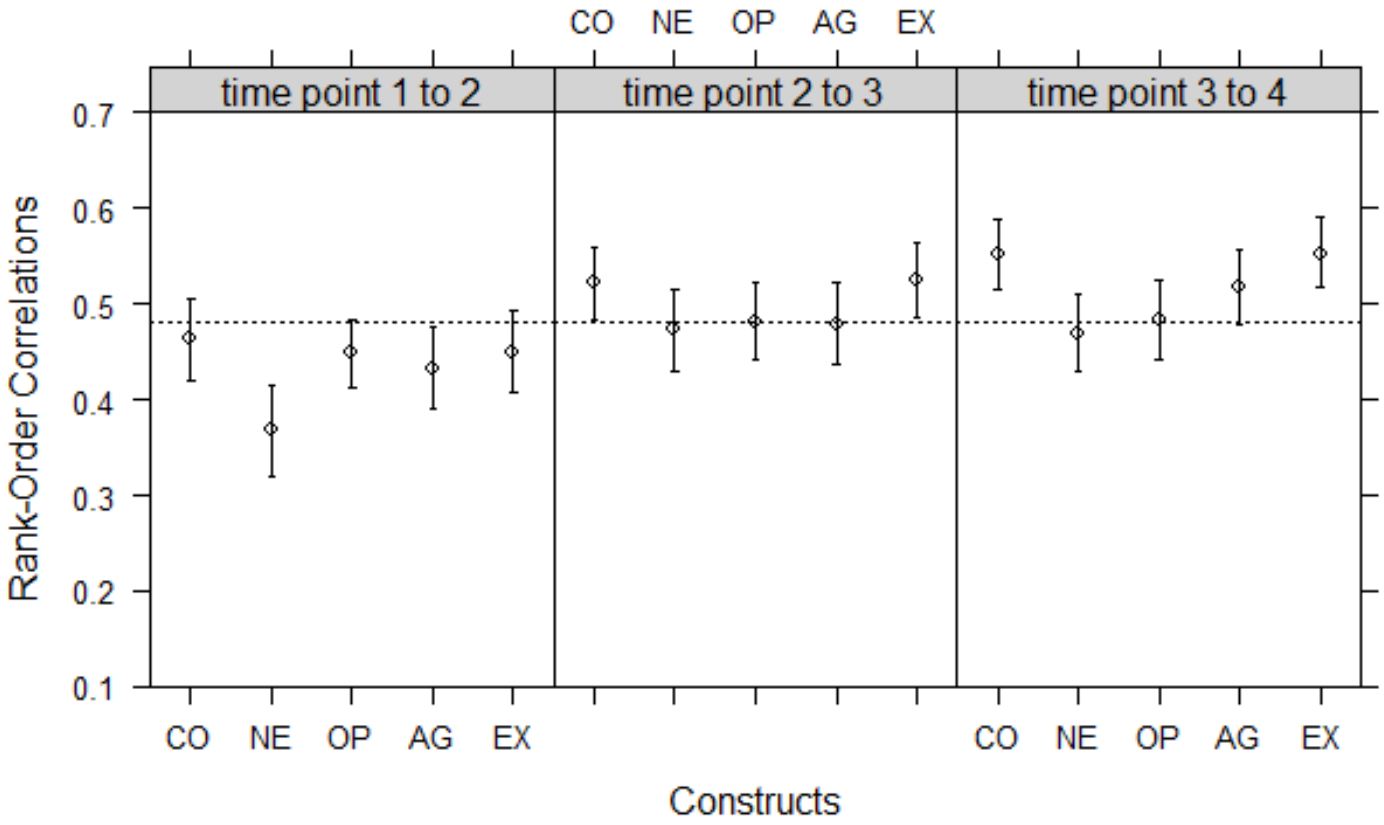

Figure S2. Manifest rank-order correlations with 95% confidence intervals. CO = Conscientiousness, NE = Neuroticism AG = Agreeableness, EX = Extraversion, The dashed line indicates the mean rank-order correlation for all constructs ($\bar{r}$ = .48).

Supporting Information C6: Results of the GSGM Models for the Big Five with all Items

Table S14

Results of the GSGM Models

Constructs	Intercept	Intercept variance	Slope	Slope variance	COR (I,S)
Big Five					
Conscientiousness	**3.07 [3.04, 3.10]**	**0.19 [0.16, 0.21]**	**-0.05 [-0.06, -0.04]**	**0.025 [0.021, 0.029]**	**-.44 [-.50, -.38]**
Neuroticism	**1.91 [1.87, 1.95]**	**0.12 [0.09, 0.15]**	-0.00 [-0.01, 0.01]	**0.017 [0.013, 0.022]**	**-.47 [-.55, -.40]**
Openness	**3.122 [3.09, 3.15]**	**0.11 [0.09, 0.14]**	**-0.03 [-0.04, -0.03]**	**0.010 [0.007, 0.014]**	**-.38 [-.48, -.27]**
Agreeableness	**3.03 [3.00, 3.06]**	**0.10 [0.07, 0.13]**	-0.02 [-0.02, -0.01]	**0.014 [0.010, 0.018]**	**-.48 [-.53, -.42]**
Extraversion	**3.02 [2.99, 3.05]**	**0.09 [0.08, 0.11]**	**0.02 [0.01, 0.03]**	**0.016 [0.013, 0.019]**	**-.43 [-.48, -.37]**
Average coefficients for the Big Five	2.83	0.12	-0.02	0.016	-.44

Note. Coefficients in bold are statistically significantly different from 0 ($p < .05$, two-tailed). The values in brackets are 95% confidence intervals.

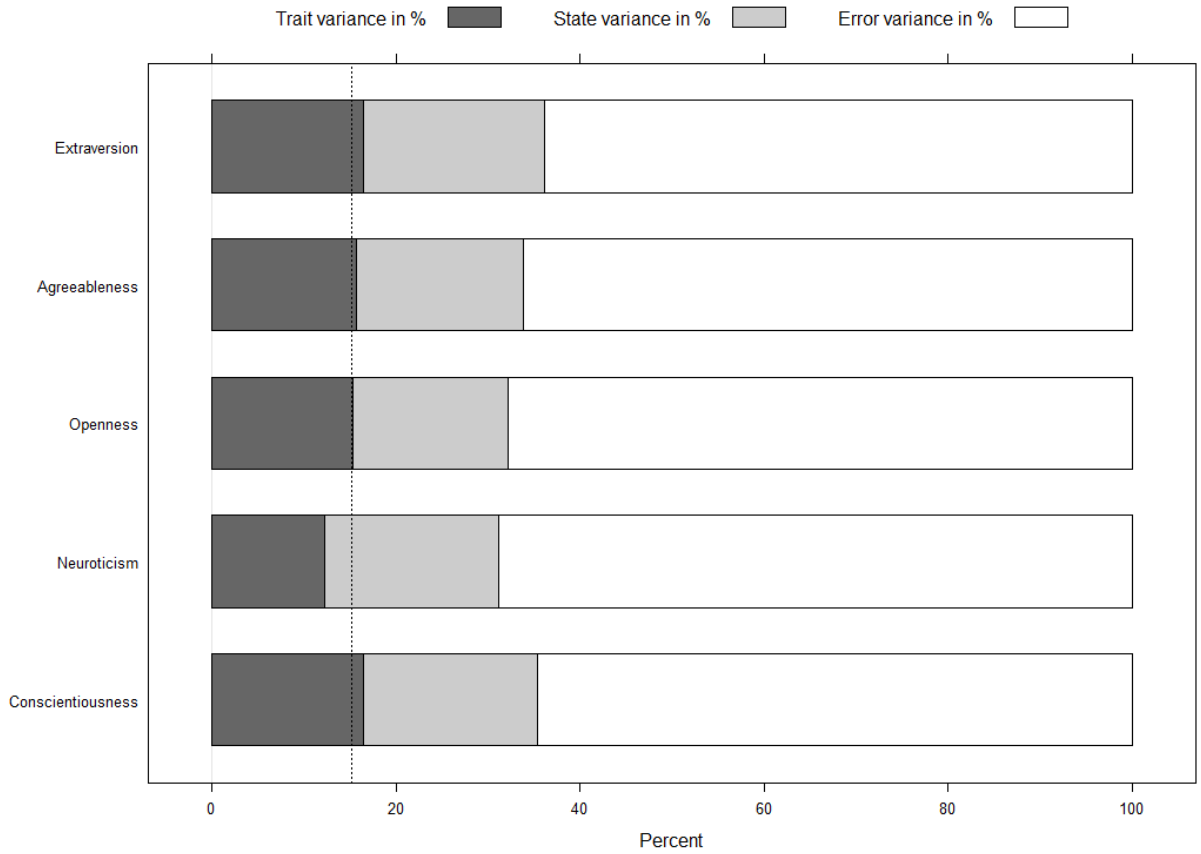

Figure S3. Proportions of variance in percentages for all constructs. The dashed line indicates the mean proportion of trait variance across all Big Five measures (15.2%).

Supporting Information C7: Averaged LST Coefficients

Table S15
Averaged LST Coefficients

Construct	CO	OS	REL[a]
Big Five			
Conscientiousness	0.165 [0.149, 0.180]	0.189 [0.174, 0.205]	0.354 [0.338, 0.370]
Neuroticism	0.122 [0.104, 0.141]	0.190 [0.175, 0.205]	0.312 [0.295, 0.329]
Openness	0.153 [0.134, 0.173]	0.169 [0.154, 0.184]	0.322 [0.306, 0.339]
Agreeableness	0.157 [0.140, 0.174]	0.181 [0.167, 0.195]	0.339 [0.322, 0.355]
Extraversion	0.164 [0.147, 0.181]	0.197 [0.182, 0.212]	0.361 [0.345, 0.378]
Average coefficients for the Big Five	0.152	0.185	0.337

Note. CO = consistency, OS = occasion specificity, REL = reliability, [a] REL = CO + OS

4 STUDY 2 THE EFFECTS OF GETTING A NEW TEACHER ON THE CONSISTENCY OF PERSONALITY

Rieger, S., Göllner, R., Spengler, M., Trautwein, U., Nagengast, B., Harring, J. R., & Roberts, B. W. (2017). The effects of getting a new teacher on the consistency of personality. Manuscript submitted for publication.

Abstract

When students get a new teacher, they are forced to adapt to a new situation with a new set of demands. Such a situation is marked by a certain degree of uncertainty that could putatively cause at least a temporary perturbation of students' thoughts, feelings, or behaviors. In order to test the effect of this type of situational transition, we analyzed two large longitudinal samples (N = 5,628 and N = 2,458) with quasi-experimental study designs. We used two consistency measures (i.e., rank-order correlations and changes in variance over time) to compare students who got a new teacher with students who had the same teacher on a number of different personality measures (including trait and social cognitive constructs). Multiple-group latent-variable analyses showed no differences in the rank-order correlations for the math-related social cognitive constructs of interest, effort, self-concept, anxiety, and the Big Five personality traits (except extraversion). Significantly lower rank-order correlations were found for some of the German- and English-related social cognitive constructs (e.g., effort, interest, and self-concept) and for self-regulation in math for the group of students who got a new teacher. Finally, regarding the changes in variance (over time), we found no systematic differences between groups in both studies.

Keywords: consistency, teacher change, Big Five, social cognitive constructs

The Effects of Getting a New Teacher on the Consistency of Personality

It is widely assumed that teachers influence and shape the life experiences of their students (Brophy, 1986; Pianta, 1999; Wentzel, 2002). Students interact with their teachers every day, and thus, it is not surprising that, for instance, positive student-teacher relationships (e.g., characterized by supportiveness, encouragement of thinking, empathy, etc.) are associated with positive school outcomes such as enhanced performance and positive socio-emotional development (Cornelius-White, 2007; Hamre & Pianta, 2001; McCormick & O'Connor, 2015). Given the impact of teachers on the development of young students and the fact that students get new teachers every year in most school systems, an important question is what happens to students when they get a new teacher? Students do not know much about their new teacher's expectations and attitudes, and consequently, such a transition entails a degree of uncertainty that should putatively cause at least a temporary change in students' thoughts, feelings, or behaviors.

In the present investigation, we were particularly interested in the extent to which a variety of personality constructs are affected by a change in situation (i.e., getting a new teacher). Constructs such as interests, self-concepts, and conscientiousness are both interesting and relevant because of the evidence that these types of school-related constructs are important for school performance and school functioning (Eccles & Wigfield, 2002; Kautz et al., 2014; Poropat, 2009). To optimally foster them, it is important to understand the nature and malleability of these variables (Bailey et al., 2017). An indication of malleability is whether and to what extent a new situation (e.g., getting a new teacher) affects these constructs.

Thus, the present article was designed to address three questions related to the effect of getting a new teacher on students' psychological functioning, broadly construed (including traits and social cognitive constructs). First, we asked whether the rank-order correlations of personality constructs are affected by getting a new teacher (new situational context)? Second, we investigated whether getting a new teacher or not getting a new teacher is associated with a change in variance over time (i.e., do individual differences become more or less pronounced) in personality constructs? Third, we asked whether social cognitive variables are more strongly influenced by getting a new teacher than the Big Five personality traits. For this purpose, we compared the two indices of consistency (i.e., rank-order correlations and changes in variance components over time) between students who had the same teacher and

students who got a new teacher on several social cognitive variables (e.g., interests, effort, and self-concepts) and the Big Five personality traits in two large longitudinal studies.

A Different Context: Getting a New Teacher

The extent to which different levels of functioning in personality are influenced by environmental factors is a question that has concerned psychologists for decades (Asendorpf & van Aken, 2003; Funder & Colvin, 1991; Johnson, 1999; Roberts & Pomerantz, 2004). In recent years, research on the composition and meaning of situations has experienced a revival (Rauthmann et al., 2014; Rauthmann et al., 2015; Reis, 2008). Similarly, it has been argued that to get a complete picture of personality development, it is essential to understand the influence, or lack thereof, of different contexts and the experiences people have in these contexts (Roberts & Nickel, 2017). This seems especially important for the periods of late childhood and early adolescence because these are the stages that are defined by fundamental changes in youths' lives (Soto & Tackett, 2015), and personality underlies rapid development (Roberts & Pomerantz, 2004).

In this study, we were particularly interested in the impact of an uncertain new context (i.e., getting a new teacher) on students' psychological functioning. Many school systems assign students to new teachers each year, and students are faced with such situations many times during their school years. When students get a new teacher, they have to adapt to new situations and circumstances. They have to deal with different attitudes and different teaching styles and are also forced to establish a new relationship. Because students do not know what to expect from a new teacher, such a transition entails some uncertainty. What can be expected to happen to students' outcomes through such a transition? One can speculate that such an uncertain transition will result in some instability in the development of students' outcomes due to adaption processes (e.g., students will change their behavior to meet new expectations). By contrast, having the same teacher over (several) school years could have stabilizing effects (e.g., Sherman, Nave, & Funder, 2010) because students would not have to adjust to a new teacher. Unfortunately, studies have yet to investigate the relation between this common change in students' environments and their psychological functioning, thus making it difficult to make concrete predictions about the effects.

What Effect Does Getting a New Teacher Have on Student Characteristics?

Personality can be construed at many different levels. For instance, constructs emerging out of a social cognitive framework are by definition malleable and contextualized (Ban-

dura, 2012; Eccles & Wigfield, 2002). Social cognitive constructs (e.g., interests and self-concepts) are understood to be narrow, relevant to specific contexts, and derived almost exclusively from experience and interactions with others (Eccles & Wigfield, 2002; Suls & Mullen, 1982). By contrast, trait-like (e.g., the Big Five personality traits) variables are often assumed to be biologically based, stable, and not amenable to change (Eysenck, 1970; McCrae & Costa, 2013). Moreover, they are often defined as consistent across situations and relatively independent of the context (see e.g., Funder & Colvin, 1991; Johnson, 1999). The distinction between traits and social cognitive constructs is supported by different theoretical models that conceptualize traits as core characteristics or basic tendencies and social cognitive variables as surface characteristics or even characteristic adaptations (Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae & Costa, 2008b).

Assumptions about which constructs are contextualized and which are not are strongly aligned with the theoretical origins of the constructs. However, a recent review of the conceptual and empirical basis of the distinction between these two classes of constructs found that the division between trait-like variables (e.g., the Big Five) and social cognitive constructs (e.g., values, self-related schemata) was conceptually larger than the empirical data could justify (Kandler et al., 2014). In addition, it is uncommon to find both kinds of variables included in the same study (Roberts, 2009), which makes it even more difficult to adequately compare these constructs. When tracked over equivalent periods of time using the same methods (i.e., self-reports), social cognitive and personality trait constructs were found to show comparable levels of continuity and change in young childhood and early adolescence (Rieger et al., 2017). Such a finding supports the idea that investigating and testing the proposed characteristics (e.g., consistency across time and contexts) behind these factors is essential for understanding the nature of these variables. In the present article, we focused on the assumption of consistency across contexts and tested the extent to which several social cognitive variables and the Big Five personality traits would respond differently to the same type of environmental experience (i.e., getting a new teacher).

Characterizing Consistency

To quantify consistency in individual differences (over time), researchers typically consider multiple indicators (see, e.g., Caspi et al., 2005; Fleeson & Noftle, 2008; Mõttus, Soto, & Slobodskaya, 2017). Two types of consistency seem most relevant for registering the perturbation in psychological functioning when the environment changes: rank-order correlations and changes in variances over time (Baltes & Nesselroade, 1973; Roberts

& Mroczek, 2008). Rank-order correlations refer to the relative placement of individuals from one time point to the next within a group. Changes (increases or decreases) in variances over time reflect whether individual differences in constructs become more or less pronounced across time (Mõttus et al., 2017). Students who transition to a new teacher are forced to adapt to the teacher's expectations and behaviors. The change in teacher would impact the relative placement of students within the group with a new teacher (i.e., some students will increase, whereas other students will decrease) but not the relative placement of the students within the group that did not get a new teacher. Consequently, students with a new teacher should show lower rank-order correlations than students without a new teacher. Also, it would make sense to expect differences in the changes in variances over time (i.e., individual differences becoming more or less pronounced in either group) between the groups. Whereas the adaption processes of the students who got a new teacher might lead to larger variation in personality constructs, students who did not get a new teacher would already be familiar with their teacher, and thus, individual differences should be more stable across time. Both processes would result in a difference in changes in variance over time between the groups. Finally, it should be noted that an examination of mean-level change was less relevant in the current analyses because the reaction to a new teacher could be a positive or negative experience, thus leading to a lack of meaningful patterns in mean-level change over time.

The Present Research

In the present research, we examined the effect of getting a new teacher on consistency in students' psychological functioning in two independent, large, longitudinal German studies. The German school system provided the opportunity to test the effect of getting a new teacher in an optimal setting. In Germany, teachers typically change classes every 2 years, whereas the composition of these classes remains the same over several years. Thus, by using quasi-experimental designs, we compared two indices of consistency (i.e., 1-year rank-order correlations and changes in variance components over time) between students who got a new teacher and those who did not on a variety of student characteristics. In Study 1, we analyzed several math-related social cognitive variables (i.e., interest, academic effort, self-regulation, and anxiety). In Study 2, we applied the same approach as in Study 1, but with two noteworthy extensions. First, the social cognitive constructs of interest and effort were complemented by self-concept, and in addition, we also examined potential differences between the school subjects of math, German, and English. Second, we also contrasted the social cognitive constructs with the Big Five personality traits and asked whether social cog-

nitive variables were more strongly influenced by getting a new teacher than the Big Five personality traits were. On the basis of the often-proposed characteristics of both types of variables, social cognitive variables (strong context-sensitivity) should be more influenced by this uncertain transitional situation than the Big Five personality traits (which are often believed to be stable across situations and contexts).

Study 1

Method

Sample. For Study 1, we analyzed data from the German national extension to the 2003 cycle of the OECD's *Programme for International Student Assessment* (PISA-E; OECD, 2004). In this national extension, a subsample of 15-year-old PISA students and their teachers from Grade 9 took part in an additional assessment in Grade 10. Participation in the study was voluntary. Data collection took part at the ends of both school years.

The complete data set contained N = 6,020 students in 275 classes. However, to avoid contamination effects due to different class compositions, we had to exclude n = 392 students who were not in the same classes at Time 2. This resulted in a data set with N = 5,628 (56.4% female) students in 259 classes with n = 1,132 (20.1%) students who had different teachers and n = 4,496 (79.9%) students who had the same teacher at both time points. The mean age of the students was 15.1 years of age in Grade 9. In Germany, a "tripartite" system consisting of lower track schools ("Hauptschule"), intermediate track schools ("Realschule"), and academic track schools ("Gymnasium") is the most common system. However, some federal states also offer multitrack schools (including "Integrierte Gesamtschule" or "Schule mit mehreren Bildungsgängen"), which include several school tracks within the same school. In this study, the students were spread across different school tracks as follows: Multitrack schools, n = 983 (17.5%); intermediate track schools, n = 2,199 (39.1%); and academic track schools, n = 2,446 (43.5%). Students from the lower track ("Hauptschule") were not included because this track ends after Grade 9.

Instruments. Five items were used to assess individual interest[24] in math (see e.g., Krapp & Prenzel, 2011). The items targeted interest in and the intrinsic value of math-related activities (Cronbach's alpha: α_{T1} = .86 and α_{T2} = .89). Academic effort in math was also measured with five items (see Pekrun et al., 2005). The items focused on the effort needed to

[24] There is no standardized and widely accepted instrument for the assessment of individual interest. In contrast, multiple questionnaires with good face validity and good psychometric quality have been used (see Renninger & Hidi, 2016).

meet subject-specific tasks (α_{T1} = .78 and α_{T2} = .80). Self-regulation in math was measured with five items (α_{T1} = .70 and α_{T2} = .75). The items assessed students' self-regulation of learning goals, use of strategies, and monitoring of learning outcomes (Goetz, 2004). Nine items served to assess math anxiety (Achievement Emotions Questionnaire-Mathematics; Pekrun, Goetz, Titz, & Perry, 2002). Students were instructed to rate how they typically felt when taking tests in math (α_{T1} = .90 and α_{T2} = .90).

Statistical analyses. We estimated all models in the framework of longitudinal confirmatory factor analyses and used full information maximum likelihood estimation with robust standard errors (MLR; using Mplus 7.31; Muthén & Muthén, 1998-2012). To make the missing at random (MAR) assumption more plausible, we included several auxiliary variables (Collins et al., 2001) in all analyses (e.g., standardized achievement tests, grades). Statistical tests were performed two-sided and used the 5% level of significance.

Measurement invariance. Before addressing our research question, we tested for measurement invariance over time and between groups. Without establishing measurement invariance, we would not be able to rule out the possibility that differences in correlations over time or between groups were due to the measurement process (Widaman, Ferrer, & Conger, 2010). For this purpose, we specified two models by starting with a model in which weak measurement invariance was imposed over time and between groups (the same factor loadings for each indicator/parcel over time and between groups; called the liberal model in the following). In the next step, we imposed strong measurement invariance over time (the same factor loadings and intercepts over time) and strict measurement invariance between groups (the same factor loadings, intercepts, and residual variances and the same residual correlations between groups; called the restrictive model in the following). To evaluate these models, we used fit indices that are commonly used for latent-variable models, namely, the Satorra-Bentler-scaled chi-square test (Satorra & Bentler, 2010), the comparative fit index (CFI), the Tucker Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR; Hu & Bentler, 1998). According to Hu and Bentler (1999), a good fit is indicated by CFI/TLI $\geq$ .95 and RMSEA/SRMR $\leq$ .05.

Comparison of rank-order correlations and variance components. To address the first research question, we compared the rank-order correlations between the groups with Fisher's z-tests (Fisher, 1925) and confidence intervals (Zou, 2007). To address the second research question, we compared the change (difference) in variance (from T1 to T2) of each group against each other. This was done with the Wald test, which is implemented in Mplus. Before doing this, we applied the natural logarithm transformation of all variances to achieve a (better) approximation of the normality assumption. All coefficients are based on the more restrictive multiple-group latent-variable model (see Figure 1).

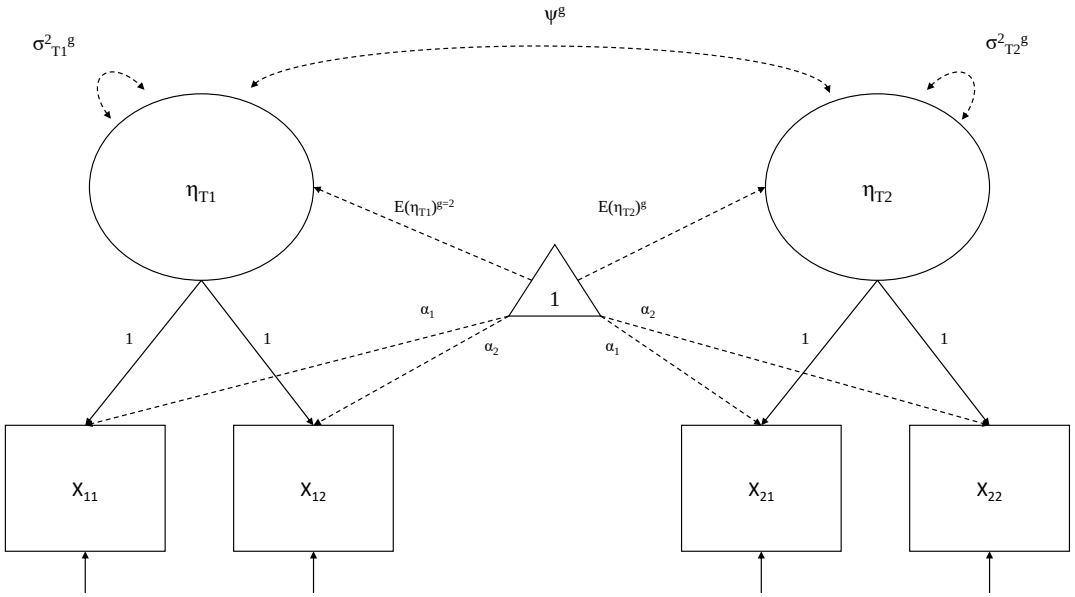

Figure 1. Multiple-group latent-variable model (restrictive). Error covariances for the same item parcels (correlated uniquenesses) are not depicted. The mean of the first group was fixed to zero so that the model would be identified.

Parceling and the nested data structure. To reduce model complexity, we decided to build item parcels for each construct. To construct balanced item parcels, we followed the *Item-to-Construct Balance* parceling strategy (see Little et al., 2002). Thus, we constructed item parcels by considering the relative balance between loadings and intercepts, starting with the highest and then adding the other items to the anchor item in an inverted order. To control for the specific item parcel variance over time, we used the correlated-uniqueness approach (Cole, Ciesla, & Steiger, 2007).

In the present investigation, students were nested within classes, resulting in a multilevel structure of the data set. Therefore, students within a class were not independent of

each other (i.e., students within classes tend to be more similar than students from different classes; Raudenbush & Bryk, 2002). Not considering this structure could lead to an underestimation of standard errors (see e.g., Satorra & Muthén, 1995). However, we were not interested in classroom effects, and thus, we relied on single-level analyses with cluster-robust standard errors (McNeish et al., 2016) as implemented in Mplus.

Results

In the following, we begin by presenting the results of the measurement invariance tests between groups and over time. This is followed by the results of the multiple-group latent-variable models. Descriptive results for the overall sample for both time points are displayed in Table S1 in the SI Appendix A1. Furthermore, we did not expect to find any meaningful patterns (e.g., a reaction to a new teacher could be a positive or negative experience) in means over time; however, we report all mean-level results in Table S2 in the SI Appendix A2. In sum, there were no significant differences in mean-level change over time between the groups.

Establishing measurement invariance. Before addressing our research question, we tested for measurement invariance over time and between groups. For this purpose, we tested a liberal model (i.e., the same factor loadings for each indicator/parcel over time and between groups) against a (more) restrictive model (i.e., the same factor loadings and intercepts over time and the same factor loadings, intercepts, residual variances, and residual correlations between groups). Table S3 in the SI Appendix A3 displays all model fit criteria of all tested models. All models demonstrated a good fit (CFI/TLI > 0.95, RMSEA/SRMR ≤ 0.06) to the data.

With regard to model comparison, the more restrictive model had a significantly worse fit to the data for math self-regulation ($\Delta\chi^2 = 15.10$, $\Delta df = 7$, $\Delta p = .034$). However, the other fit indices (CFI, TLI, RMSEA, and SRMR) were above or below the cut-off values of .95 or .05, respectively. All remaining variables displayed strong measurement invariance over time and strict measurement invariance between groups.

Comparison of rank-order correlations. We estimated the 1-year rank-order correlations of the two groups (same teacher; st vs. new teacher; nt) and all variance components separately for each construct by means of the (more restrictive) multiple-group latent-variable models. The latent rank-order correlations are presented in Table 1.

Table 1
Results of Multiple-Group Latent-Variable Models (PISA Study)

Constructs	Same teacher r_{12}	New teacher r_{12}	Difference in time consistency (Δ)[a] [Zou's CI[b]]
Social cognitive variables			
Math interest	.76 [.74, .79]	.75 [.70, .80]	-.01 [-.04, .01]
Math effort	.59 [.55, .64]	.57 [.48, .66]	-.03 [-.07, .02]
Math self-regulation	.61 [.56, .66]	.55 [.46, .64]	-.06* [-.10, -.01]
Math anxiety	.72 [.70, .75]	.73 [.68, .77]	.01 [-.03, .03]

[a]Fisher's z-test (Fisher, 1925). [b]Zou's Confidence Intervals (Zou, 2007).

* $p < .05$.

We found no significant differences in the rank-order correlations for interest (r_{st} = .76 vs. r_{nt} = .75, Δ = -.01, Z = -0.99, p = .325), academic effort (r_{st} = .59 vs. r_{nt} =.57, Δ = -.03, Z = -1.17, p = .239), or anxiety (r_{st} = .72 vs. r_{nt}= .73, Δ = .00, Z = 0.25, p = .800), but we found differences for self-regulation. On the self-regulation measure, the students who got a new teacher showed statistically significantly lower rank-order correlations than students who had the same teacher (r_{st} = .61 vs. r_{nt} = .55, Δ = -.06, Z = -2.59, p = .010).

Comparison of variance components. With regard to the second research question, we compared the change in variance from T1 to T2 between the groups (Δ). All estimated variances as well as the differences between the changes in variances from T1 to T2 are presented in Table 2. There were no significant differences in the changes in variances between the groups. However, the variance significantly increased from T1 to T2 in the group that did not get a new teacher (δ_{st}) for the variables of math interest (δ_{st} = 0.07, Z = 2.26, p = .024) and self-regulation (δ_{st} = 0.19, Z = 3.03, p = .002).

Table 2

Results of Multiple-Group Latent-Variable Models (PISA Study)

Constructs	Same teacher			New teacher			Difference (Δ) of δ_{st} and δ_{nt}
	Var_{T1}	Var_{T2}	Var_{T2}-Var_{T1} (δ)	Var_{T1}	Var_{T2}	Var_{T2}-Var_{T1} (δ)	
Social cognitive variables							
Math interest	0.53 [0.49, 0.56]	0.57 [0.54, 0.59]	0.07* [0.01, 0.14]	0.53 [0.46, 0.60]	0.57 [0.51, 0.62]	0.07 [-0.08, 0.21]	0.00 [-0.16, 0.15]
Math effort	0.28 [0.26, 0.31]	0.31 [0.28, 0.34]	0.08 [-0.03, 0.19]	0.26 [0.22, 0.31]	0.29 [0.24, 0.33]	0.08 [-0.12, 0.29]	0.00 [-0.23, 0.23]
Math self-regulation	0.23 [0.21, 0.25]	0.28 [0.25, 0.31]	0.19* [0.07, 0.31]	0.22 [0.18, 0.25]	0.23 [0.18, 0.28]	0.07 [-0.22, 0.36]	-0.12 [-0.43, 0.19]
Math anxiety	0.47 [0.45, 0.49]	0.48 [0.46, 0.50]	0.02 [-0.02, 0.06]	0.49 [0.45, 0.53]	0.48 [0.44, 0.52]	-0.02 [-0.10, 0.06]	-0.04 [-0.13, 0.04]

Note. Before subtracting the variances, we applied a natural logarithm transformation.

* $p < .05$.

Discussion

In Study 1, we found no significant differences in the rank-order correlations for the two groups on three of the four social cognitive constructs (i.e., interest, effort, anxiety). However, for self-regulation, students who got a new teacher had a lower rank-order correlation than students who did not get a new teacher. In sum, we found only a little support for the impact of a new teacher on the rank-order correlations (a change in the relative placement from one time point to the next) of math-related social cognitive variables.

Regarding the variance comparison, we found an increase in the variance in the group that did not get a new teacher for math interest and self-regulation. However, this increase was not statistically significantly different from the change in variance in the group that got a new teacher. Moreover, on all other variables, there were no significant differences in the changes in the variances from T1 to T2 between the groups. Consequently, our results suggest that individual differences in the variables included in this study do not get more pronounced for students who get a new teacher than for students who keep the same teacher.

Study 2

Method

Sample. In Study 2, we used data from a large longitudinal German study ("Tradition and Innovation in Educational Systems"; TRAIN; Jonkmann et al., 2013), which is hosted by the Hector Research Institute of Education Sciences and Psychology at the University of Tübingen. TRAIN is a large-scale school-achievement study that encompasses four time points (from Grades 5 to 8). The study comprises N = 3,876 students in 136 classes in 99 schools from two federal states (Baden-Württemberg and Saxony).

To have a design that was comparable to Study 1, we used the third and fourth time points from the TRAIN study (called T1 and T2 in the following). In the TRAIN study, the teachers of each class were tracked. Class teachers have different main subjects that offered us the opportunity to investigate differential effects between school subjects.[25] For a detailed overview of the distribution of teachers across the subjects, see Table S4 in the SI Appendix B1. In sum, there was complete information for N = 2,458 (54.6% male) students such that *n*

[25] Due to the different school subjects, it was not possible to consider more than two time points because the sample sizes of the cells became too small to obtain reliable estimations of the rank-order correlations and especially the variance components.

= 1,546 (62.9%) had different teachers and *n* = 912 (37.1%) had the same teacher at both time points.

The students were spread across the two federal states such that, in Baden-Württemberg, *n* = 1,008 (36.5%) of the students came from the lower track ("Hauptschule"), and *n* = 733 (26.6%) came from the intermediate track ("Realschule"). The remaining students, *n* = 1,017 (36.9%), attended multitrack schools ("Mittelschule") in Saxony.

Instruments. ***Social cognitive variables.*** The social cognitive constructs (i.e., self-concept, interest, and academic effort) were assessed with four items each in three different school subjects, namely, math, German, and English (see Krapp & Prenzel, 2011; Marsh, 1992; Pekrun et al., 2005; Wigfield & Eccles, 2000). The items were rated on a 4-point Likert scale ranging from 1 (*I do not agree at all*) to 4 (*I agree entirely*). The domain-specific interest items focused on the intrinsic value of and interest in the respective school subject (Cronbach's αs ranged from .68 to .75). The items from the academic effort scales (developed for the TRAIN study) focused on the effort needed to meet subject-specific tasks (αs ranged from .85 to .90). The self-concept items targeted the students' own evaluations of their ability in the respective school subjects (αs ranged from .64 to .86).

Big Five personality traits. The Big Five were measured with the German version (Lang et al., 2001) of the Big Five Inventory (John et al., 1991). The items were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In line with findings from other studies with the same data set (Rieger et al., 2017; Trautwein et al., 2015), for all Big Five traits, the negatively worded items showed negative or low item-total correlations (all *r*s < .22). Thus, we used only the positively worded items. The Cronbach's α values ranged from .66 to .80

Statistical analyses. We again used multiple-group latent-variable models to estimate the 1-year rank-order correlations in both groups (students who had the same teacher vs. students who had different teachers) as well as all variance components (see Figure 1). To compare the differences in the rank-order correlations, we again used Fisher's z-tests (Fisher, 1925) and confidence intervals (Zou, 2007). We compared the differences in variances (from T1 to T2) between the groups with the Wald test.

The model estimation (full information maximum likelihood estimation with robust standard errors), model fit evaluation criteria, parceling strategy, and the way in which we dealt with the multilevel structure of the data set were the same as in Study 1.

Results

We again begin by presenting the results of the measurement invariance tests between the groups and over time. Then we present the results of the multiple-group latent-variable models. Descriptive results for the overall sample for both time points are displayed in Table S5 in the SI Appendix B2. Again, we did not expect to find any meaningful patterns in means over time, but we report all mean-level results in Table S6 in the SI Appendix B3. In sum, for most variables, there were no significant differences in mean-level change over time between the groups. Significant differences emerged for conscientiousness, openness, and extraversion. However, these differences were rather small, $\Delta d < 0.10$.

Establishing measurement invariance. In line with the procedure used in Study 1, we first tested for measurement invariance over time and between groups. Thus, we tested a liberal model (the same factor loadings for each indicator/parcel over time and between groups) against a more restrictive model (the same factor loadings and intercepts over time and the same factor loadings, intercepts, residual variances, and residual correlations between groups). Table S7 in the SI Appendix B4 displays all model fit criteria of all tested models. Most of the models demonstrated a good fit (CFI/TLI > 0.95, RMSEA/SRMR ≤ 0.07) to the data. Exceptions were found for one to two of the goodness-of-fit indices in the following models: the math interest model (liberal model: TLI = 0.93, RMSEA = 0.12 and restrictive model: RMSEA = 0.08), and the liberal model for openness (RMSEA = 0.09). However, all other fit indices indicated a good fit to the data.

When we compared the liberal and restrictive models, the restrictive model fit the data significantly worse for the variables of neuroticism ($\Delta\chi^2 = 17.92$, $\Delta df = 7$, $\Delta p = .012$) and agreeableness ($\Delta\chi^2 = 16.16$, $\Delta df = 7$, $\Delta p = .024$). However, the other fit indices (CFI, TLI, RMSEA, and SRMR) were above or below the cut-off values of .95 or .05, respectively. There were no significant differences between the models on all remaining variables, and consequently, we were able to assume strong measurement invariance over time and strict measurement invariance between groups.

Comparison of rank-order correlations. We estimated the 1-year rank-order correlations and all variance components of both groups (same teacher; st vs. new teacher; nt) separately for each construct by means of the more restrictive multiple-group latent variables. The results of the 1-year rank-order correlations are displayed in Table 3.

Table 3
Results of Multiple-Group Latent-Variable Models (TRAIN Study)

Constructs	Same teacher Stability r_{12}	New teacher Stability r_{12}	Difference in time consistency (Δ)[a] [Zou's CI[b]]
Social cognitive variables			
Math interest	.56 [.41, .71]	.47 [.33, .61]	-.09 [-.21, .02]
German interest	.61 [.48, .73]	.37 [.18, .56]	-.24* [-.35, -.13]
English interest	.38 [.10, .65]	.26 [-.02, .55]	-.12 [-.34, .11]
Math effort	.57 [.45, .68]	.54 [.44, .63]	-.03 [-.14, .08]
German effort	.61 [.54, .68]	.42 [.28, .56]	-.19* [-.30, -.08]
English effort	.58 [.45, .70]	.29 [.07, .51]	-.28* [-.48, -.08]
Math self-concept	.62 [.49, .76]	.65 [.56, .73]	.03 [-.07, .13]
German self-concept	.82 [.70, .94]	.68 [.55, .81]	-.14* [-.20, -.07]
English self-concept	.69 [.56, .83]	.66 [.44, .87]	-.03 [-.17, .11]
Big Five personality traits			
Conscientiousness	.56 [.47, .64]	.52 [.44, .59]	-.04 [-0.10, .02]
Neuroticism	.49 [.38, .61]	.49 [.41, .58]	.00 [-.06, .06]
Openness	.55 [.44, .66]	.52 [.45, .59]	-.03 [-.09, .03]
Agreeableness	.55 [.42, .67]	.49 [.38, .60]	-.05 [-.11, .01]
Extraversion	.66 [.53, .78]	.53 [.45, .61]	-.13* [-.18, -.07]

[a]Fisher's z-test (Fisher, 1925). [b]Zou's Confidence Intervals (Zou, 2007).

* $p < .05$.

For the interest measures, we found significantly lower rank-order correlations for the group of student who got a new teacher in German (r_{st} = .61 vs. r_{nt} = .37, Δ = -.24, Z = -4.06, $p < .000$) but not in math (r_{st} = .56 vs. r_{nt} = .47, Δ = -.09, Z = -1.57, p = .117) or English (r_{st} = .38 vs. r_{nt} = .26, Δ = -.12, Z = -1.01, p = .314). On the effort measures, students who had a new teacher showed statistically significantly lower rank-order correlations than the students who had the same teacher in German (r_{st} = .61 vs. r_{nt} = .42, Δ = -.19, Z = -3.40, p = .001) and English (r_{st} = .58 vs. r_{nt} = .29, Δ = -.29, Z = -2.80, p = .005) but not in math (r_{st} = .57 vs. r_{nt} = .54, Δ = -.03, Z = -0.51, p = .611). Regarding the self-concept measures, we found no significant differences in the rank-order correlations between the two groups for math (r_{st} = .62 vs. r_{nt} = .65, Δ = .03, Z = 0.57, p = .568) or English (r_{st} = .69 vs. r_{nt} = .66, Δ = -.03, Z = -0.45, p = .656), but we found differences for German (r_{st} = .82 vs. r_{nt} = .68, Δ = -.14, Z = -4.19, $p < .000$). However, it should be noted that the rank-order correlation was very high in the group that did not get a new teacher. This was due to the rather small variances of the latent variables in this group.

As a last step, we compared the rank-order correlations between the groups on the Big Five personality traits. We found no statistically significant differences between the two groups on the Big Five traits except for extraversion. For extraversion, the students who got a new teacher showed a statistically significant lower rank-order correlation than the students who had the same teacher (r_{st} = .66 vs. r_{nt} = .53, Δ = -.13, Z = 3.24, p = .001).

Comparison of variance components. With regard to our second research question, paralleling Study 1, we compared the change in variance from T1 to T2 between the groups (Δ) separately for each construct. All estimated variances as well as the differences between the variances are reported in Table 4. Using the Wald test, we found significant differences in the changes in the variances from T1 to T2 between the groups on the variables of interest in the subject of English (Δ = -0.78, Z = 2.60, p = .009) and on conscientiousness (Δ = 0.26, Z = 2.54, p = .011). For conscientiousness, the variance for the group that had the same teacher decreased significantly (δ_{st} = -0.25, Z = -3.65, p < .001), and the variance for the group that got a new teacher remained virtually unchanged (δ_{nt} = 0.01, Z = 0.10, p = .921). Regarding interest in the subject of English, it was the opposite; the variance for the group that had the same teacher did not significantly increase or decrease over time (δ_{st} = -0.05, Z = -0.19, p = .853), but the variance for the group that got a new teacher decreased significantly over time (δ_{nt} = -0.83, Z = -4.29, p < .000). On all other variables, we found no significant differences in the change in the variance from T1 to T2 between the groups. However, two additional issues should be noted. First, there were significant increases or decreases in variances over time within the groups (i.e., math interest, effort in math and German, as well as math self-concept), which, however, were not statistically significantly different from the change in variance in the other group. Second, the variances of the Big Five traits got descriptively smaller in the group that did not get a new teacher, and no systematic pattern emerged in the group that got a new teacher (see Table 4).

Table 4
Results of Multiple-Group Latent-Variable Models (TRAIN Study)

Constructs	Same teacher			New teacher			Difference (Δ) of δ_{st} and δ_{nt}
	Var_{T1}	Var_{T2}	Var_{T2}-Var_{T1} (δ)	Var_{T1}	Var_{T2}	Var_{T2}-Var_{T1} (δ)	
Social cognitive variables							
Math interest	0.32 [0.26, 0.39]	0.33 [0.24, 0.42]	0.02 [-0.27, 0.32]	0.28 [0.22, 0.34]	0.38 [0.28, 0.47]	0.30* [0.04, 0.56]	0.28 [-0.11, 0.66]
German interest	0.38 [0.28, 0.49]	0.28 [0.16, 0.40]	-0.32 [-0.70, 0.05]	0.38 [0.28, 0.47]	0.29 [0.22, 0.36]	-0.27 [-0.54, 0.01]	0.06 [-0.39, 0.50]
English interest	0.36 [0.19, 0.54]	0.35 [0.17, 0.52]	-0.05 [-0.54, 0.45]	0.40 [0.28, 0.52]	0.18 [0.12, 0.23]	-0.83* [-1.21, -0.45]	-0.78* [-1.37, -0.19]
Math effort	0.36 [0.22, 0.49]	0.43 [0.30, 0.56]	0.20 [-0.01, 0.41]	0.30 [0.24, 0.35]	0.40 [0.34, 0.45]	0.28* [0.08, 0.49]	0.08 [-0.21, 0.37]
German effort	0.48 [0.36, 0.60]	0.44 [0.27, 0.60]	-0.10 [-0.48, 0.28]	0.44 [0.37, 0.52]	0.33 [0.26, 0.41]	-0.29* [-0.52, -0.06]	-0.19 [-0.62, 0.24]
English effort	0.41 [0.22, 0.60]	0.37 [0.23, 0.50]	-0.11 [-0.60, 0.39]	0.31 [0.28, 0.33]	0.38 [0.30, 0.46]	0.21 [0.00, 0.43]	0.32 [-0.20, 0.84]
Math self-concept	0.48 [0.38, 0.57]	0.57 [0.46, 0.68]	0.19* [0.04, 0.34]	0.49 [0.40, 0.57]	0.55 [0.44, 0.66]	0.12 [-0.16, 0.40]	-0.06 [-0.36, 0.24]
German self-concept	0.24 [0.14, 0.35]	0.20 [0.13, 0.26]	-0.21 [-0.54, 0.12]	0.22 [0.15, 0.29]	0.19 [0.14, 0.23]	-0.18 [-0.52, 0.15]	0.02 [-0.33, 0.37]
English self-concept	0.45 [0.34, 0.56]	0.52 [0.36, 0.68]	0.14 [-0.26, 0.55]	0.34 [0.22, 0.46]	0.45 [0.27, 0.64]	0.30 [-0.01, 0.60]	0.16 [-0.34, 0.65]
Big Five personality traits							
Conscientiousness	0.32 [0.27, 0.37]	0.25 [0.21, 0.28]	-0.25* [-0.38, -0.12]	0.27 [0.24, 0.31]	0.27 [0.24, 0.31]	0.01 [-0.15, 0.16]	0.26* [0.06, 0.46]
Neuroticism	0.21 [0.17, 0.26]	0.20 [0.17, 0.23]	-0.07 [-0.25, 0.11]	0.26 [0.22, 0.30]	0.29 [0.26, 0.32]	0.11 [-0.06, 0.29]	0.19 [-0.05, 0.42]
Openness	0.27 [0.23, 0.31]	0.24 [0.20, 0.27]	-0.13 [-0.30, 0.05]	0.26 [0.23, 0.29]	0.25 [0.22, 0.28]	-0.02 [-0.17, 0.14]	0.11 [-0.11, 0.34]
Agreeableness	0.24 [0.20, 0.29]	0.21 [0.16, 0.26]	-0.15 [-0.36, 0.07]	0.20 [0.16, 0.24]	0.22 [0.18, 0.25]	0.08 [-0.11, 0.26]	0.22 [-0.05, 0.50]
Extraversion	0.25 [0.20, 0.29]	0.22 [0.19, 0.26]	-0.11 [-0.29, 0.08]	0.24 [0.21, 0.28]	0.25 [0.22, 0.28]	0.03 [-0.14, 0.20]	0.14 [-0.10, 0.37]

Note. Before subtracting the variances, we applied a natural logarithm transformation.

* $p < .05$.

Discussion

In line with Study 1, we found no differences in the rank-order correlations for the math-related social cognitive variables between students who got a new teacher and students who did not get a new teacher. However, on the social cognitive constructs that are related to German and English (i.e., effort in English and German as well as interest and self-concept in German), students who got a new teacher showed significantly lower rank-order correlations (i.e., their relative placement within the group changed) than students who did not get a new teacher. On the Big Five personality traits, there were no significant differences in the rank-order correlations between the groups (except extraversion). In sum, our results suggest that social cognitive variables are slightly more influenced by a changing context (i.e., getting a new teacher) than the Big Five personality traits.

Regarding the variance comparison, we found only two (of 14) significant differences in the change in the variances over time between the groups (i.e., interest in English and conscientiousness). Moreover, there were significant increases or decreases in variances over time within the groups (i.e., math interest, effort in math and German, math self-concept). On the basis of these contradictory patterns, we concluded that there were no systematic patterns in the increases or decreases in variances over time within or between groups.

General Discussion

In the present investigation, we examined consistency in students' psychological functioning in two independent longitudinal studies of students who got a new teacher in comparison with those who did not get a new teacher. For this purpose, we compared the 1-year rank-order correlations and variance components of a variety of personality variables between students who got new teachers and those who did not. By analyzing two large data sets, we found (a) no differences in the rank-order correlations of math-related social cognitive constructs (except self-regulation) between the two groups. Furthermore, we found (b) no significant differences in rank-order correlations for the Big Five personality traits (except extraversion). However, we found (c) significantly lower time consistency for the group of students who got a new teacher on some of the German- and English-related social cognitive constructs (e.g., effort, interest, and self-concept). Finally, regarding the comparison of variances, we found (d) no systematic differences (increases or decreases) within or between groups across the two studies.

Cross-Situational Consistency in Students' Characteristics

The extent to which students' personality is influenced by environmental factors is a central question in personality research (Asendorpf & van Aken, 2003; Funder & Colvin, 1991; Johnson, 1999; Roberts & Pomerantz, 2004). We examined the effect of getting a new teacher—a situation that students face many times in their school careers—on consistency in a variety of student characteristics. We were particularly interested in whether social cognitive constructs would be more susceptible to this kind of situation than trait constructs such as the Big Five. Multiple theoretical models can distinguish between two groups of variables, namely, core traits/characteristics (also called basic tendencies) and surface characteristics (also called characteristic adaptions; Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae & Costa, 2008b). On the basis of group allocation, the constructs are conceptualized as either stable and consistent across contexts or unstable and contextualized. Past research showed that social cognitive and personality trait constructs are comparable regarding levels of continuity and change in a stable environment (Rieger et al., 2017).

In the present research, we focused on consistency across different environmental experiences (i.e., getting a new teacher) and found partial support for the idea that social cognitive variables are more susceptible to environmental changes than the Big Five personality traits are. The strongest effects were found for the effort measures (in the subjects English and German), a finding that coincides with the strong relation between teacher behavior and student effort (Pianta, Hamre, & Allen, 2012). It is interesting, however, that the math-related social cognitive constructs (self-concept, interest, effort, and anxiety) were unaffected by the change in teachers. One explanation could be that the relation between math-related constructs are more entwined with the ability of a person, which might lead to a certain robustness against environmental influences such as getting a new teacher.

In line with the theoretical assumptions about core traits/basic tendencies (McCrae & Costa, 2008b), we found no effect of getting a new teacher on the consistency of the Big Five personality traits (except extraversion). Thus, it can be concluded that there is no marked impact of this particular different contextual situation (i.e., getting a new teacher) on the consistency of the broad personality traits. This finding is in line with Funder and Colvin's (1991) reasoning. They suggested that cross-situational consistency also depends on the "level" of behavior and that high-level (global personality) traits show more consistency

than the middle or lower behavioral levels[26] (which are more concrete; (see also Leikas, Lönnqvist, & Verkasalo, 2012). Consequently, focusing on the lower levels of the Big Five personality traits can offer suitable insights for identifying and understanding the processes behind the broader traits. Research has not paid much attention to the extent to which the facets of personality traits are stable and changeable, especially in adolescence. However, initial insights can be derived from the study by Jackson et al. (2009). They found that not all facets of conscientiousness change in a similar way from early to later adulthood. However, how stable and context-sensitive the facets are has yet to be addressed by research.

Finally, it is important to note that our results do not mean that teachers do not influence the development of students' psychological functioning. The present study tested solely the extent to which a variety of personality constructs would respond (differently) to the same environmental experience (i.e., a new teacher). The beneficial impact of positive teacher characteristics (e.g., supportiveness) on social cognitive variables such as engagement and interest are well-documented (Frenzel et al., 2010; Pianta et al., 2012; Wentzel, 1998, 2002; Wigfield & Eccles, 1992). The extent to which teacher characteristics (e.g., attitude toward orderliness) influence students' personality development has not been the subject of (much) research until now, but it is definitely worth exploring.

Limitations and Future Directions

Although both studies used a quasi-experimental design and large samples and examined a variety of social cognitive constructs as well as all Big Five personality traits, some limitations should be kept in mind when interpreting the results. First, both studies relied on self-reports. Self-reports are commonly used to measure constructs such as effort, individual interest, self-concept and also the Big Five personality traits. Given the focus on a variety of social cognitive constructs, self-reports are perhaps one of the most valid measures for adequately capturing students' feelings and perceptions. Moreover, using the same method helped to maintain the comparability of the two construct classes. Nevertheless, it is important for future studies to examine the context-sensitivity also with different measures (e.g., behavioral measures). Second, we investigated pure between-person time-consistency indicators. Considering also intrapersonal processes (e.g., within-person time-consistency; Hamaker, Kuiper, & Grasman, 2015; Sherman et al., 2010) is essential for understanding the

[26] It is also important to distinguish between controlled and automatic behavior. Automatic behaviors can show remarkably high cross-situational consistency (Weisbuch, Slepian, Clarke, Ambady, & Veenstra-Vanderweele, 2010).

nature of the constructs. Finally, although it was one aim of the present research to compare the social cognitive constructs with the personality traits, it should be noted that these classes differ in their conception and granularity. Whereas the Big Five traits are defined as broad and domain-general constructs, social cognitive constructs are conceptualized as narrow and domain-specific. Researchers should consider examining lower order models (facets) of each of the Big Five domains to achieve a more fine-grained understanding of the Big Five (e.g., the extent to which the facets are stable and contextualized) in future studies.

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Supporting Information

Supporting Information A: Study 1

Supporting Information Study 1 A1: Descriptive Statistics of the PISA Study

Table S1
Descriptive Statistics of the PISA Study

Variable	T1 (Grade 9)							T2 (Grade 10)						
	N	*M*	*SD*	*Min*	*Max*	*Skew*	*Kurtosis*	*N*	*M*	*SD*	*Min*	*Max*	*Skew*	*Kurtosis*
Social cognitive variables														
Interest	2451	2.20	0.77	1	4	0.34	-0.62	5302	2.23	0.79	1	4	0.33	-0.62
Effort	2453	3.14	0.58	1	4	-0.58	0.42	2373	3.14	0.61	1	4	-0.69	0.52
Self-regulation	2451	2.92	0.55	1	4	-0.20	0.35	2369	2.95	0.58	1	4	-0.49	0.79
Anxiety	5463	2.01	0.73	1	4	0.53	-0.48	5304	2.01	0.73	1	4	0.53	-0.48

Supporting Information Study 1 A2: Results of Multiple-Group Latent-Variable Models in the PISA Study (mean-level)

Table S2
Results of Multiple-Group Latent-Variable Models (PISA Study)

Constructs	Same teacher			New teacher			Δ $d_{T2\text{-}T1}$	Δ Var[b]
	M_{T1}[a] *(Var)*	M_{T2} *(Var)*	$d_{T2\text{-}T1}$ *(Var)*	M_{T1} *(Var)*	M_{T2} *(Var)*	$d_{T2\text{-}T1}$ *(Var)*		
Social cognitive variables								
Math interest	0.00 (0.53 [0.49, 0.56])	0.02 [-0.01, 0.05] (0.57 [0.54, 0.59])	0.02 [-0.01, 0.05] (0.26 [0.23, 0.29])	-0.03 [-0.11, 0.05] (0.53 [0.46, 0.60])	0.01 [-0.06, 0.08] (0.57 [0.51, 0.62])	0.04 [-0.02, 0.10] (0.28 [0.22, 0.33])	0.03 [-0.04, 0.09]	0.06 [-0.16, 0.28]
Math effort	0.00 (0.28 [0.26, 0.31])	0.00 [-0.03, 0.03] (0.31 [0.28, 0.34])	0.00 [-0.03, 0.03] (0.24 [0.21, 0.27])	-0.03 [-0.09, 0.03] (0.26 [0.22, 0.31])	-0.02 [-0.08, 0.05] (0.29 [0.24, 0.33])	0.01 [-0.04, 0.06] (0.24 [0.18, 0.29])	0.01 [-0.05, 0.07]	-0.01 [-0.27, 0.25]
Math self-regulation	0.00 (0.23 [0.21, 0.25])	0.02 [0.00, 0.05] (0.28 [0.25, 0.31])	0.02 [0.00, 0.05] (0.20 [0.17, 0.23])	0.01 [-0.04, 0.07] (0.22 [0.18, 0.25])	0.05 [-0.01, 0.10] (0.23 [0.18, 0.28])	0.03 [-0.02, 0.09] (0.20 [0.15, 0.25])	0.01 [-0.05, 0.07]	0.00 [-0.29, 0.30]
Math anxiety	0.00 (0.47 [0.45, 0.49])	0.01 [-0.01, 0.03] (0.48 [0.46, 0.50])	0.01 [-0.01, 0.03] (0.26 [0.24, 0.29])	-0.04 [-0.10, 0.03] (0.49 [0.45, 0.53])	-0.05 [-0.12, 0.01] (0.48 [0.44, 0.52])	-0.02 [-0.07, 0.04] (0.26 [0.22, 0.30])	-0.03 [-0.08, 0.03]	0.00 [-0.18, 0.18]

[a]The mean of the first group is fixed to 0 in order to identify the model. [b]Before subtracting the variances, we applied a natural logarithm transformation.

Supporting Information Study 1 A3: Model Fit of the Models Tested in the PISA Study

Table S3
Model Fit of the Models Tested in the PISA Study

Constructs	Subject	*N* (n_{st} *vs.* n_{nt})[a]	Model[b]	Estimated parameters	χ^2	*df*	SCF	CFI	TLI	RMSEA	SRMR
Social cognitive variables											
Interest	Math	5,613 (4,482 vs. 1,131)	lib.	24	11.25	4	0.96	1.00	1.00	0.03	0.01
			restr.	17	13.39	11	1.13	1.00	1.00	0.01	0.01
Effort	Math	5,611 (4,480 vs. 1,131)	lib.	24	6.57	4	1.00	1.00	1.00	0.02	0.01
			restr.	17	20.73	11	1.12	1.00	1.00	0.02	0.04
Self-regulation	Math	5,611 (4,480 vs. 1,131)	lib.	24	26.54	4	1.10	0.99	0.98	0.05	0.02
			restr.	17	42.14	11	1.07	0.99	0.99	0.03	0.03
Anxiety	Math	5,626 (4,494 vs. 1,132)	lib.	32	292.97	22	1.17	0.98	0.98	0.07	0.06
			restr.	21	295.24	33	1.23	0.98	0.99	0.05	0.06

[a]st = Students who had the same teacher; nt = Students who had a new teacher. [b]lib = liberal model; restr. = more restrictive model. χ^2 = Yuan–Bentler robust test statistic; *df* = degrees of freedom; SCF = Scale correction factor; CFI = comparative fit index; TLI = Tucker Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Supporting Information B: Study 2

Supporting Information Study 2 B1: Number of Teacher per Subjects

Table S4
Number of Teachers per Subject

	T1	T2
Math teachers	38 (832 students)	40 (902 students)
German teachers	53 (1060 students)	44 (881 students)
English teachers	13 (279 students)	17 (356 students)
“Other” teachers	14 (287 students)	17 (319 students)
Total	118	118

Supporting Information Study 2 B2: Descriptive Statistics of the TRAIN Study

Table S5
Descriptive Statistics for the TRAIN Study

Variable	T1 (Grade 7)							T2 (Grade 8)						
	N	*M*	*SD*	*Min*	*Max*	*Skew*	*Kurtosis*	*N*	*M*	*SD*	*Min*	*Max*	*Skew*	*Kurtosis*
Social cognitive variables														
Math interest	2,078	2.75	0.69	1	4	-0.21	-0.28	2,093	2.64	0.69	1	4	-0.06	-0.34
German interest	2,077	2.63	0.71	1	4	-0.09	-0.39	2,094	2.55	0.65	1	4	0.07	-0.08
English interest	2,076	2.65	0.73	1	4	-0.15	-0.37	2,086	2.60	0.69	1	4	-0.05	-0.26
Math effort	2,072	3.15	0.66	1	4	-0.83	0.72	2,097	3.02	0.70	1	4	-0.62	0.20
German effort	2,072	3.15	0.70	1	4	-0.81	0.56	2,098	3.05	0.69	1	4	-0.62	0.35
English effort	2,071	3.16	0.70	1	4	-0.77	0.35	2,098	3.06	0.71	1	4	-0.65	0.25
Math self-concept	2,055	2.85	0.78	1	4	-0.29	-0.56	2,078	2.73	0.80	1	4	-0.19	-0.60
German self-concept	2,059	2.95	0.60	1	4	-0.32	-0.06	2,077	2.92	0.58	1	4	-0.17	-0.13
English self-concept	2,039	2.92	0.76	1	4	-0.34	-0.55	2,071	2.84	0.77	1	4	-0.26	-0.55
Big Five personality traits														
Conscientiousness	2,070	2.89	0.60	1	4	-0.23	0.11	2,068	2.82	0.57	1	4	-0.04	0.25
Neuroticism	2,065	2.28	0.61	1	4	0.23	-0.02	2,062	2.32	0.60	1	4	0.21	0.19
Openness	2,070	2.84	0.57	1	4	-0.10	0.05	2,067	2.80	0.55	1	4	0.01	0.30
Agreeableness	2,066	2.90	0.59	1	4	-0.35	0.37	2,057	2.91	0.56	1	4	-0.29	0.50
Extraversion	2,070	2.87	0.59	1	4	-0.17	0.05	2,070	2.86	0.58	1	4	-0.17	0.21

Supporting Information Study 2 B3: Results of Multiple-Group Latent-Variable Models in the TRAIN Study (mean-level)

Table S6
Results of Multiple-Group Latent-Variable Models (TRAIN Study)

Constructs	Same teacher			New teacher			Δ d_{T2-T1}	Δ Var[b]
	M_{T1}[a] *(Var)*	M_{T2} *(Var)*	d_{T2-T1} *(Var)*	M_{T1} *(Var)*	M_{T2} *(Var)*	d_{T2-T1} *(Var)*		
Social cognitive variables								
Math interest	0.00 (0.32 [0.26, 0.39])	-0.17 [-0.28, -0.05] (0.33 [0.24, 0.42])	-0.17 [-0.28, -0.05] (0.29 [0.20, 0.37])	0.04 [-0.09, 0.16] (0.28 [0.22, 0.34])	-0.09 [-0.22, 0.04] (0.38 [0.28, 0.47])	-0.13 [-0.21, -0.04] (0.35 [0.26, 0.45])	0.04 [-0.10, 0.18]	0.20 [-0.19, 0.60]
German interest	0.00 (0.38 [0.28, 0.49])	-0.10 [-0.18, -0.01] (0.28 [0.16, 0.40])	-0.10 [-0.18, -0.01] (0.26 [0.13, 0.40])	0.16 [-0.04, 0.36] (0.38 [0.28, 0.47])	0.12 [-0.07, 0.30] (0.29 [0.22, 0.36])	-0.04 [-0.15, 0.06] (0.42 [0.24, 0.60])	0.05 [-0.08, 0.19]	0.47 [-0.19, 1.12]
English interest	0.00 (0.36 [0.19, 0.54])	-0.06 [-0.16, 0.02] (0.35 [0.17, 0.52])	-0.06 [-0.16, 0.02] (0.44 [0.10, 0.78])	-0.03 [-0.23, 0.18] (0.4 [0.28, 0.52])	-0.15 [-0.34, 0.03] (0.18 [0.12, 0.23])	-0.13 [-0.26, 0.00] (0.44 [0.19, 0.68])	-0.06 [-0.22, 0.10]	0.00 [-0.96, 0.95]
Math effort	0.00 (0.36 [0.22, 0.49])	-0.22 [-0.35, -0.09] (0.43 [0.30, 0.56])	-0.22 [-0.35, -0.09] (0.34 [0.18, 0.51])	0.09 [0.00, 0.18] (0.30 [0.24, 0.35])	-0.02 [-0.11, 0.07] (0.4 [0.34, 0.45])	-0.11 [-0.18, -0.04] (0.32 [0.26, 0.38])	0.11 [-0.03, 0.25]	-0.06 [-0.57, 0.45]
German effort	0.00 (0.48 [0.36, 0.60])	-0.06 [-0.15, 0.03] (0.44 [0.27, 0.60])	-0.06 [-0.15, 0.03] (0.36 [0.23, 0.48])	0.20 [0.02, 0.38] (0.44 [0.37, 0.52])	0.16 [-0.02, 0.33] (0.33 [0.26, 0.41])	-0.04 [-0.12, 0.04] (0.46 [0.33, 0.58])	0.02 [-0.10, 0.14]	0.24 [-0.21, 0.70]
English effort	0.00 (0.41 [0.22, 0.60])	-0.12 [-0.23, -0.01] (0.37 [0.23, 0.50])	-0.12 [-0.23, -0.01] (0.33 [0.16, 0.50])	0.03 [-0.11, 0.17] (0.31 [0.28, 0.33])	-0.14 [-0.33, 0.05] (0.38 [0.30, 0.46])	-0.17 [-0.32, -0.02] (0.49 [0.34, 0.63])	-0.05 [-0.24, 0.14]	0.39 [-0.21, 0.99]
Math self-concept	0.00 (0.48 [0.38, 0.57])	-0.13 [-0.28, 0.02] (0.57 [0.46, 0.68])	-0.13 [-0.28, 0.02] (0.40 [0.26, 0.54])	0.10 [-0.03, 0.23] (0.49 [0.40, 0.57])	-0.03 [-0.15, 0.09] (0.55 [0.44, 0.66])	-0.13 [-0.22, -0.05] (0.37 [0.29, 0.45])	0.00 [-0.18, 0.17]	-0.08 [-0.50, 0.34]
German self-concept	0.00 (0.24 [0.14, 0.35])	0.00 [-0.08, 0.07] (0.20 [0.13, 0.26])	0.00 [-0.08, 0.07] (0.08 [0.02, 0.14])	0.12 [-0.01, 0.25] (0.22 [0.15, 0.29])	0.12 [0.00, 0.25] (0.18 [0.14, 0.23])	0.00 [-0.08, 0.08] (0.13 [0.07, 0.19])	0.01 [-0.10, 0.12]	0.48 [-0.35, 1.30]
English self-concept	0.00 (0.45 [0.34, 0.56])	0.01 [-0.10, 0.12] (0.52 [0.36, 0.68])	0.01 [-0.10, 0.12] (0.30 [0.14, 0.46])	0.09 [-0.12, 0.30] (0.34 [0.22, 0.46])	-0.04 [-0.28, 0.21] (0.45 [0.27, 0.64])	-0.13 [-0.34, 0.09] (0.28 [0.12, 0.43])	-0.14 [-0.38, 0.11]	-0.09 [-0.83, 0.66]
Big Five personality traits								
Conscientiousness	0.00 (0.32 [0.27, 0.37])	-0.02 [-0.07, 0.03] (0.25 [0.21, 0.28])	-0.02 [-0.07, 0.03] (0.26 [0.19, 0.32])	0.17 [0.10, 0.24] (0.27 [0.24, 0.31])	0.07 [0.00, 0.14] (0.27 [0.24, 0.31])	-0.10 [-0.14, -0.06] (0.26 [0.21, 0.32])	-0.08* [-0.14, -0.02]	0.03 [-0.28, 0.34]
Neuroticism	0.00 (0.21 [0.17, 0.26])	0.06 [0.01, 0.11] (0.20 [0.17, 0.23])	0.06 [0.01, 0.11] (0.21 [0.16, 0.26])	0.05 [-0.02, 0.13] (0.26 [0.22, 0.30])	0.08 [0.00, 0.15] (0.29 [0.26, 0.32])	0.02 [-0.03, 0.07] (0.28 [0.23, 0.33])	-0.04 [-0.10, 0.03]	0.28 [-0.04, 0.61]
Openness	0.00 (0.27 [0.23, 0.31])	0.01 [-0.03, 0.05] (0.24 [0.20, 0.27])	0.01 [-0.03, 0.05] (0.23 [0.16, 0.30])	0.11 [0.05, 0.18] (0.26 [0.23, 0.29])	0.03 [-0.04, 0.10] (0.25 [0.22, 0.28])	-0.08 [-0.12, -0.05] (0.25 [0.20, 0.29])	-0.09* [-0.14, -0.04]	0.08 [-0.28, 0.43]
Agreeableness	0.00 (0.24 [0.20, 0.29])	0.01 [-0.04, 0.07] (0.21 [0.16, 0.26])	0.01 [-0.04, 0.07] (0.21 [0.13, 0.28])	0.12 [0.05, 0.19] (0.20 [0.16, 0.24])	0.11 [0.03, 0.18] (0.22 [0.18, 0.25])	-0.02 [-0.05, 0.02] (0.21 [0.16, 0.26])	-0.03 [-0.09, 0.03]	0.02 [-0.41, 0.44]
Extraversion	0.00 (0.25 [0.20, 0.29])	0.02 [-0.02, 0.06] (0.22 [0.19, 0.26])	0.02 [-0.02, 0.06] (0.16 [0.10, 0.23])	0.10 [0.04, 0.17] (0.24 [0.21, 0.28])	0.05 [-0.02, 0.13] (0.25 [0.22, 0.28])	-0.05 [-0.09, -0.01] (0.23 [0.18, 0.28])	-0.07* [-0.13, -0.02]	0.35 [-0.13, 0.83]

[a]The mean of the first group was fixed to 0 in order to identify the model. [b]Before subtracting the variances, we applied a natural logarithm transformation.

Supporting Information Study 2 B4: Model Fit of the Models Tested in the TRAIN Study

Table S7
Model Fit of the Models Tested in the TRAIN Study

Constructs	Subject	*N* (n_{st} vs. n_{nt})[a]	Model[b]	Estimated parameters	χ^2	*df*	SCF	CFI	TLI	RMSEA	SRMR
Social cognitive variables											
Interest	Math	644 (239 vs. 405)	lib.	24	22.24	4	1.28	0.98	0.93	0.12	0.04
			restr.	17	30.89	11	0.97	0.97	0.97	0.08	0.04
	German	716 (259 vs. 457)	lib.	24	1.07	4	1.32	1.00	1.01	0.00	0.01
			restr.	17	8.46	11	1.10	1.00	1.00	0.00	0.03
	English	252 (123 vs. 129)	lib.	24	5.02	4	0.73	1.00	0.99	0.05	0.03
			restr.	17	11.32	11	0.94	1.00	1.00	0.02	0.06
Effort	Math	644 (239 vs. 405)	lib.	24	5.29	4	0.91	1.00	1.00	0.03	0.01
			restr.	17	6.09	11	1.11	1.00	1.00	0.00	0.02
	German	716 (259 vs. 457)	lib.	24	4.84	4	0.89	1.00	1.00	0.02	0.01
			restr.	17	11.76	11	1.39	1.00	1.00	0.01	0.03
	English	252 (123 vs. 129)	lib.	24	2.72	4	1.10	1.00	1.00	0.00	0.01
			restr.	17	12.53	11	0.86	1.00	1.00	0.03	0.07

Table S7 (continued)
Model Fit of the Models Tested in the TRAIN Study

Constructs	Subject	*N* (n_{st} vs. n_{nt})[a]	Model[b]	Estimated parameters	χ^2	*df*	SCF	CFI	TLI	RMSEA	SRMR
Self-concept	Math	644 (239 vs. 405)	lib.	24	8.62	4	1.05	1.00	0.99	0.06	0.04
			restr.	17	18.83	11	1.13	0.99	0.99	0.05	0.04
	German	716 (259 vs. 457)	lib.	24	1.56	4	0.82	1.00	1.02	0.00	0.01
			restr.	17	9.81	11	1.18	1.00	1.01	0.00	0.04
	English	252 (123 vs. 129)	lib.	24	4.51	4	0.87	1.00	1.00	0.03	0.03
			restr.	17	13.53	11	1.34	0.99	0.99	0.04	0.07
Big Five personality traits											
Conscientiousness	--	2,458 (912 vs. 1,546)	lib.	24	20.97	4	0.95	0.99	0.98	0.06	0.02
			restr.	17	24.23	11	1.10	1.00	1.00	0.03	0.03
Neuroticism	--	2,458 (912 vs. 1,546)	lib.	24	11.14	4	1.22	1.00	0.98	0.04	0.01
			restr.	17	29.06	11	1.23	0.99	0.99	0.04	0.04
Openness	--	2,458 (912 vs. 1,546)	lib.	24	40.38	4	0.88	0.99	0.96	0.09	0.03
			restr.	17	35.37	11	1.07	0.99	0.99	0.04	0.03
Agreeableness	--	2,458 (912 vs. 1,546)	lib.	24	16.59	4	1.02	0.99	0.97	0.05	0.03
			restr.	17	31.49	11	1.23	0.98	0.98	0.04	0.04
Extraversion	--	2,458 (912 vs. 1,546)	lib.	24	12.72	4	1.13	0.99	0.98	0.04	0.02
			restr.	17	16.94	11	1.41	1.00	0.99	0.02	0.04

Note. [a]st = Students who had the same teacher; nt = Students who had a new teacher. [b]lib = liberal model; restr. = more restrictive model. χ^2 = Yuan–Bentler robust test statistic; *df* = degrees of freedom; SCF = Scale correction factor; CFI = comparative fit index; TLI = Tucker Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

5 STUDY 3 THE DEVELOPMENT OF STUDENTS' ACADEMIC EFFORT: THE UNIQUE AND COMBINED EFFECTS OF CONSCIENTIOUSNESS AND INDIVIDUAL INTEREST

Rieger, S., Göllner, R., Spengler, M., Trautwein, U., Nagengast, B., & Roberts, B. W. (2017). The development of students' academic effort: The unique and combined effects of conscientiousness and individual interest. Manuscript submitted for publication.

Abstract

Academic effort plays a focal role in explaining academic success. Understanding the development as well as the potential antecedents of effort is indispensable for understanding how to facilitate students' major school outcomes. The present longitudinal study (four time points; N = 3,876 students in 136 classes) was designed, first, to investigate the development of academic effort in three major school subjects (math, German, and English) in Grades 5 to 8. The second aim was to test the predictive power of two important predictors of academic effort, namely, conscientiousness and individual interest. Results showed a decrease in academic effort over time across the three school subjects. However, both conscientiousness and individual interest significantly and positively predicted the change in academic effort such that when conscientiousness and individual interest were higher, the decrease in academic effort was smaller. In addition, conscientiousness and individual interest interacted in a compensatory manner such that individual interest was less important for academic effort in students who were high in conscientiousness. The results held for most prospective paths across three waves of longitudinal data.

Keywords: academic effort, interest, conscientiousness, compensatory-effects model, latent change models

The Development of Students' Academic Effort: The Unique and Combined Effects of Conscientiousness and Individual Interest

For most students, working hard is a necessary prerequisite for achieving success in school, and there is little doubt that being persistent, such as trying hard at (school) tasks—even and especially when they are exhausting—is associated with academic success (Eccles et al., 1983; Fredricks et al., 2004; Newmann, 1992; Nicholls, 1978; Pintrich & de Groot, 1990). In the literature, such behavior is described by many different names such as engagement, effort, compliance, or persistence (Azevedo, 2015; Sinatra, Heddy, & Lombardi, 2015). Independent of the label, however, effortful and persistent behavior plays a focal role in explaining academic success (e.g., achievement, grades) and, consequently, it is important to understand and investigate the development as well as the potential predictors of it.

During the secondary school years, effortful behavior tends to decline across all school subjects (Upadyaya & Salmela-Aro, 2013; Wang & Eccles, 2012a). These trends make it all the more important to explore potential antecedents that can serve as buffers against this decline. In the present study, we examined the unique and combined effects of individual interest and conscientiousness in predicting academic effort. A number of cross-sectional studies (Di Domenico & Fournier, 2015; Sansone & Thoman, 2006; Trautwein et al., 2015) have shown that both conscientiousness and interest uniquely predict academic effort. It is intriguing that, in these studies, conscientiousness and interest also interacted with each other in a compensatory manner such that high interest was able to compensate for low conscientiousness, and vice versa, high conscientiousness was able to compensate for low interest. However, the studies did not test whether these relations held over time.

Using a large longitudinal study with four time points and N = 3,876 students in 136 classes (99 schools), we first investigated the development of academic effort in the three major school subjects of math, German, and English. Second, we investigated the prospective predictive power of conscientiousness and individual interest in predicting the development of academic effort. In addition, we were particularly interested in the interplay between conscientiousness and individual interest in predicting the development of academic effort.

Academic Effort: Importance, Characteristics, and Development

Working and trying hard on school tasks is linked to a variety of positive learning outcomes such as better grades, higher achievement, and lower dropout rates and is a key variable in many theoretical models of academic learning (Eccles et al., 1983; Fredricks et al., 2004; Newmann, 1992; Nicholls, 1978; Pintrich & de Groot, 1990). However, such behavior goes by many different names such as engagement, effort, persistence, or compliance, and there is still some lack of consensus on the definition (Azevedo, 2015; Fredricks et al., 2004; Sinatra et al., 2015; Skinner, Kindermann, Connell, & Wellborn, 2009). In this article, we use the term academic effort which is defined by persistent and enduring behavior in academic situation (see Nicholls, 1978; Pintrich & de Groot, 1990). Academic effort is conceptualized as the amount of time and energy that persons expend on academic tasks. Moreover, persons who report high academic effort tend to work accurately and show persistence when faced with difficult tasks, which can be captured by an attitude of "I do my best when it comes to …" (Corno, 1986; Trautwein & Lüdtke, 2007).

Interestingly, how students' academic effort develops over time period has not been the focus of much longitudinal research (Fredricks et al., 2004). Developmental processes are often pictured as generalizable patterns (also called normative change), and they appear when most people exhibit similar changes (e.g., in terms of mean-level change) during a specific period of time (Caspi & Roberts, 1999). For instance, in childhood and adolescence, generalizable patterns commonly result from maturational processes (e.g., biological changes; Crone & Dahl, 2012), interactions with others (e.g., peers, parents, and teacher), and environment (e.g., kindergarten, school; Wigfield et al., 2015). With regards to academic effort, some longitudinal studies (e.g., Rieger et al., 2017; Upadyaya & Salmela-Aro, 2013; Wang & Eccles, 2012a, 2012b) have investigated school engagement/academic effort over time, but only a few studies have examined the development of academic effort in terms of normative change.

What can be expected to happen to academic effort during adolescence? Previous studies have found declines in academic effort and engagement during the secondary school years (Rieger et al., 2017; Wang & Eccles, 2012a, 2012b). A typical explanation for decreasing engagement/effort during this period is an increase in the misfit between students' developing needs and the opportunities provided by their school environments as proposed by Stage-Environment Fit Theory (Eccles et al., 1993). Moreover, a shift in interest during adolescence to nonacademic domains (e.g., video games; Sharif et al., 2010) as well as the desire

to explore their own capabilities (e.g., showing risk behavior; Arnett, 1992) are additional potential explanations for why students show lower effort on school tasks as they get older. Finally, some students maintain high effort in some subjects but not in all subjects, and this may result in an average decline in effort across all subjects.

Conscientiousness and Individual Interest

Besides examining the developmental patterns of academic effort in math, German, and English, the second aim of this article was to predict variation in these patterns. For this purpose, we were particularly interested in conscientiousness and individual interest. Interest in a topic and conscientiousness are two influential variables in the fields of educational and personality psychology. It is widely accepted that both conscientiousness and individual interest have strong predictive effects on achievement and achievement-related behaviors (e.g., academic effort), but they have rarely been integrated theoretically or investigated simultaneously in empirical studies (Roberts, 2009). However, to understand individual differences in achievement and achievement-related outcomes such as academic effort, the simultaneous examination of conscientiousness and individual interest should be able to offer valuable insights (see Trautwein, Lüdtke, Kastens, & Köller, 2006).

Both conscientiousness and individual interest are driving forces that lead people to engage in activities. However, due to the different origins of the constructs, they differ in their conceptual levels (Roberts & Pomerantz, 2004). On the one hand, conscientiousness is conceptualized as an enduring, broad, and heritable personality trait, which is believed to be consistent across situations (e.g., McCrae & Costa, 2008a). On the other hand, topic-specific interests[27] are conceptualized as narrow, relevant only to a very specific context (e.g., a school subject), and derived almost exclusively from experience rather than genetics (Eccles & Wigfield, 2002; Hidi & Harackiewicz, 2000; Krapp, 2002). Accordingly, prevailing theoretical systems in psychology consider conscientiousness to be a dispositional trait, basic tendency, or core characteristic, whereas individual interest can be considered a surface characteristic or characteristic adaption (Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae & Costa, 2008a; for critical discussions regarding this distinction, see Kandler et al., 2014; Rieger et al., 2017; Roberts & Nickel, 2017).

[27] It is common to differentiate between situational and individual interest. Situational (or activated) interest is described as a certain condition that is caused by a stimulus in the environment. By contrast, individual interest is supposed to be a relatively stable motivational predisposition toward a certain domain/object (Hidi & Harackiewicz, 2000). In the present article, we focus on the latter.

One challenge when considering conscientiousness and individual interest as predictors is that conscientiousness and interests also change during the periods of childhood and adolescence (Soto, John, Gosling, & Potter, 2008; Wigfield et al., 2015). These periods are defined by fundamental changes in youths' lives (e.g., rapid biological changes, shifting demands in school life, initiation of new relationships with peers, etc.; Soto & Tackett, 2015). Consequently, it is not surprising that various longitudinal studies have shown heterogeneous but mostly decreasing mean-level changes in both conscientiousness and individual interest (Jacobs et al., 2002; Musu-Gillette et al., 2015; Soto et al., 2011; Van den Akker et al., 2014). In the present article, we considered these changes as co-development.

The Hypothesized Relation between Conscientiousness and Individual Interest in Predicting Academic Effort

To date, there are few studies that have considered conscientiousness and individual interest together in the same study to predict learning outcomes. Notable exceptions are Di Domenico and Fournier (2015), Sansone and Thoman (2006), and a multiple-study paper by Trautwein et al. (2015). In each of these articles conscientiousness and interest were used to predict learning outcomes such as academic effort or achievement. Although the design of these studies differed (both lab and classroom-based research was used), the interest measure varied (individual, "stable" interest vs. situational interest), and both between- and within-person designs were used, the studies have found consistent support for a compensatory pattern (Di Domenico & Fournier, 2015; Sansone et al., 2010; Trautwein et al., 2015). This compensatory pattern indicates that high levels on one of the predictors can (at least partly) compensate for low levels on the other predictor in terms of an "either/or" pattern (Cohen et al., 2003, p. 285). Based on these studies, Trautwein et al. (in press) formulated the CONscientiousness × Interest Compensation (CONIC) model to describe the interactive nature of conscientiousness and interest in predicting academic effort. The CONIC model postulates that individual interest will be less important for academic effort in students who are high in conscientiousness and vice versa (see alsoTrautwein et al., 2015).

What could explain this interactive mechanism? Conscientiousness and interest are both forces that drive individuals to engage in activities, but they are quite distinct on how they initiate activity. In particular, conscientiousness, being less context driven, reflects a default tendency to work hard in almost any achievement setting. Any challenge is an opportunity for a conscientious person to overcome obstacles. Thus, conscientiousness can be described as a domain-independent "built-in" push factor. By contrast, individual interest

draws people toward specific activities. People are interested in domains, and thus, they voluntarily spend additional time engaged in activities linked to this domain. They expect to experience positive emotions when they engage in these activities, and they experience these activities as energizing. Thus, individual interest can be described as a powerful emotional "pull factor" (Sansone et al., 1999; Sansone et al., 2010; Trautwein et al., 2015). For example, if a student is not interested in math but is conscientious, he or she will usually complete the required school task anyway. The "built-in push" factor of conscientiousness steps in and compensates for a lack of interest. Consequently, considering both qualities could offer promising insights for understanding the factors that influence the development of academic effort. To adequately examine the relation between the two qualities in predicting academic effort, it is important to take into account nonlinear effects in terms of an interaction effect.

The Present Study

In the present study, we examined the development of academic effort, and furthermore, we tested the unique and combined effects of conscientiousness and individual interest on the development of academic effort in the school subjects of math, German, and English in a large longitudinal study with four time points (Grades 5 to 8). We focused on three research questions. First, we examined the development of conscientiousness, individual interest and academic effort (in three school subjects) in terms of temporal stability and mean-level change over time. Our main focus was on the development of academic effort. In a second step, we investigated whether conscientiousness and individual interest uniquely and independently predicted changes in academic effort over time. Third, to test the CONscientiousness × Interest Compensation (CONIC) model in a longitudinal setting, we included the proposed interaction between conscientiousness and individual interest in the analyses. On the basis of previous research (see e.g., Domenico & Fournier, 2015; Trautwein et al., 2015), we expected support for the CONIC model; in other words, we expected to find support for a compensatory (negative) interaction between conscientiousness and individual interest in predicting change in academic effort across all three subjects. This would indicate that the effect of conscientiousness on the change in academic effort is stronger when individual interest is low and vice versa.

Method

Sample

We used data from a large longitudinal German study ("*Tradition and Innovation in Educational Systems*"; TRAIN; Jonkmann et al., 2013),[28] which is hosted by the Hector Research Institute of Education Sciences and Psychology at the University of Tübingen, Germany. TRAIN is a large-scale school achievement study that encompasses four time points (from Grades 5 to 8; T1, T2, T3, and T4). The study comprises 136 classes in 99 schools from two federal states (Baden-Württemberg and Saxony). Data were available for n = 2,894 (46% female) students at T1 (Grade 5; mean age M = 11.1 years, SD = 0.56), n = 2,936 (45% female) students at T2 (Grade 6), n = 2,993 (46% female) individuals at T3 (Grade 7), and n = 3,060 (46% female) students at T4 (Grade 8). The sample size of the pooled data set was N = 3,876. This data set contained all individuals who provided information at a minimum of one time point. Detailed Information regarding attrition analyses is reported in the Supporting Information (SI) Appendix A1.

The students were spread across the two federal states in the following way: In Baden-Württemberg, 43.2% of the students (n = 1,678, 46.8% of the students had at least one parent who was born in another country) came from the lower track ("Hauptschule"), and 22.7% (n = 881, 16.9% of the students had at least one parent who was born in another country) came from the intermediate track ("Realschule"). The remaining students (34.0%; n = 1,321, 4.6% of the students had at least one parent who was born in another country) attended multitrack schools ("Mittelschule") in Saxony. Multitrack schools are a combination of lower and intermediate track schools.

Instruments

Individual interest and academic effort in math, German, and English were assessed with four items each. The items were rated on a 4-point Likert scale ranging from 1 (*do not agree at all*) to 4 (*agree entirely*). The interest items focused on intrinsic value and interest in subject-related activities (e.g., "Working on math [German, English] tasks is fun for me"). The items from the academic effort scales asked students to report their effort in meeting subject-specific tasks (e.g., "I do my best when it comes to math [German, English]"). Consci-

[28] Other published papers have used the same data set (e.g., Göllner et al., 2016; Rieger et al., 2017; Trautwein et al., 2015). However, the main research question (what explains the variation in the developmental patterns in academic effort across three school subjects) has not been addressed previously. Consequently, the main analyses from the present paper have not been reported yet.

entiousness (e.g., “I see myself as someone who does a thorough job”) was measured with the German version (Lang et al., 2001) of the Big Five Inventory (John et al., 1991). The nine items were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). We applied a linear transformation (scale = 3/4 + 0.25) to convert the 5-point Likert scale into a scale with a minimum of 1 and a maximum of 4 so that we could compare it with the interest measure. In line with findings from other studies (Rieger et al., 2017; Trautwein et al., 2015), the four negatively worded items showed negative or low item-total correlations (all *rs* < .22; see also in the SI Appendix C of Rieger et al., 2017 for a detailed examination of the item properties). Thus, we used only the positively worded items. However, we also reran all of our analyses with the complete set of items and the main results remained virtually unchanged.

Sample items, the number of items, and Cronbach’s alpha (ranging from .55 to .90) for all four time points are also presented in Table S3 in the SI Appendix A2.

Statistical Analyses

We estimated all models in the framework of longitudinal confirmatory factor analyses and used full information maximum likelihood estimation with robust standard errors (MLR; using Mplus 7.31; Muthén & Muthén, 1998-2012). To make the missing at random (MAR) assumption more plausible, we included several auxiliary variables (Collins et al., 2001) in all analyses (e.g., standardized achievement tests, grades, socioeconomic status, gender, etc.). Statistical tests were performed two-sided and used the 5% level of significance.

The analytical procedure encompassed three steps: First, to properly interpret latent variable change in the longitudinal models, we had to establish at least strong measurement invariance (Meredith, 1993; Meredith & Teresi, 2006). Thus, we specified four-dimensional latent state models (Steyer, Ferring, & Schmitt, 1992) with strong measurement invariance imposed (the same loadings and intercepts for each indicator/parcel over time) for each construct in one model. From this model, we derived means, standard deviations, as well as latent rank-order correlations between all three constructs. Second, to investigate the unique and combined effects of individual interest and conscientiousness on the development of academic effort, we estimated three latent change models separately for each subject (math, German, and English; for a graphical representation, see Figure 1). In each latent change

model, we predicted the change components from one time point to the next for all three variables by the previous states of all three variables.

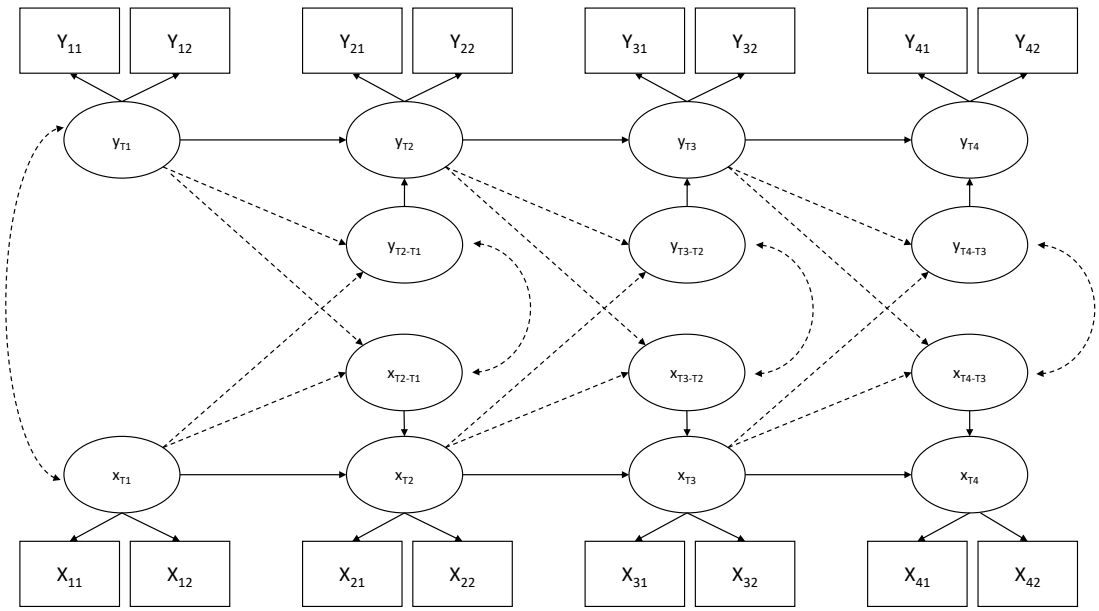

Figure 1. Simplified presentation: The estimated model is extended by a third construct. The mean structure, residual variances, and correlated uniqueness are not depicted. Solid paths are fixed to 1. Dashed paths were estimated. Indicators represent item parcels.

Third, to answer the research question about the interaction between individual interest and conscientiousness, we additionally included a latent interaction term between individual interest and conscientiousness. For this purpose, we applied latent moderated structural (LMS) equations (Klein & Moosbrugger, 2000; for a comparison of different approaches that can be applied to model latent interactions, see e.g., Cham, West, Ma, & Aiken, 2012; Kelava et al., 2011). It should be noted that it is not possible to simultaneously consider auxiliary variables when modeling latent interaction terms. Thus, a reduced sample size (N = 3,518) was used for these analyses.

To assess model fit, we relied mainly on the common fit indices used with latent variable models: The comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR; Hu & Bentler, 1998). According to Hu and Bentler's (1999) recommendations, a good fit is indicated by values equal to or greater than 0.95 for the CFI/TLI and equal to or less than 0.05 for RMSEA/SRMR. For models with latent interactions, one might use the AIC and BIC for model evaluation.

To reduce model complexity, we decided to build two-item parcels per time point for all constructs. To construct balanced item parcels, we followed the *Item-to-Construct Balance* parceling strategy (see Little et al., 2002). Consequently, we constructed item parcels by considering the relative balance between loadings and intercepts. We started with the highest and then added the other items to the anchor item in inverted order. To control for the specific item parcel variance over time, we used the correlated uniqueness approach (Cole et al., 2007). To evaluate our strategy, we conducted additional analyses to carefully check the impact of parceling. Thus, we specified all models on the indicator level and reran all analyses. The main results were virtually unaltered.

In the present study, students were nested within classes, and thus, students within a class were not independent from each other (i.e., students within classes tend to be more similar than students from different classes; Raudenbush & Bryk, 2002). This meant that our data had a multilevel structure, and failing to consider this structure could lead to an underestimation of the standard errors (see e.g.,). However, we were not interested in contextual effects and thus relied on single-level analyses with cluster-robust standard errors (McNeish et al., 2016) as implemented in Mplus. In addition, before we conducted any analyses, we examined the intraclass correlation coefficients (ICCs). The ICCs for individual interest, academic effort, and conscientiousness were rather small and ranged from .02 to .09.

Results

Developmental Patterns of Academic Effort, Interest, and Conscientiousness

With reference to developmental patterns in terms of temporal stability and mean-level change over time, we specified four-dimensional latent state models in which we imposed strong measurement invariance (i.e., the loadings and intercepts were the same over time) for each construct in one model. The model fits the data well, $\chi^2(1023) = 2684.20$, CFI = 0.98, TLI = 0.97, RMSEA = 0.02, and SRMR = 0.04 (see also Table S4 in the SI Appendix B1 for an overview of the model fit criteria for all fitted models). Tables 1 and 2 present the means, standard deviations, and mean differences between the time points as well as the latent rank-order correlations of all constructs (see also Figure S1 in the SI Appendix B2 for an overview). The means of all constructs decreased consistently over time. In one school year, the strongest decrease was found for interest (math: $d_{T2\text{-}T1}$ = -0.36, $d_{T3\text{-}T2}$ = -0.19, $d_{T4\text{-}T3}$ = -0.17, German: $d_{T2\text{-}T1}$ = -0.31, $d_{T3\text{-}T2}$ = -0.17, $d_{T4\text{-}T3}$ = -0.14, and English: $d_{T2\text{-}T1}$ = -0.30, $d_{T3\text{-}T2}$ = -0.22, $d_{T4\text{-}T3}$ = -0.11), followed by academic effort (math: $d_{T2\text{-}T1}$ = -0.26, $d_{T3\text{-}T2}$ = -0.08, $d_{T4\text{-}T3}$

= -0.19, German: $d_{T2\text{-}T1}$ = -0.21, $d_{T3\text{-}T2}$ = -0.07, $d_{T4\text{-}T3}$ = -0.16, and English: $d_{T2\text{-}T1}$ = -0.32, $d_{T3\text{-}T2}$ = -0.13, $d_{T4\text{-}T3}$ = -0.14), and conscientiousness ($d_{T2\text{-}T1}$ = -0.10, $d_{T3\text{-}T2}$ = -0.06, $d_{T4\text{-}T3}$ = -0.14).

Table 1
Means, Standard Deviations, and Mean-Level Change for All Constructs

Construct	T1		T2		T3		T4	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
EFF in M.	3.28 [3.25, 3.31]	0.53 [0.50, 0.55]	3.13 [3.09, 3.16]	0.59 [0.57, 0.62]	3.08 [3.04, 3.11]	0.63 [0.60, 0.66]	2.95 [2.91, 2.99]	0.68 [0.65, 0.70]
EFF in G.	3.29 [3.26, 3.33]	0.53 [0.51, 0.56]	3.17 [3.13, 3.22]	0.61 [0.57, 0.64]	3.13 [3.09, 3.17]	0.68 [0.65, 0.71]	3.02 [2.98, 3.06]	0.66 [0.63, 0.69]
EFF in E.	3.35 [3.31, 3.39]	0.56 [0.53, 0.59]	3.21 [3.17, 3.25]	0.61 [0.58, 0.64]	3.13 [3.09, 3.17]	0.68 [0.64, 0.70]	3.04 [3.00, 3.08]	0.68 [0.65, 0.71]
INT in M.	3.15 [3.12, 3.19]	0.51 [0.48, 0.54]	2.96 [2.92, 2.99]	0.57 [0.54, 0.59]	2.84 [2.81, 2.88]	0.61 [0.58, 0.63]	2.74 [2.7, 2.78]	0.61 [0.58, 0.63]
INT in G.	3.05 [3.01, 3.08]	0.50 [0.48, 0.52]	2.88 [2.84, 2.92]	0.57 [0.54, 0.60]	2.78 [2.73, 2.82]	0.62 [0.59, 0.65]	2.69 [2.66, 2.73]	0.56 [0.53, 0.59]
INT in E.	3.10 [3.06, 3.15]	0.55 [0.52, 0.58]	2.93 [2.89, 2.97]	0.60 [0.58, 0.63]	2.79 [2.75, 2.83]	0.64 [0.61, 0.67]	2.72 [2.69, 2.76]	0.60 [0.57, 0.63]
CON	2.93 [2.89, 2.96]	0.55 [0.52, 0.57]	2.87 [2.84, 2.91]	0.56 [0.54, 0.58]	2.84 [2.81, 2.88]	0.55 [0.53, 0.58]	2.76 [2.73, 2.79]	0.53 [0.51, 0.55]

Table 1 (continued)
Means, Standard Deviations, and Mean-Level Change for All Constructs

Construct			T1 to T2		T2 to T3		T3 to T4	
			Δ	*d*	*Δ*	*d*	*Δ*	*d*
EFF in M.	--	--	-0.15 [-0.12, -0.18]	-0.26 [-0.21, -0.32]	-0.05 [-0.02, -0.08]	-0.08 [-0.03, -0.13]	-0.12 [-0.09, -0.16]	-0.19 [-0.14, -0.24]
EFF in G.	--	--	-0.12 [-0.09, -0.15]	-0.21 [-0.15, -0.26]	-0.05 [-0.02, -0.08]	-0.07 [-0.02, -0.12]	-0.11 [-0.07, -0.14]	-0.16 [-0.11, -0.21]
EFF in E.	--	--	-0.13 [-0.09, -0.18]	-0.23 [-0.16, -0.30]	-0.08 [-0.05, -0.12]	-0.13 [-0.07, -0.19]	-0.09 [-0.05, -0.13]	-0.14 [-0.08, -0.19]
INT in M.	--	--	-0.20 [-0.16, -0.23]	-0.36 [-0.29, -0.43]	-0.11 [-0.08, -0.15]	-0.19 [-0.14, -0.25]	-0.10 [-0.07, -0.14]	-0.17 [-0.11, -0.23]
INT in G.	--	--	-0.17 [-0.13, -0.21]	-0.31 [-0.24, -0.38]	-0.10 [-0.07, -0.14]	-0.17 [-0.11, -0.23]	-0.08 [-0.05, -0.12]	-0.14 [-0.08, -0.20]
INT in E.	--	--	-0.18 [-0.13, -0.22]	-0.30 [-0.23, -0.38]	-0.14 [-0.10, -0.18]	-0.22 [-0.16, -0.28]	-0.07 [-0.03, -0.1]	-0.11 [-0.05, -0.16]
CON	--	--	-0.05 [-0.02, -0.08]	-0.10 [-0.04, -0.15]	-0.03 [0.00, -0.06]	-0.06 [0.00, -0.12]	-0.08 [-0.05, -0.10]	-0.14 [-0.09, -0.19]

Note. *N* = 3,876. EFF = Effort; INT = Individual Interest; CON = Conscientiousness. M = Math; G = German; E = English.
Values in brackets are 95% confidence intervals.

In line with previous research (Rieger et al., 2017)[29], the latent rank-order correlations were comparable across all three constructs, ranging from .41 to .56 for effort, .47 to .63 for interest, and .53 to .55 for conscientiousness. These coefficients indicated a moderate 1-year stability.

Table 2
Latent Rank-Order Correlations for All Constructs

Construct	r_{12}	r_{23}	r_{34}
EFF in M.	.50 [.44, .55]	.56 [.51, .62]	.55 [.51, .59]
EFF in G.	.51 [.45, .56]	.52 [.47, .57]	.51 [.46, .56]
EFF in E.	.41 [.36, .47]	.50 [.45, .56]	.53 [.47, .58]
INT in M.	.54 [.47, .61]	.63 [.57, .69]	.58 [.53, .63]
INT in G.	.57 [.51, .63]	.62 [.56, .67]	.53 [.47, .60]
INT in E.	.47 [.41, .53]	.58 [.52, .63]	.52 [.46, .57]
CON	.53 [.48, .58]	.55 [.50, .60]	.55 [.50, .60]

Note. N = 3,876. EFF = Effort; INT = Individual Interest; CON = Conscientiousness. M = Math; G = German; E = English.
All coefficients are statistically significantly different from 0 ($p < .05$, two-tailed). Values in brackets are 95% confidence intervals.

In sum, all three constructs showed moderate 1-year rank-order stability coefficients (ranging from .41 to .63) with consistent declines over time. In the next step, we used conscientiousness and individual interest to explain the variation in the change components for academic effort.

[29] Rieger et al. (2017) used the same data set as the present article, why the results regarding the stability of the constructs are highly similar. The results differ somewhat because Rieger et al. (2017) conducted analyses on the manifest level whereas the results of the present article are based on latent variable models.

Unique Effects of Conscientiousness and Individual Interest on the Development of Academic Effort

To examine our second research question, which addressed the unique effects of conscientiousness and individual interest on academic effort, we estimated three latent change models (separately for math, German, and English; for a graphical representation, see Figure 1). With these models, we predicted the change components for all constructs from the previous latent state variables of the three constructs. All models fit the data well (CFIs > 0.95, TLIs > 0.95, RMSEAs < 0.04, and SRMRs ≤ 0.06; see Table S4 in the SI Appendix B1).

Table 3 presents the result of all models that predicted change in academic effort (for the results for individual interest and conscientiousness, see Tables S5 and S6 in the SI Appendices B3 and B4). The significant negative change parameters for academic effort in math (Δ = -0.11 to -0.18) were significantly and positive predicted by math interest (b = 0.16 to 0.31, except for T2 to T3, where there was no significant effect) and conscientiousness (b = 0.15 to 0.19) at all time points, controlling for previous levels of academic effort in math (see Model 1 in Table 3). This indicates that high values in both individual interest and conscientiousness were associated with a smaller decrease in academic effort in math.

For effort in German, again, all change parameters were negative and statistically significantly different from zero (Δ = -0.08 to -0.18). When we controlled for previous levels of effort in German, the change parameters were positively and significantly predicted by interest in German (b = 0.15 to 0.22) and conscientiousness (b = 0.21 to 0.31). No statistically significant effect was found for interest on the change in effort from T3 to T4 (see Model 3 in Table 3).

Finally, the change components for effort in English ranged from Δ = -0.14 to -0.19 and were all statistically significantly different from zero. When we controlled for previous levels of effort in English, interest in English (b = 0.16 to 0.20) and conscientiousness (b = 0.23 to 0.27) were statistically significant predictors of the change in academic effort in English. Again, there was no statistically significant effect of interest on the change in effort from T3 to T4 (see Model 5 in Table 3).

In sum, the results show that when individual interest and conscientiousness were higher, the decrease in academic effort across the three subjects of math, German, and English was smaller.

Table 3

Predicting Change in Academic Effort

	Effort in Math (Model 1 and 2)					
	Change from T1 to T2		Change from T2 to T3		Change from T3 to T4	
Intercept (Δ)	**-0.16 [-0.19, -0.12]**	**-0.15 [-0.18, -0.11]**	**-0.11 [-0.14, -0.08]**	**-0.10 [-0.14, -0.06]**	**-0.18 [-0.22, -0.14]**	**-0.18 [-0.22, -0.14]**
EFF in M	**-0.73 [-0.86, -0.59]**	**-0.771 [-0.92, -0.62]**	**-0.57 [-0.73, -0.40]**	**-0.64 [-0.82, -0.46]**	**-0.61 [-0.74, -0.48]**	**-0.65 [-0.78, -0.51]**
INT in M	**0.31 [0.18, 0.44]**	**0.33 [0.19, 0.47]**	0.13 [-0.04, 0.29]	**0.18 [0.00, 0.35]**	**0.16 [0.02, 0.29]**	**0.17 [0.04, 0.30]**
CON	**0.15 [0.07, 0.24]**	**0.17 [0.09, 0.26]**	**0.19 [0.10, 0.28]**	**0.19 [0.10, 0.28]**	**0.19 [0.11, 0.26]**	**0.17 [0.09, 0.24]**
CON X INT in M		-0.10 [-0.22, 0.02]		**-0.12 [-0.24, -0.00]**		**-0.10 [-0.20, -0.01]**

Table 3 (continued)

Predicting Change in Academic Effort

	Effort in German (Model 3 and 4)					
	Change from T1 to T2		Change from T2 to T3		Change from T3 to T4	
Intercept (Δ)	**-0.12 [-0.16, -0.09]**	**-0.13 [-0.15, -0.08]**	**-0.08 [-0.11, -0.05]**	**-0.10 [-0.12, -0.04]**	**-0.18 [-0.21, -0.14]**	**-0.21 [-0.24, -0.14]**
EFF in G	**-0.62 [-0.74, -0.50]**	**-0.67 [-0.80, -0.55]**	**-0.65 [-0.77, -0.54]**	**-0.70 [-0.82, -0.57]**	**-0.67 [-0.77, -0.57]**	**-0.68 [-0.78, -0.58]**
INT in G	**0.15 [0.02, 0.29]**	**0.20 [0.07, 0.33]**	**0.22 [0.10, 0.34]**	**0.24 [0.12, 0.37]**	0.07 [-0.04, 0.17]	0.07 [-0.03, 0.18]
CON	**0.21 [0.13, 0.30]**	**0.22 [0.13, 0.30]**	**0.22 [0.13, 0.30]**	**0.20 [0.11, 0.28]**	**0.31 [0.24, 0.39]**	**0.30 [0.22, 0.37]**
CON X INT in G		**-0.19 [-0.34, -0.05]**		**-0.16 [-0.26, -0.06]**		-0.06 [-0.16, 0.04]

Table 3 (continued)

Predicting Change in Academic Effort

	Effort in English (Model 5 and 6)					
	Change from T1 to T2		Change from T2 to T3		Change from T3 to T4	
Intercept (Δ)	**-0.14 [-0.18, -0.10]**	**-0.13 [-0.17, -0.09]**	**-0.14 [-0.17, -0.11]**	**-0.12 [-0.16, -0.09]**	**-0.19 [-0.23, -0.15]**	**-0.19 [-0.23, -0.15]**
EFF in E	**-0.81 [-0.94, -0.67]**	**-0.84 [-0.99, -0.70]**	**-0.66 [-0.80, -0.52]**	**-0.71 [-0.85, -0.57]**	**-0.64 [-0.76, -0.52]**	**-0.65 [-0.78, -0.52]**
INT in E	**0.20 [0.07, 0.32]**	**0.22 [0.09, 0.35]**	**0.16 [0.04, 0.28]**	**0.19 [0.06, 0.31]**	0.10 [-0.03, 0.23]	0.11 [-0.02, 0.24]
CON	**0.27 [0.18, 0.35]**	**0.28 [0.19, 0.37]**	**0.23 [0.14, 0.32]**	**0.21 [0.13, 0.30]**	**0.23 [0.16, 0.30]**	**0.23 [0.16, 0.30]**
CON X INT in E		-0.13 [-0.27, 0.01]		**-0.15 [-0.24, -0.06]**		-0.03 [-0.11, 0.05]

Note. N = 3,876 for Models 1, 3, and 5 and N = 3,518 for Models 2, 4, and 6. EFF = Effort; INT = Individual Interest; CON = Conscientiousness. M = Math; G = German; E = English; All coefficients are unstandardized. Coefficients in bold are statistically significantly different from 0 (p < .05, two-tailed). The values in brackets are 95% confidence intervals.

Combined Effects of Conscientiousness and Individual Interest on the Development of Academic Effort

To address the third research question (i.e. the CONIC model which postulates a compensatory effect among conscientiousness and individual interest in predicting change in academic effort in math, German, and English), we included latent interaction terms between conscientiousness and individual interest at T1, T2, and T3 to test for compensatory effects. For models with latent interactions, the common fit indices such as the CFI, TLI, RMSEA, and SRMR are not defined. Furthermore, because it is not possible to simultaneously consider auxiliary variables when modeling latent interaction terms, a reduced sample size (N = 3,518) was used for these analyses. However, the AIC and BIC can be used for model evaluation. To adequately compare the latent interaction models with the latent change models, we reran all latent change models without auxiliary variables (see Table S4 in the SI Appendix B1).

The effect of the interaction between interest and conscientiousness on the change in academic effort was statistically significant in math from T2 to T3 (b = -0.12, [-0.24, -0.003]) and from T3 to T4 (b = -0.10, [-0.20, -0.01]). Statistically significant interactions were found in German from T1 to T2 (b = -0.19, [-0.34, -0.05]) and from T2 to T3 (b = -0.16, [-0.26, -0.06]) and in English from T2 to T3 (b = -0.15, [-0.24, -0.06]; see also Table 4). In line with the predictions of the CONIC model, the statistically significant interactions indicate that conscientiousness and interest moderated each other's predictive effects on the change in academic effort across the three school subjects. Thus, the positive effect of conscientiousness on the development of academic effort was stronger when interest was low, or vice versa, the positive effect of interest on the development of academic effort was stronger when conscientiousness was low. In total, compensatory effects were found for five out of the nine instances in which they were tested, which should be viewed as substantial support for the CONIC model. However, it should be noted that the 95% CIs for the interaction terms were relatively large due to the high complexity of the model (three latent interactions in one model). All interaction effects were in the expected direction, but four did not reach statistical significance.

Discussion

In the present longitudinal study, we examined, first, the developmental patterns in academic effort in three central school subjects (math, German, and English) and, second, how these developmental patterns could be explained by two personal qualities, namely, conscientiousness and individual interest. In a third step, we tested how these two qualities interacted with each other in predicting the development of academic effort (i.e., we tested the CONIC model). The results were as follows: (a) We found that academic effort and individual interest in the school subjects of math, German, and English as well as conscientiousness decreased over a 3-year period of time. Furthermore, (b) both conscientiousness and interest significantly and positively predicted negative change in academic effort, even after previous levels of academic effort were controlled for. This indicates that higher values in individual interest and conscientiousness are associated with smaller decreases or even positive change in academic effort over time. Finally, (c) we found significant interactions between conscientiousness and individual interest in predicting change in academic effort in five out of nine situations across the school subjects. These findings provide partial support for the CONIC model and indicate that the effect of conscientiousness on academic effort is stronger when individual interest is low, and again, these findings held even after we controlled for previous levels of academic effort.

Decreasing Academic Effort Over Time

In line with previous engagement research, we found decreasing mean-level trajectories for academic effort during the secondary school years in each of the three school subjects of math, German, and English (Upadyaya & Salmela-Aro, 2013; Wang & Eccles, 2012a, 2012b). Typical explanations for these decreasing trends in engagement/effort are the increasing misfit between students' needs and the opportunities provided in their school environments (Eccles et al., 1993) as well as shifts in interests to other nonacademic domains during the period of adolescence. However, previous research has also reported substantial variation in these declines (Janosz, Archambault, Morizot, & Pagani, 2008), and external factors (e.g., support of teachers) that can explain the variation in these declines have been identified (Wang & Eccles, 2012b). The present article built on this research and investigated whether conscientiousness and individual interest could predict academic effort.

Prediction of Academic Effort Trajectories

Our results suggest that conscientiousness and individual interest play particularly important roles in explaining the variation in the declines in academic effort across the secondary school years. Both qualities explained a significant amount of variance, however, the predictive power of individual interest decreased slightly over time (i.e., it was partially non-significant), whereas the predictive power of conscientiousness remained the same (i.e., it was significant across all time lags and subjects). What could be a potential explanation for the slightly diminishing effects of individual interest? One interpretation is that being conscientious is a default internal tendency that is independent of specific topics and contexts and that leads students to work hard across domains. By contrast, interest in a specific subject is presumably a reflection of experience with that topic, and the motivational draw of that subject may be (more) difficult to maintain. However, it should be noted that individual interest at two of three time points significantly explained variation in change in academic effort after we controlled for previous levels of academic effort and conscientiousness, and the diminishing effects were rather small.

Not only do the results of the present article provide support for the prospective predictive power of both conscientiousness and interest on the development of academic effort, but they also strengthen the evidence that the two constructs may compensate for each other, as postulated in the CONIC model (Trautwein et al., in press). The results extend previous cross-sectional studies (Di Domenico & Fournier, 2015; Sansone et al., 1999; Sansone et al., 2010; Trautwein et al., 2015) that found support for this compensatory mechanism in cross-sectional studies. Thus, the CONIC model appears to be especially robust for the constructs of conscientiousness and interest. For example, if a student is not very interested in math but happens to be conscientious, this student's math effort will likely be comparable to the effort of a student who is interested in math but not conscientious. The self-controlling and self-regulating properties of conscientious people can stand in for a lack of interest. The reverse interpretation, however, is also conceivable: A student who is very interested in a specific school subject does not have to be conscientious in order to engage in this specific subject. Consequently, it is conceivable that these two personal resources can be substituted for each other. It is *sufficient* to have either a "built-in push" factor (being conscientious) or a powerful "pull factor" (being interested).

Educational Relevance: Conscientious or Interested?

The compensatory relation between conscientiousness and interest in predicting effort invites a follow-up question: What should be fostered: conscientiousness or interest? This question is difficult to answer, but again, conscientiousness and individual interest differ in their conceptual levels and also in how they initiate activity. Individual interest is narrow and is a domain-specific personal resource that draws people toward activities (e.g., doing interesting homework voluntarily). Due to the autonomous decision to do the activity, people experience positive emotions, and this "replenishes" their energy (Ryan & Deci, 2000). On the other hand, conscientiousness is a domain-independent personal tendency that leads people to overcome internal barriers (e.g., also doing undesirable homework) and to work hard in many settings. It is not hard to understand that such processes of overcoming something undesirable—dependent of the task—consume energy. Consequently, fostering interest seems to be preferable because it results in the experience of positive emotions, especially in the long run (Sansone, Weir, Harpster, & Morgan, 1992). Moreover, the fact that previous intervention research showed substantial effects on interest (Lazowski & Hulleman, 2016) makes interest a promising target of interventions. Finally, fostering interest appears especially intriguing because it can compensate for a lack of a conscientious internal tendency. However, as it is also well known that students are not interested in everything or in all subjects (domain-specificity of interest) and, moreover, that interventions on one domain can lead to unintended side effects in other domains (Gaspard et al., 2016), perhaps conscientiousness still needs to be considered. The extent to which conscientiousness is a good target for interventions is still unknown but is definitely worth exploring (Rieger et al., 2017; Roberts, Hill, & Davis, 2017). Finally, it should be mentioned that students who are both conscientious and interested still show the highest levels of effort and performance, and fostering either of these attributes does not mean that the other must be excluded.

Limitations and Future Directions

Although we used a large sample over a 3-year period of time in the current study, some limitations should be kept in mind when interpreting the results. First, we should note that students in the highest school track in Germany (i.e., the Gymnasium) did not participate in the study. It is possible that different contexts (e.g., distinct educational experiences) might have a different impact on the development of academic effort as well as on the mutual impact of interest and conscientiousness. Regardless, focusing on students from lower and intermediate tracks seems to be especially important because these are the populations that

require special attention with regard to academic success and educational attainment (Carbonaro, 2016).

Second, we used only the positively worded items from the conscientiousness scale because the negatively worded items demonstrated low, zero, or even negative item-total correlations. Despite the fact that several robustness analyses showed comparable results (e.g., analyses on the indicator level and analyses with all conscientiousness items), future studies should test this relation with alternative measures of personality (e.g., NEO-FFI or NEO-PI).

In addition, all three constructs were assessed with self-reports. Self-reports are commonly used to measure constructs such as effort, individual interest, and also conscientiousness. However, shared method variance might influence the associations between the constructs. Hence, it is important for future studies to examine these relations also with different methods (e.g., peer and teacher reports or observation measures). However, given the focus on students' interest as well as on perceived effort, self-reports are perhaps one of the most valid measures for adequately capturing the feelings and perceptions of the students.

Conclusion

Given that academic effort is a strong predictor of academic success, it is important to understand its development as well as potential antecedents. In line with previous research, we found that academic effort decreases during the secondary school years. However, we also identified two personal qualities (i.e., conscientiousness and individual interest) that serve as potential buffers against this decrease. Moreover, our results suggest that conscientiousness and individual interest can compensate for each other such that a tendency to be conscientious can make up for a low level of interest in a subject. Vice versa, a high level of interest in a subject can make up for low conscientiousness. Finally, our results highlight the idea that considering qualities from different research traditions can offer promising insights for understanding individual differences in important school outcomes such as academic effort.

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Supporting Information

Supporting Information A: Method

Supporting Information A1: Attrition Analyses

NOTE: This text passage was also published in Rieger et al. (2017), which used the same data set.

Table S1 shows the complete sample composition, including students who dropped out or joined the study late.

Table S1
Overview of Sample Composition

	T1 (Grade 5)	T2 (Grade 6)	T3 (Grade 7)	T4 (Grade 8)	Pooled data
Complete sample all variables	2,894	2,936	2,993	3,060	3,880
Dropped out of the study	--	-226	-359	-235	
Changed classes		8 (3.5%)	28 (7.8%)	10 (4.3%)	
Moved		63 (27.9%)	72 (20.1%)	66 (28.1%)	
Repeated a grade		39 (17.3%)	50 (13.9%)	46 (19.6%)	
Other / no information		116 (51.3%)	209 (58.2%)	113 (48.1%)	
Joined the study later	--	+268	+416	+302	
Changed classes		18 (6.7%)	98 (23.6%)	8 (2.6%)	
Moved		107 (39.9%)	65 (15.6%)	93 (30.8%)	
Repeated a grade		50 (18.7%)	28 (6.7%)	74 (24.5%)	
Changed classes		93 (34.7%)	225 (54.0%)	127 (42.1%)	

To examine possible differences between students who dropped out or joined the study after it had begun, we contrasted the continuers with students who dropped out or joined the study late. First, we compared students who dropped out of the study after they provided data at one time point with those who provided data at the next time point as well. This was done at all time points for the study variables and for several demographic variables (gender, SES) and achievement measures (grades, standardized achievement tests in German and math). Significant differences between these groups are displayed in Table S2.

Table S2
Differences (Cohen's d) between Students who Dropped Out or Joined the Study Late with the Continuers

	T1 » T2	T2 » T3	T3 » T4
Dropouts	*n* = 226	*n* = 359	*n* = 310
Gender (male = 1)	--	--	--
Socioeconomic status	--	-0.18	--
Math grade	0.20	0.48	0.69
German grade	--	0.58	0.70
English grade	--	0.31	0.61
Math achievement	-0.22	-0.34	-0.56
German achievement	-0.21	-0.23	-0.40
Big Five	--	--	--
Conscientiousness	0.17	--	-0.23
Neuroticism	0.17	0.20	0.32
Openness	0.25	--	-0.19
Agreeableness	--	--	-0.18
Extraversion	--	--	--
Social cognitive constructs	--	--	--
Self-concept in math	--	-0.15	-0.41
Self-concept in German	0.16	-0.13	--
Self-concept in English	--	--	-0.27
Interest in math	0.19	--	--
Interest in German	0.17	0.13	--
Interest in English	--	--	--
Effort in math	--	-0.23	-0.35
Effort in German	--	--	--
Effort in English	--	--	-0.29

Table S2 (continued)
Differences (Cohen's d) between Students who Dropped Out or Joined the Study Late with the Continuers

	T1 » T2	T2 » T3	T3 » T4
Joined the study late	*n* = 429	*n* = 424	*n* = 302
Gender (male = 1)	OR = 1.36	--	--
Socioeconomic status	--	0.14	--
Math grade	0.68	0.29	0.84
German grade	0.60	0.36	0.65
English grade	0.64	0.38	0.64
Math achievement	-0.22	--	--
German achievement	-0.18	--	--
Big Five			--
Conscientiousness	--	--	-0.25
Neuroticism	0.17	--	--
Openness	--	--	--
Agreeableness	--	--	-0.31
Extraversion	--	--	--
Social cognitive constructs			
Self-concept in math	--	--	-0.23
Self-concept in German	-0.15	-0.14	--
Self-concept in English	--	-0.17	--
Interest in math	--	--	--
Interest in German	--	--	-0.19
Interest in English	--	--	--
Effort in math	--	--	-0.35
Effort in German	-0.25	--	-0.32
Effort in English	--	-0.17	-0.18

Overall, the differences between continuers and dropouts ranged from d = -0.32 to 0.49 and between students who joined the study late and students who were already in the study from d = -0.35 to 0.84. Due to the fact that a considerable proportion (13.9% to 24.5%) of the students dropped out or joined the study late because of grade repetition, the moderate

to huge effect sizes were not unexpected. However, to reduce possible biases in the parameter estimates, we used the full information maximum likelihood procedure (see e.g., Enders, 2001).

Supporting Information A2: Instruments

Table S3
Example Items, Number of Items, and Cronbach's Alpha for the Scales

Construct	Subject	Number of Items	Sample items (wording)	Cronbach's alpha (T1, T2, T3, T4)
			I see myself as someone who...	
Conscientiousness	--	*5 of 9*	...does a thorough job.	*.77, .80, .80, .80*
			What applies to you?	
	Math			*.56, .62, .68, .71*
Interest	*German*	*4*	"*Working on math [German, English] tasks is fun for me.*"	*.55, .65, .72, .71*
	English			*.62, .70, .74, .75*
	Math			*.79, .83, .85, .87*
Effort	*German*	*4*	"*I do my best when it comes to math [German, English].*"	*.81, .85, .89, .89*
	English			*.83, .86, .89, .90*

Note. Part of this table is also published in Rieger et al. (2017).

Supporting Information B: Results

Supporting Information B1: Model Fits

Table S4

Model Fit of the Models Tested

Nr.	Subject	Model	*N*	Estimated parameters	χ^2	*df*	*SCF*	CFI	TLI	RMSEA	SRMR	AIC	BIC
0	--	LS Model	3,876	629	2684,20	1023	1.12	0.98	0.97	0.02	0.04	359346.60	372723.4
1		LC Model	3,876	126	988.98	198	1.10	0.97	0.96	0.03	0.06	250229.00	256046.9
1.1	Math	LC Model[a]	3,518	126	976.31	198	1.11	0.97	0.95	0.03	0.06	93012.81	93789.68
2		LC Model[b]	3,518	129	--	--	--	--	--	--	--	93025.46	93820.83
3		LC Model	3,876	126	712.94	198	1.13	0.98	0.97	0.03	0.06	249845.3	255663.2
3.1	German	LC Model[a]	3,518	126	699.85	198	1.13	0.98	0.97	0.03	0.05	92365.95	93142.82
4		LC Model[b]	3,518	129	--	--	--	--	--	--	--	92367.23	93162.6
5		LC Model	3,876	126	731.00	198	1.13	0.98	0.97	0.03	0.06	252399.24	258217.161
5.1	English	LC Model[a]	3,518	126	725.45	198	1.13	0.98	0.97	0.03	0.05	94897.87	95674.74
6		LC Model[b]	3,518	129	--	--	--	--	--	--	--	94904.49	95699.86

Note. LS = Latent State Model; LC = Latent Change Model; SCF = Scaling Correction Factor for MLR.

[a]without auxiliary variables; [b]with latent interaction terms.

Supporting Information B2: Figures presenting the Latent State Models for Effort, Interest, and Conscientiousness

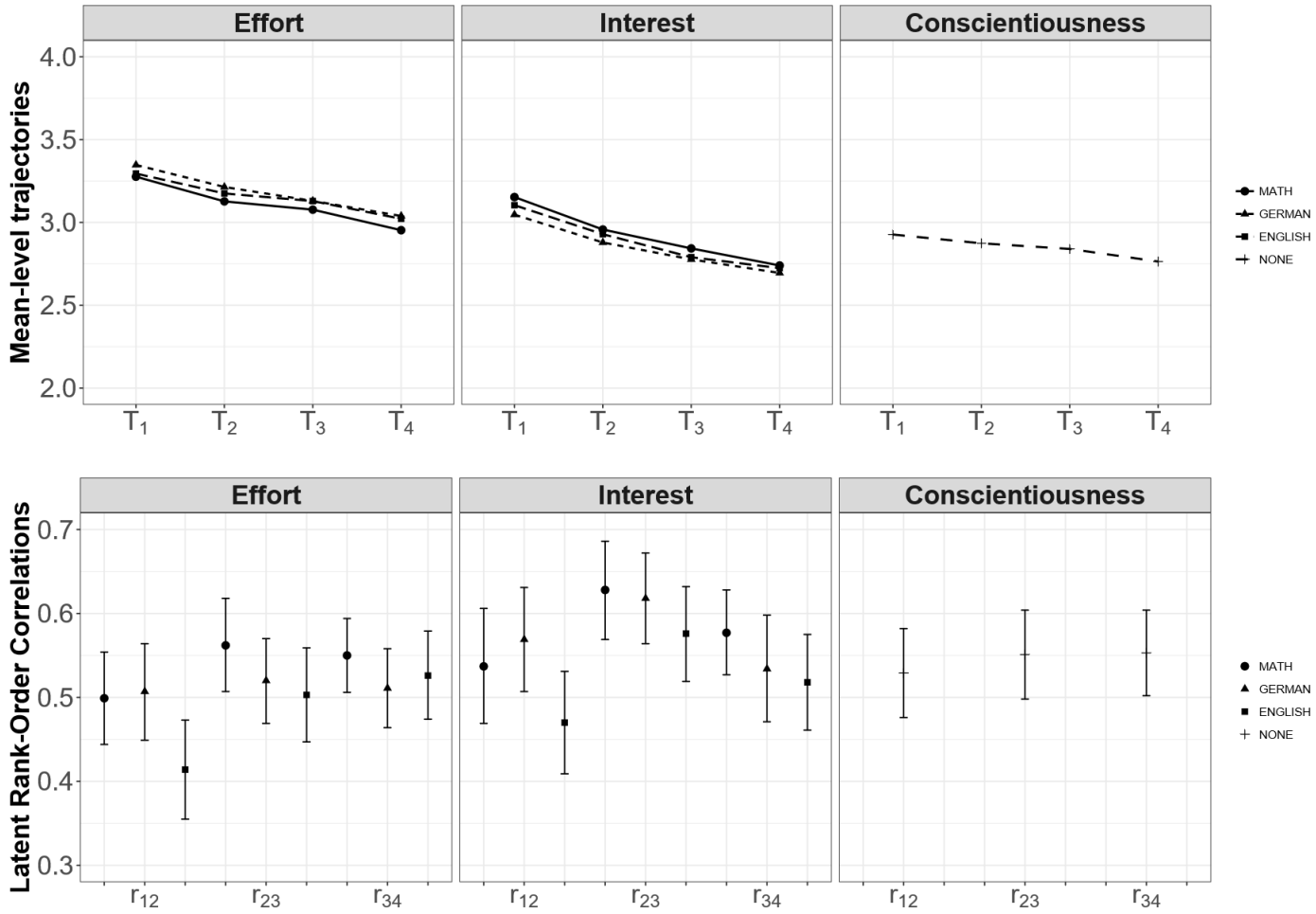

Figure S1. Mean-level trajectories and latent rank-order correlations for adjacent time points.

Supporting Information B3: Results of the Latent Change Models for Individual Interest

Table S5

Predicting Change in Individual Interest

	Individual Interest in Math (Model 1)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.20 [-0.23, -0.16]**	**-0.18 [-0.22, -0.15]**	**-0.24 [-0.28, -0.20]**
EFF in M	-0.03 [-0.16, 0.10]	-0.04 [-0.23, 0.14]	-0.03 [-0.18, 0.12]
INT in M	**-0.46 [-0.59, -0.32]**	**-0.33 [-0.52, -0.14]**	**-0.46 [-0.62, -0.31]**
CON	**0.11 [0.02, 0.19]**	**0.10 [0.01, 0.19]**	**0.14 [0.04, 0.23]**

Table S5 (continued)

Predicting Change in Individual Interest

	Individual Interest in German (Model 3)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.17** **[-0.21, -0.13]**	**-0.16** **[-0.19, -0.12]**	**-0.23** **[-0.26, -0.19]**
EFF in G	-0.06 [-0.18, 0.06]	-0.12 [-0.24, 0.00]	-0.04 [-0.14, 0.07]
INT in G	**-0.37** **[-0.52, -0.22]**	**-0.27** **[-0.40, -0.14]**	**-0.58** **[-0.70, -0.46]**
CON	**0.10** **[0.01, 0.19]**	**0.10** **[0.01, 0.20]**	**0.21** **[0.15, 0.27]**

Table S5 (continued)

Predicting Change in Individual Interest

	Individual Interest in English (Model 5)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.18** **[-0.22, -0.14]**	**-0.22** **[-0.25, -0.18]**	**-0.24** **[-0.27, -0.20]**
EFF in E	-0.12 [-0.26, 0.03]	-0.06 [-0.22, 0.10]	0.02 [-0.08, 0.13]
INT in E	**-0.49** **[-0.64, -0.35]**	**-0.40** **[-0.56, -0.24]**	**-0.59** **[-0.71, -0.47]**
CON	**0.21** **[0.11, 0.30]**	**0.15** **[0.05, 0.25]**	**0.15** **[0.07, 0.23]**

Note. N = 3,876 for all models. EFF = Effort; INT = Individual Interest; CON = Conscientiousness. M = Math; G = German; E = English; All coefficients are unstandardized. Coefficients in bold are statistically significantly different from 0 ($p < .05$, two-tailed). The values in brackets are 95% confidence intervals.

Supporting Information B4: Results from the Latent Change Models for Conscientiousness

Table S6

Predicting Change in Conscientiousness

	Conscientiousness (Model 1)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.06 [-0.09, -0.02]**	**-0.05 [-0.08, -0.02]**	**-0.11 [-0.14, -0.07]**
EFF in M	**0.15 [0.05, 0.25]**	**0.22 [0.10, 0.34]**	0.09 [-0.01, 0.20]
INT in M	0.06 [-0.05, 0.17]	-0.10 [-0.23, 0.02]	-0.02 [-0.11, 0.08]
CON	**-0.55 [-0.62, -0.47]**	**-0.50 [-0.57, -0.42]**	**-0.50 [-0.57, -0.44]**

Table S6

Predicting Change in Conscientiousness

	Conscientiousness (Model 3)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.06 [-0.09, -0.02]**	**-0.05 [-0.08, -0.02]**	**-0.11 [-0.14, -0.07]**
EFF in G	**0.14 [0.03, 0.25]**	**0.17 [0.08, 0.27]**	**0.09 [0.02, 0.17]**
INT in G	0.12 [0.00, 0.24]	-0.05 [-0.16, 0.05]	-0.01 [-0.10, 0.08]
CON	**-0.56 [-0.64, -0.48]**	**-0.49 [-0.56, -0.42]**	**-0.51 [-0.58, -0.45]**

Table S6

Predicting Change in Conscientiousness

	Conscientiousness (Model 5)		
	Change from T1 to T2	Change from T2 to T3	Change from T3 to T4
Intercept (Δ)	**-0.05** **[-0.08, -0.02]**	**-0.05** **[-0.08, -0.02]**	**-0.11** **[-0.14, -0.08]**
EFF in E	0.01 [-0.10, 0.12]	**0.20** **[0.09, 0.32]**	**0.08** **[0.00, 0.17]**
INT in E	**0.15** **[0.04, 0.26]**	**-0.14** **[-0.25, -0.02]**	-0.01 [-0.10, 0.09]
CON	**-0.51** **[-0.58, -0.44]**	**-0.47** **[-0.54, -0.40]**	**-0.51** **[-0.58, -0.44]**

Note. N = 3,876 for all models. EFF = Effort; INT = Individual Interest; CON = Conscientiousness. M = Math; G = German; E = English; All coefficients are unstandardized. Coefficients in bold are statistically significantly different from 0 ($p < .05$, two-tailed). The values in brackets are 95% confidence intervals.

6 GENERAL DISCUSSION

Economists and educational researchers discovered that noncognitive factors such as interests, self-concepts, and conscientiousness are both interesting and relevant because of the evidence that these types of constructs can be used to predict important human-capital outcomes such as school performance and school functioning (see e.g., Almlund et al., 2011; Eccles & Wigfield, 2002; Kautz et al., 2014). Given the impact of these factors, the discussion quickly turned to how these factors can be changed, enhanced and fostered. There is an especially strong focus on the periods of childhood and adolescence (Heckman & Kautz, 2012) because these are the periods that are defined by fundamental changes and rapid development (Roberts & Pomerantz, 2004; Soto & Tackett, 2015). The ongoing changes in development are potential sources of instability and also mutability, thus rendering these periods ideal for studies. Moreover, from the viewpoint of economics, investing in young students will pay off because larger gains can be expected throughout the life course (Cunha & Heckman, 2010). However, the group of noncognitive factors reflects an inclusive conglomerate of variables, and researchers have yet to clearly determine which constructs are best to foster. It was recently claimed that a construct's malleability is one precondition for applying an intervention (Bailey et al., 2017). The umbrella of noncognitive factors includes a variety of constructs including personality traits and social cognitive variables. The inclusive grouping of concepts belies the often stark theoretical and conceptual distinctions dividing these constructs when used in research. For instance, the Big Five personality traits originate from trait theories, and constructs such as self-concepts and interests come from theoretical models that take a social cognitive perspective. Whereas traits are often defined as stable and cross-situationally consistent (McCrae & Costa, 2008b), social cognitive constructs are conceptualized as less stable, relevant to very specific contexts, and derived almost exclusively from experience (Bandura, 2001b; Eccles & Wigfield, 2002). In addition, because of their different origins, it is uncommon to find both types of constructs included in the same study (Roberts, 2009). This has created an asymmetry in the understanding of how changeable and malleable (e.g., stable or context-sensitive) the two classes of constructs are. Testing these assumptions within the same study is a necessary step to achieve a deeper understanding about the changeability and malleability of both construct classes.

In an effort to address this issue, Studies 1 and 2 of the current dissertation tested two basic assumptions of the malleability (i.e., time-consistency and context-sensitivity) of the two classes of constructs. By contrast, Study 3 examined potential synergies when variables were considered from the two perspectives. Focusing on conscientiousness (a personality trait) and individual interest (a social cognitive variable) in predicting academic effort in three school subjects (math, German, and English), Study 3 investigated the (interactive) relation of these constructs in predicting an achievement-related construct in a longitudinal setting.

In the following, the findings of the three studies will be summarized and embedded in a broader research context. The discussion of these findings is organized around the three studies, which simultaneously reflect the two superordinate topics of the dissertation: (a) the stability and cross-situational consistency of personality traits and social cognitive constructs and (b) the emerging synergies when considering both types of constructs in predicting achievement-related behavior (e.g., academic effort). Readers who carefully read the three empirical studies (Chapters 3 to 5) might skip Chapter 6.1 and continue with Chapter 6.2. In Chapter 6.2, implications for educational practice are elaborated. The dissertation closes with directions for future research (Chapter 6.3).

6.1 Discussion of the Results

6.1.1 The time-consistency and context-sensitivity of traits and social cognitive constructs

In the first study, multiple indicators of the stability (i.e., rank-order correlations, trait-state variance proportions, and slope variances) of the Big Five personality traits and social cognitive constructs (i.e., subject-specific individual interest, self-concept, and academic effort) were examined and contrasted against each other. The results showed no meaningful differences in (a) the stability of the constructs at the manifest level (test-retest correlations), (b) the percentage of stable trait variance for the classes of constructs, and (c) the amount of change that students showed on each construct over time in the form of the average variance in the slopes. Consequently, the results from the first study suggested that there are no meaningful differences between the stability of social cognitive and personality trait variables in a sample of adolescent students.

The second study examined the context-sensitivity of social cognitive constructs and Big Five traits in two independent longitudinal studies (TRAIN and PISA-E). For this purpose, two indices of consistency (i.e., test-retest correlations and change in variance over time) were compared between students who got a new teacher in comparison with those who did not get a new teacher (i.e., to explore the influence of an environmental factor). First, (a) there were no differences in the test-retest correlations of math-related social cognitive constructs (except self-regulation) between the two groups. Furthermore, (b) there were no significant differences in the test-retest correlations for the Big Five personality traits (except extraversion). However, (c) significantly lower time-consistency for the group of students who got a new teacher on some of the German- and English-related social cognitive constructs (e.g., effort, interest, and self-concept) emerged. Finally, with regard to the comparison of the changes in variance over time, (d) there were no systematic differences (increases or decreases) within or between groups across the two studies.

In sum, the results of Study 1 suggest that, when tracked over equivalent periods of time using the same methods (i.e., self-reports), social cognitive constructs and personality traits show comparable levels of continuity and change in young childhood and early adolescence. This goes against the proposal that personality traits are more stable than social cognitive constructs (see, e.g., Asendorpf & van Aken, 2003; McAdams & Pals, 2006; McCrae & Costa, 2008b).

On the other hand, the results of Study 2 provided partial support for the idea that social cognitive variables are more susceptible to environmental changes (in terms of getting a new teacher) than the Big Five personality traits. The strongest effects were found for academic effort in the subjects of English and German which is in line with the strong relation between teacher behavior and student effort (Pianta et al., 2012). It is interesting, however, that the math-related social cognitive constructs (self-concept, interest, effort, and anxiety) were unaffected by the change in teachers. A potential explanation could be that math-related variables are more entwined with a person's ability. This would lead to a certain robustness against environmental influences (e.g., getting a new teacher). Moreover, there was no effect on the consistency of the broad Big Five personality traits (except for extraversion). Consequently, it can be concluded that there is no marked impact of this particular different contextual situation on the consistency of the Big Five personality traits in this particular study. What could explain the absence of an effect on personality traits? To recap the definition of personality traits by Roberts (2009), "*Personality traits are relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances*" (p. 140). The focus hereby should be directed toward the last part of the definition: "*under certain circumstances.*" Although different teachers show different characteristics (e.g., teaching styles, personalities etc.), it might be the case that the overall circumstances in the school setting (i.e., same class composition, same environment) are too similar to evoke different *patterns of thoughts, feelings, and behaviors*.

Overall, it can be concluded that there is only weak empirical support for the stark conceptual distinction between traits and social cognitive constructs. These findings corroborate other findings that have shown that other construct domains (e.g., goals, values, motives, or self-schemata, etc.) can be considered separate and independent domains of personality and not just by-products of personality traits (Bleidorn et al., 2010; Kandler et al., 2014; Lubinski, 2000; Roberts & Robins, 2000).

6.1.2 Relation between conscientiousness (a trait) and individual interest (a social cognitive construct) in predicting academic effort

The results of the third study demonstrated the beneficial effects of considering two constructs from different traditions in predicting the development of academic effort. Academic effort is a key variable in many theoretical models (see e.g., Eccles & Wigfield, 2002; Pintrich & de Groot, 1990) and it can be defined as the amount of time and energy that persons expend on academic tasks in terms of "*I do my best when it comes to …*" (Corno, 1986; Trautwein & Lüdtke, 2007). However, in line with previous research (Upadyaya & Salmela-Aro, 2013; Wang & Eccles, 2012a, 2012b), academic effort decreased during the secondary school years in all three school subjects (math, German, and English). Typical explanations for these decreasing trends in academic effort are the increasing misfit between students' needs and the opportunities provided in their school environments (Eccles et al., 1993). Moreover, during the period of adolescence, the interests of young students shift to other nonacademic domains (Arnett, 1992; Sharif et al., 2010), which also might lead them to put less effort toward school tasks.

Both conscientiousness and individual interest play particularly important roles in explaining the variation in the declines in academic effort across the secondary school years. Thus, when students showed higher values on individual interest and conscientiousness, the decrease in academic effort across the three subjects of math, German, and English was smaller. However, not only do the results provide support for the prospective predictive power of both conscientiousness and interest on the development of academic effort, but they also strengthen the evidence that the two constructs compensate for each other, as postulated by the CONIC model (see Trautwein et al., in press; see also Chapter 1.2.3). Consequently, the results extend previous cross-sectional studies (Di Domenico & Fournier, 2015; Sansone et al., 1999; Sansone et al., 2010; Trautwein et al., 2015). This implies that, for instance, if a student is not very interested in math but is conscientious, this student's math effort will likely be comparable to the effort of a student who is interested in math but not conscientious. The self-controlling and self-regulating attributes of conscientious people can compensate for their lack of interest. This relation also holds in a longitudinal setting.

In sum, the third study highlighted the idea that considering qualities from different research traditions offers promising insights for understanding individual differences in important school outcomes such as academic effort.

6.1.3 Strengths and limitations of the three empirical studies and future directions

When interpreting the results of the three studies conducted in this dissertation, it is important to keep some general strengths and limitations in mind. All three studies benefited from large-scale longitudinal study designs with *adequate* sample sizes. The inclusive strategy of data collection in large-scale studies offered the opportunity to contrast the Big Five personality traits against social cognitive constructs and also to investigate their combined effects (interaction effects) in a longitudinal setting. Moreover, the data were analyzed by applying state-of-the-art statistical models, which corrected for measurement error (latent variable models; Nagengast & Trautwein, 2015), took the multilevel nature of the data into account (cluster-robust standard errors; McNeish et al., 2016), and used a model-based approach to deal with missing data (full information maximum likelihood estimation; FIML; Enders, 2010). Nevertheless, there were also some noteworthy limitations that should be kept in mind.

First, it should be noted that students in the highest school track in Germany (i.e., the Gymnasium) did not participate in the TRAIN[30] study. It is possible that different contexts (e.g., distinct educational experiences) could have a different impact on the development (e.g., time-consistency) of social cognitive constructs or the Big Five personality traits as well as on the associations between these constructs. This represents a limit to the generalizability of the findings. Regardless, focusing on students from the lower and intermediate tracks seems to be especially important because these are the populations that require special attention with regard to academic success and educational attainment (Carbonaro, 2016).

Second, all three studies relied on self-reports. Self-reports provide valuable information (see e.g., Vazire, 2010) and are commonly used to measure social cognitive constructs (e.g., academic effort, individual interest, and self-concepts) and also the Big Five personality traits. Given the strong focus on a variety of social cognitive constructs (e.g., interest, perceived effort, and self-concept), self-reports are perhaps one of the most valid measures for adequately capturing students' feelings and perceptions. Moreover, using the same method helped to maintain the comparability of the two classes of constructs (traits and social cognitive constructs) in Studies 1 and 2. However, especially the measurement of the Big Five personality traits was difficult in the TRAIN study (i.e., adolescent sample). All negatively worded items from the Big Five Inventory

[30] By contrast, in the PISA-E study, students from the Gymnasium also participated. However, the Big Five personality traits were not assessed in this study.

(BFI; John et al., 1991; Lang et al., 2001) showed low, zero, or even negative item-total correlations. These results probably had to do with response biases in terms of acquiescence, or extreme responding. Although this issue has been discussed in the literature (Göllner et al., 2016; Soto et al., 2008), and several robustness analyses (e.g., analyses on the indicator level and analyses with all items) have shown comparable results, the administration of self-reports to young children clearly requires careful consideration (see also Chapter 6.3.2). Finally, using the same method (e.g., self-reports) for all constructs can come with problems, and this issue applied in particular to Study 3. The reliance on self-report might have inflated (i.e., due to shared method variance) the relations between conscientiousness, interest, and academic effort. Thus, it is important for future studies to examine these relations with different methods as well (e.g., peer and teacher reports or observation measures).

Finally, although it was one aim of this dissertation to compare the social cognitive constructs with the personality traits, it should be noted that these classes (obviously) differ in their conception and granularity. Whereas the Big Five traits are defined as broad, domain-general, higher order constructs (i.e., comprising several facets), social cognitive constructs are conceptualized as narrow and domain-specific. Researchers have not paid much attention to the extent to which the facets of personality traits are stable and changeable, especially in adolescence. Initial insights can be derived from the study by Jackson et al. (2009). They found that not all facets of conscientiousness changed in similar ways from early to later adulthood. However, research has yet to determine how stable and context-sensitive the facets are. Focusing on the lower levels of the Big Five personality traits can offer suitable insights for identifying and understanding the processes behind the broader traits.

6.2 Implications for Educational Practice

Multiple reviews have shown that noncognitive factors are critical for success in educational settings and that interventions should focus on them, especially in childhood and adolescence (Cunha & Heckman, 2010; Kautz et al., 2014). Bailey et al. (2017) argued that skill-building interventions should be targeted toward the so-called "trifecta" skills. Trifecta means that the variables should be *malleable*, *fundamental*, and *would not have developed eventually in the absence of the intervention.* It can be assumed that most of the noncognitive factors that emerged as predictors of important human capital outcomes such as school performance are fundamental (Almlund et al., 2011; Eccles & Wigfield, 2002; Kautz et al., 2014; Poropat, 2009). The assumption of the malleability of constructs, however, seem to be a bit more complicated. It is important to understand that the nature of the numerous constructs that are subsumed under the term noncognitive factors is far more diverse than those typically found in, for instance, cognitive skills. Moreover, behind the different classes of constructs in the noncognitive set, there are many assumptions. The most prevalent assumption is that personality traits are not changeable, whereas social cognitive constructs are changeable, and therefore, the latter should be the focus of interventions (Bailey et al., 2017; Pintrich, 2003; Whitehurst, 2016). Although neither Study 1 nor Study 2 directly tested whether either class of variables could be more easily changed through a direct intervention, both studies tested basic assumptions behind the stability, mutability, and context-sensitivity of these classes of constructs. Both studies showed no marked differences in stability and only small differences in context-sensitivity (in favor of the social cognitive constructs). Whereas this does not prove that personality traits can be changed through interventions or that social cognitive variables are difficult to change, it does suggest that a more open approach be used to consider which variables should be included in future intervention studies. This is particularly important for educational policymakers who are currently focused on how to best enhance noncognitive skills (Heckman & Kautz, 2012; Kautz et al., 2014).

If one is willing to accept that personality traits are not perfectly stable and it is possible to change them, the next questions are: Should we intervene, and if yes, for which traits, and how? To recap the definition of malleability from the Oxford English dictionary: something is malleable when it is *easily influenced* or when it could be *hammered or pressed into shape without breaking or cracking*. The latter part of the definition seems particularly important. Personality, broadly construed, reflects a broad and complex formation of psychological constructs (e.g., Shiner & Caspi, 2003; Shiner & De Young, 2013) and underlies rapid development in childhood

and adolescence (e.g., Roberts & Pomerantz, 2004; Soto & Tackett, 2015). What will happen if we intervene? It is hard to guess. However, by contrast, there are multiple intervention studies to enhance social cognitive constructs (e.g., interests and self-concepts; see, Lazowski & Hulleman, 2016; O'Mara et al., 2006) and there are few concerns that fostering and intervening with social cognitive constructs could be harmful to the development of young people (but see Gaspard et al., 2016; Marsh et al., 2016). Now, why should it be harmful to intervene with personality traits, especially when people are barely conscientious or highly neurotic? Nevertheless, intervening in personality traits should be done very carefully and with continuous evaluation. However, the same is true for social cognitive variables. The next question is: Which personality traits are best to focus on in interventions that are designed to enhance school functioning and school performance? The evidence speaks for openness, neuroticism, and most clearly for conscientiousness (e.g., de Raad & Schouwenburg, 1996; Noftle & Robins, 2007; Poropat, 2009). Fittingly, Roberts et al. (2017), for instance, proposed the sociogenomic trait intervention model (STIM), which offers a theoretically driven bottom-up approach[31] for changing conscientiousness. Putting it simply, they stated that the goal is to "*change the states associated with the trait in a way that ensures that the change is enduring*" (p. 200). The assumption is that targeting and activating core behaviors (which underlie the respective personality trait) in specific situations (states) and emphasizing the routinized practice of these behaviors would result in a consistent change in behavior over time (i.e., in the trait; for a detailed description, see also Magidson et al., 2014; for an empirical study regarding the relation between homework effort and the development of conscientiousness, see e.g., Göllner et al., 2017).

Enhancing and fostering conscientiousness seems promising not only because there is ample evidence of the positive effects of conscientiousness on academic performance (and other life domains such as work and health; Barrick & Mount, 1991; Kotov et al., 2010; Noftle & Robins, 2007; Roberts et al., 2007). There is also another line of research that has shown that conscientiousness is able to compensate (at least partly) for background disadvantages (resource substitution hypothesis; see e.g., Damian et al., 2015) and also for a lack of motivational resources such as interest (CONscientiousness × Interest Compensation; CONIC model, see e.g., Trautwein et al., in press; see also Chapter 1.2.3 and Study 3 in Chapter 5). The compensatory relation be-

[31] The STIM model depicts an integration of behavioral activation theory (a form of cognitive behavior therapy), information from developmental research, and the sociogenomic model of personality traits (Roberts & Jackson, 2008; see also Magidson, Roberts, Collado-Rodriguez, & Lejuez, 2014).

tween conscientiousness and (individual) interest implies that individual interest will be less relevant for the academic effort of students who are high in conscientiousness (and vice versa). The understanding of this compensatory relation might also contribute to educational practice by helping to overcome the problematic division between practitioners who emphasize the need to strengthen "personality factors" and those who highlight the need to make school "interesting." However, as it is also well-documented that students are not interested in everything or in all subjects (strong domain-specificity of interest) and, moreover, that interventions in one domain can lead to unintended side effects in other domains (as a consequence of internal dimensional comparisons, see e.g., Gaspard et al., 2016), conscientiousness might be a good construct to think about. Research on the CONIC model has indicated that both factors play a critical role in achievement-related behavior such as academic effort (Trautwein et al., in press; Trautwein et al., 2015).

6.3 Implications for Future Research

The implications for future research focus on two superordinate topics. First, the findings from this dissertation provide additional support for the usefulness of integrating different perspectives and approaches into an overarching framework (e.g., the Neo-Socioanalytic Model; NSM; Roberts & Nickel, 2017). Second, this dissertation provides evidence that (young) students have certain difficulties in reporting on their personality (e.g., in terms of broad abstract questions about their personality traits). This is why it seems essential to focus on improving the measurement of personality.

6.3.1 Promoting and conducting integrative research

Integrating different perspectives with each other is hard. One prominent example from history is the person-situation debate in personality research (see e.g., Kenrick & Funder, 1988). Ignited by Mischel's book (1968), the person-situation debate concerned the field of personality research for several years, and many researchers are still discussing it today (see e.g., Funder, 2009). In his book, Mischel (1968) questioned the basic assumptions behind personality traits (e.g., cross-situational consistency). This evoked multiple reactions, which ranged from ignoring traits, to accepting that traits are stable and do not change, to refuting the arguments completely. Although Mischel's arguments also drew lines between researchers, it can be retrospectively concluded that the points he made led to a better understanding of personality (Kenrick & Funder, 1988). The discussion produced hundreds of studies and encouraged researchers to rethink their initial claims and broaden their views. The steps needed to move toward integrating different views are exhausting, but they are necessary to move personality research forward. To facilitate the understanding of personality, it seems reasonable to avoid prematurely excluding any approaches that might provide further explanation (see e.g., John & Robins, 1994), or as Allport (1946) advised, "*no doors should be closed in the study of personality*" (pp. 133-134).

The Neo-Socioanalytic Model (NSM; see e.g., Roberts & Wood, 2006) is one example of a model in which traditional trait and social cognitive views are integrated and merged. It subsumes four different units of analyses (i.e., traits, motives and values, abilities, and narratives) in one model and gives them all equal weight. Such integrative models offer the opportunity for new theorizing and the generation of further research questions. Bringing different constructs such as personality traits and social cognitive variables together in one model offers promising insights in explaining human behavior as exemplified by the CONscientiousness × Interest Com-

pensation (CONIC; Trautwein et al., in press) model. The CONIC model describes a compensatory pattern between conscientiousness and individual interest that indicates that individual interest is less relevant for the academic effort of students who are high in conscientiousness (and vice versa; see also Trautwein et al., 2015, and Chapter 1.2.3 and Study 3 in Chapter 5). This compensatory pattern can primarily be traced back to the difference in how conscientiousness and individual interest initiate activity. Conscientiousness, a default tendency to work hard in almost any achievement setting, reflects a domain-independent "*built-in push factor"*. By contrast, individual interest can be described as a powerful emotional "*pull factor"*. People engage in activities because they are interested in these activities (see also Chapter 1.2.3). This indicates that if a student is not interested in a task but is conscientious, he or she will usually complete the required school task anyway. The "built-in push factor" of conscientiousness steps in and compensates for the lack of interest. In sum, considering both variables in one model (and their product term; interaction term) has enabled researchers to explore an interesting mechanism that functions between these two distinct variables. This view is in line with the view of Lubinski (2000), who suggested that a multifaceted approach might be best and most productive to fully understand complex human phenomena. He highlighted the importance of assessing relatively distinct classes of constructs such as personality, interests, and cognitive ability to explain the full range of human behavior. Consequently, considering distinct classes of variables offers the opportunity to identify other interesting and promising mechanisms that can lead to the creation of new theories.

Moreover, the NSM is not restricted to biological or environmental influences either way but considers both sources to explain human functioning and personality development in general (see e.g., the sociogenomic model of personality traits; Roberts, 2017). This is an important step toward facilitating the understanding of personality. Why should one ignore further possible and meaningful explanations for human behavior and personality development, especially when it is possible to test them empirically? Studies 1 and 2 can serve as prototypical examples of testing such assumptions that lie behind each class of constructs. Both studies showed that the division between traits and social cognitive concepts was conceptually larger than the empirical data would justify (see also Kandler et al., 2014), findings that clearly speak in favor of conducting integrative research.

6.3.2 Improving the measurement of personality

To further facilitate the understanding of personality, it is necessary to enhance the measurement of personality. The appropriate measurement of constructs provides a foundation without researchers would be unable to obtain valid information from data (Borsboom, 2005). Thus, appropriate measurement is a necessary precondition for deriving valid conclusions (e.g., stability coefficients also rely on the method of assessment). Although there are multiple calls and commentaries that have stated that researchers should use various modalities (e.g., observer reports), personality and educational research is overwhelmingly dominated by self-report methods (Baumeister, Vohs, & Funder, 2007; Vazire, 2010). This dissertation provided additional evidence that young students have certain difficulties when answering a standard Big Five questionnaire (Big Five Inventory; BFI; Lang et al., 2001). This view has been supported by multiple studies that have referred to similar assessment issues (e.g., acquiescent tendencies, midpoints, or extreme responding; see e.g., Göllner et al., 2016; Mõttus et al., 2017; Soto et al., 2008). One issue may have been the broad and somewhat abstract formulation of personality items (e.g., "*I see myself as someone who perseveres until the task is finished"*), as this can aggravate the understanding of the items. By contrast, the social cognitive constructs, which are measured as narrow constructs that are connected to specific contexts (e.g., "I am interested in math"), showed mostly good measurement properties. However, as a consequence thereof, researchers must ask: At what level of specificity should constructs be assessed? This is compellingly described by Bandura (1999), although in a somewhat different context:

> *Once one starts fractionating the self, where does one stop? For example, an athletic self can be split into an envisioned tennis self and a golfing self. These separable selves would, in turn, have their subselves. Thus, a golfing self can be subdivided into different facets of the athletic ability to include a driving self, a fairway self, a sand-trapped self, and a putting self. How does one decide where to stop fractionating selves?* (p. 169)

This fractioning could be transferred to personality (see Funder, 2009). Thus, someone can be industrious in general or industrious only in school but not at home. Or someone can be industrious only in the subject of math but not in German or English. This fractioning could be arbitrarily continued. However, the narrower a construct becomes, the more specific is the power it provides for explanation (Funder, 2009; Wood, 2007). This is why it seems useful to keep personality traits broad. Moreover, we can ask: Would we have found the interaction effect between do-

main-specific individual interest and conscientiousness across subjects (see Chapter 5)? Probably not.

Roberts (2017) posed another recent criticism against the assessment of global, retrospective reports of personality traits. He claimed, first, that global, retrospective reports of personality traits fail to reflect a sufficient measure of a trait in general, and second, that they undermine the possibility to detect any meaningful within-person variation. Indeed, the focus on within-person variation in personality is another legacy of Mischel's (e.g., 1968; see also Mischel & Shoda, 1995) critique and a prominently suggested direction in personality research ("*if…then*…"; see Funder, 2009; Hamaker et al., 2015). Instead of measuring global, retrospective reports of personality traits, Roberts (2017) suggested that only states should be assessed (e.g., by tracking information from smartphones, tablets, etc.). Statistical models, proposed, for instance, by Latent-State Trait theory (LST; see e.g., Steyer et al., 1992; Steyer et al., 1999), offer the opportunity to separate the fixed or slow-changing parts (stable trait part) from the fluctuating parts (state part) of a measure (see e.g., Bishop et al., 2015). In fact, LST is a substantive theory that is able to model and distinguish between these different components. The concepts of states and traits, represented as latent variables, are well-defined (i.e., in terms of probability theory) and have an explicit mathematical definition as well as a precise meaning (Steyer, Mayer, Geiser, & Cole, 2015).

Furthermore, the measurement of personality could be enhanced by measuring situations and contexts in a standardized way (see e.g., Rauthmann et al., 2014; Rauthmann, Sherman, & Funder, 2015). Not only would this facilitate the understanding of personality (i.e., help the understanding of the "*patterns of thoughts, feelings, and behaviors* […] *under certain circumstances"*), it would also improve the measurement process. As measurement becomes more contextualized, it is easier for people to retrieve information as they have a reference point (e.g., a past experience).

Taken together, to move forward and facilitate the understanding of personality, it seems necessary to improve the measurement of personality, to be open to other perspectives, and continue to unify existing approaches. And so, this dissertation closes with a quote by Funder (2009, p. 125):

> *In principle, it ought to someday be possible to understand an individual's personality so thoroughly as to be able to anticipate what he or she would do in completely new and unique situations. That entity–personality itself–is a latent construct in more than a statistical sense, and is at best only indirectly suggested through its behavioral manifestations.* (p. 125)

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