The Development of Vocational Interests in Early Adolescence: Stability, Change, and State-Trait Components

Thomas Gfrörer (0000-0002-4817-2296), Gundula Stoll (0000-0003-1129-983X), Sven Rieger (0000-0002-0339-0695), Ulrich Trautwein (0000-0003-0647-0057), and Benjamin Nagengast (0000-0001-9868-8322)

Hector Research Institute of Education Sciences and Psychology, University of Tübingen

—Gfrörer, T., Stoll, G., Rieger, S., Trautwein, U., & Nagengast, B. (2021). The Development of Vocational Interests in Early Adolescence: Stability, Change, and State-Trait Components. *European Journal of Personality*. Advance online publication. <https://doi.org/10.1177/08902070211035630>—

Author Note

Thomas Gfrörer is a doctoral student at the LEAD Graduate School & Research Network [GSC1028], which was funded by the Excellence Initiative of the German federal and state governments. This research project was also supported by the Tübingen Postdoctoral Academy for Research on Education (PACE) at the Hector Research Institute of Education Sciences and Psychology, Tübingen, funded by the Baden-Württemberg Ministry of Science, Research, and the Arts. The TRAIN study was initiated and funded by grants from the Ministries of Education, Youth, and Sports in Baden-Württemberg and Saxony, Germany.

We have no known conflict of interest to disclose.

OSF link: https://osf.io/tuys8/?view_only=9f05a36a29bd49e5b700a0ee4b40eb78

Correspondence concerning this manuscript should be directed to Thomas Gfrörer, Hector Research Institute of Education Sciences and Psychology, University of Tübingen, Europastraße 6, 72072 Tübingen, Germany. E-mail: t.gfroerer@uni-tuebingen.de, Phone: +49 7071/29-74385; Fax: +49 7071/29-5371.

Abstract

Vocational interests predict major life outcomes such as job performance, college major choice, and life goals. It is therefore important to gain a better understanding of their development during the crucial years of late childhood and early adolescence, when trait-like interests are starting to develop. The present study investigated the development of vocational interests in a longitudinal sample, comprising $N = 3,876$ participants—assessed at four time points from ages 11 to 14. Stability, state-trait variance components, mean-level development, and gender differences in mean-levels of Holland's (1997) RIASEC dimensions were examined. Stabilities were moderate for all dimensions, but Realistic, Investigative, Social, and Conventional interests became more stable over time. For Realistic, Artistic, Social, and Conventional interests, the trait variance increased over time. At age 14, all dimensions had substantial trait variance components. The mean-levels of Realistic, Investigative, Artistic, and Conventional interests decreased over the 3 years ($-0.44 < d < -0.24$). Initial gender differences—with girls having higher Artistic and Social interests and boys having higher Realistic and Investigative interests—increased over time. By investigating the development of vocational interests in late childhood and early adolescence, we complement previous findings and provide first insights about state-trait proportions in early adolescence.

Keywords: vocational interests; development; multiwave longitudinal study; late childhood & early adolescence

The Development of Vocational Interests in Early Adolescence: Stability, Change, and State-Trait Components

Vocational interests shape people's lives in many different ways. They are important predictors of work- and achievement-related outcomes, such as job performance (Nye et al., 2012, 2017; Van Iddekinge et al., 2011), gross income (Stoll et al., 2017), and academic performance (Rounds & Su, 2014; Su, 2012). In addition, they predict life decisions with long-lasting consequences such as the choice to attend a higher educational school track (Usslepp et al., 2020), choice of college major (Päßler & Hell, 2012; Wille et al., 2020), and the persistence of these choices (Allen & Robbins, 2008), major life goals (Stoll, Einarsdóttir, et al., 2020), and even life outcomes such as getting married and having children (Stoll et al., 2017).

Early adolescence is supposed to be particularly relevant for vocational interest development because, on the one hand, it is assumed that vocational interests are not yet fully developed at that time (Gottfredson, 1981; Holland, 1997; Low et al., 2005), and on the other hand, adolescents are encouraged by their parents (Kracke, 1997; Whiston & Keller, 2004) as well as their schools (Gysbers, 2005; Noack et al., 2010) to explore occupational opportunities and various career paths (Gati et al., 2019). In addition, late childhood and early adolescence is generally regarded as a crucial period for an individual's development and maturation (Petersen, 1987)—indicating that this life phase constitutes a transitional phase in young people's lives. However, to date, only a few studies (see Päßler & Hell, 2020; Tracey, 2002) have investigated stability and change in vocational interests during these crucial years.

The present study addresses this gap in research by providing detailed descriptive information about the longitudinal development of vocational interests over the course of late childhood and early adolescence. We used data from a large longitudinal study ($N = 3,876$, 136 classes) in which students in Germany were followed across four time points, at intervals of 1 year each, from fifth to eighth grade (ages 11 to 14). To provide a detailed picture of

various aspects of development, we investigated three complementary indicators. Besides approaches that are commonly used, such as mean-level change and stability, as well as gender differences in mean-level change, we also investigated proportions of state and trait variance components, to gain further insights about the nature of vocational interests.

Indicators of Development in Vocational Interests

The development of vocational interests is usually investigated with various indicators that capture different perspectives on continuity and change—with mean-level changes and retest correlations constituting the two most common methods (Low & Rounds, 2007). Overall shifts in mean levels represent changes in interest intensity averaged across an entire sample. Mean-level changes are often described as normative change, indicating “generalizable patterns of personality development that apply to most people” (Roberts et al., 2006, p. 1). Retest correlations are frequently used as indicators of the stability of constructs, capturing the relative rank order between individuals over time (Low & Rounds, 2007).

Additional information about the stability of and change in a construct can be obtained by disentangling its stable, long-term changing and short-term fluctuating components through the use of state and trait variance components (Geiser et al., 2015). This approach allows researchers to investigate whether a construct is better characterized as exhibiting long-lasting irreversible trait development or short-term reversible fluctuations (Bishop et al., 2015; Geiser et al., 2015). As recent theories described that vocational interests may consist of both, state and trait components (Su et al., 2019), this approach could facilitate the understanding of how large the respective state and trait components are and how they change over time. Disentangling state and trait variance components is especially promising during late childhood and early adolescence, when major biological (e.g., puberty) and social transitions (e.g., changes in requirements in school life and changes in peer constellations) are assumed to initiate long-lasting, irreversible trait development (Soto & Tackett, 2015). Separating proportions of state and trait variance has already been used in other research areas

(e.g., Braun et al., 2020; Schmukle & Egloff, 2005), however, we are not aware of any study that has to date investigated state and trait variance components in vocational interests.

Theoretical Assumptions and Empirical Findings on the Development of Vocational Interests in Late Childhood and Early Adolescence

Longitudinal research on the development of vocational interests in childhood and adolescence is still scarce to date. Even though the existing meta-analyses on stability (Low et al., 2005) and mean-level change (Hoff et al., 2018) both comprise the time period of late childhood and early adolescence as the youngest age group, their aggregated coefficients are based on only five (age group 12 to 14 for Low et al., 2005) and two (age group 11 to 14 for Hoff et al., 2018) primary studies. Of these studies (Knapp & Knapp, 1984; Kuder, 1964, 1975; Lubinski et al., 1995; Tracey, 2002; Zytowski, 1976), only one (Tracey, 2002) investigated vocational interest development during early adolescence, whereas the others either validated interest inventories or measured interests only once during the respective time frame.

In addition, all studies included in the meta-analyses comprised only two time points. Therefore, the aggregated coefficients provided information about stability and change in different age groups but did not necessarily resemble longitudinal pattern of development across multiple time points. Recent multiwave studies (Hoff et al., 2020; Stoll et al., 2020) with older samples have demonstrated that the pattern of development observed in one sample across time can differ from the pattern suggested by the existing meta-analyses.

Due to the lack of empirical findings, we drew on assumptions from three relevant theoretical frameworks to develop expectations about how vocational interests should develop during late childhood and early adolescence. First, we drew on Holland's (1997) theory of vocational personalities and work environments, which constitutes the most widely used framework for interest classification (Hoff et al., 2018). Second, we used the Trait Situation Interest Dynamic (TSID; Su et al., 2019) model, which integrates conceptions of state and

trait interests. Third, we used Gottfredson's (1981) theory of circumscription and compromise, which focuses specifically on the development of occupational preferences from childhood to adolescence. To complement these theoretical assumptions, we tie in the existing empirical evidence and describe how our study builds on these findings.

Late Childhood and Early Adolescence as a Phase of Increasing Interest Stability?

According to Holland (1997), people can be characterized by six general interest dimensions: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC; for more information, see Table 1). He emphasized that vocational interests are personal dispositions, and he described the RIASEC dimensions as "personality types" (p. 2). Vocational interests are therefore defined as preferences that are "trait-like" and consequently seen as relatively stable over longer periods of time (Rounds & Su, 2014, p. 1).

Holland (1997) made only a few predictions about how vocational interests should develop over the course of late childhood and early adolescence. He stated that stability is fostered through cumulative learning on the basis of experiences, where preferences for single activities are gradually rewarded and reinforced—for example, through personal satisfaction or external rewards. Preferences for certain activities that are reinforced eventually transform into a disposition, whereas preferences that are not reinforced are neglected. Although changes in vocational interests are possible across the entire life span, such changes become less likely with age (Holland, 1997). This also implies that changes in vocational interests are more likely during late childhood and early adolescence. Hence, investigating the development of vocational interests during that respective time period seems particularly vital.

Recently, Su et al. (2019) proposed the TSID model by suggesting that, despite their generally high stabilities, vocational interests also comprise parts that are influenced by situational characteristics. Stable interests reflect a mental representation of an object, including the related affective and cognitive responses. If interests are less stable and are

highly prone to the influence of situational characteristics, this mental representation cannot be assumed to be fully developed yet. Su et al. (2019) assumed a fluent transition between the stable and the situational component of interests, which resembles a state-trait continuum (Braun et al., 2020). According to the TSID model, interests solidify through an accumulation of positive experiences—such as novel activities that arouse curiosity, provide surprising information or are cognitively engaging (Hidi & Renninger, 2006; Renninger & Hidi, 2011)—or are altered through an accumulation of negative experiences (Su et al., 2019). By describing reengagement in specific activities as a key mechanism of interest development, the TSID model builds on Holland's assumption of cumulative learning as well as processes described by other interest theories (Hidi & Renninger, 2006; Holland, 1997; Renninger & Hidi, 2011; Silvia, 2001). In addition, people have experiences that are embedded in a multiplicity of different environments. People usually choose environments that offer activities that are in line with their interests. Their experiences strengthen (or weaken) their interests in these activities and increase (or decrease) the probability that they will choose similar environments in the future. The TSID model therefore emphasizes that interests also develop on the basis of a dynamic interplay between the person and the environment (Su et al., 2019).

Empirical results on vocational interest stability support Holland's (1997) assumptions. The meta-analysis by Low et al. (2005) showed that vocational interests reflect relatively high retest correlations, especially during adulthood (peaking around $r = .65$ and $r = .77$), and already demonstrate moderate retest correlations during early adolescence ($r = .51$). In addition, their results suggest that retest correlations are higher in older age groups like late adolescence and young adulthood. Taken together, these results indicate that vocational interests possess moderate stability in late childhood and early adolescence, but their stability increases with age.

However, the empirical basis for the stability of vocational interests is still sparse. The meta-analysis by Low et al. (2005) comprised only 5 studies in the youngest age group (12-14 years) and of these five studies, only Tracey (2002) investigated the development of vocational interests across two time points during adolescence. Tracey's (2002) sample consisted of two cohorts of U.S. students that were followed from fifth to sixth ($N = 126$) and from seventh to eighth ($N = 221$) grade. He reported an increase in stability, with moderate retest correlations ($.35 < r < .62$) for the interval between fifth and sixth and high retest correlations ($.72 < r < .81$) for the interval between seventh and eighth grade.

Päßler and Hell (2020) investigated the development of vocational interests in a longitudinal sample of 541 Swiss children between the ages of 10 and 12. The sample comprised three waves, each including students from different grade levels (T1 = Grades 4 to 6, T2 = Grades 5 to 7, T3 = Grades 6 to 8). Päßler and Hell (2020) reported moderate stabilities between the first two waves ($.37 < r < .44$) and small to moderate stabilities between the last two ($.17 < r < .47$). The current study builds on findings by Tracey (2002) and Päßler and Hell (2020) by investigating whether the differences in stability they reported can also be found when a sample of participants enrolled in the same grade levels are followed over time.

Normative Change in Late Childhood and Early Adolescence—a Period of Decreasing Interests?

Gottfredson (1981) described the development of occupational preferences from childhood to adolescence. According to Gottfredson, the overarching processes that are central for shaping adolescents' vocational interests are *circumscription* and *compromise*. During circumscription, children and adolescents gradually integrate the concepts of size and power (ages 3 to 5), gender (ages 6 to 8), prestige (ages 9 to 13), and views of their own unique self (age 14 and older), such as abilities, values, and personality, into their self-concept (Gottfredson, 1981). This integration takes place in the respective environment or social

context, and self-concept is therefore very likely to be influenced by and to interact with the environment as it develops. Different environments may consequently lead to different self-concepts. Through their experiences and interactions with other people in different environments or social contexts, children and adolescents gradually rule out occupations that do not match their developing self-concept. According to Gottfredson (1981), vocational interests therefore depend on the internal comparison between one's views of oneself and one's views of certain occupations. After the phase of circumscription, Gottfredson postulated a phase of compromise in which adolescents begin to realize that some of the occupations they regard as suitable for their self-concept might not be available to them. Accordingly, adolescents shift their interests to occupations that might be less compatible with their self-concepts but more accessible. The process of compromise again highlights that interests interact with the respective environment as these interests develop

Against this background, it could be assumed that through the process of circumscription, vocational interests become more differentiated with age because adolescents gradually figure out which activities they do not like. This differentiation on the individual level could manifest in mean-level decreases on the group level (e.g., in RIASEC dimensions; see also Tracey, 2002). In addition, there is evidence of a similar pattern of mean-level decreases in other motivational constructs, for example, the intrinsic value of school subjects (Gaspard et al., 2017) and academic self-concept (Cole et al., 2001) as well as an increase in the specialization of school-subject domains over time (Denissen et al., 2007). Furthermore, the process of circumscription could also initiate a general disinterest in the world of work at first, as the gradual identification of unsuitable occupations may be accompanied by an accumulation of negative experiences. This circumstance would also manifest in mean-level decreases of interests during these specific years (e.g., in RIASEC dimensions; see also Tracey, 2002).

Evidence of decreasing mean levels was identified in the meta-analysis by Hoff et al. (2018), who reported mean-level decreases for five of the six RIASEC dimensions during late childhood and early adolescence (ages 11 to 14). Two of these five interest dimensions showed decreases that were statistically significant, with small effect sizes between $d = -0.30$ and $d = -0.17$. These results were based on two studies, of which Tracey's (2002) two-cohort study was once again the only one that was published. He reported mean-level decreases in four of the six RIASEC dimensions for each cohort, from fifth to sixth (i.e., decreases in Realistic, Investigative, Artistic, and Enterprising interests) and from seventh to eighth grade (i.e., decreases in Realistic, Investigative, Enterprising, and Conventional interests). Päßler and Hell (2020) obtained similar results, reporting significant decreases in Realistic, Investigative, Artistic, and Social interests from ages 10 to 12.

Late Childhood and Early Adolescence as a Phase of Gender Differentiation?

Gottfredson's (1981) theory suggests that the manifestation of gender differences in vocational interests has already begun by the age of 6. At this age, children begin to understand the concept of gender roles and start to recognize cues, such as stereotypical gender-specific clothing and activities (Gottfredson, 1981). With increasing age, children understand more abstract cues, such as differences in stereotypical gender-specific personality characteristics (Gottfredson, 1981). According to Gottfredson (1981), the behavior of children during this time can be characterized as "concern[ed] with doing what is appropriate for one's sex" (p. 569). Gender differences in vocational interests should therefore begin to manifest during childhood and should be present over the course of adolescence and adulthood.

Indeed, there is empirical evidence for robust and large gender differences in the mean levels of vocational interests in adolescence and adulthood. Su et al. (2009) conducted a meta-analysis on gender differences in vocational interests in which they included cross-sectional studies with participants who ranged in age from 13 to 43. The results showed that across all age groups, males had higher mean-level scores in Realistic and Investigative interests,

whereas females had higher scores in Artistic, Social, and Conventional interests. The effect sizes for these gender differences were quite large, with $|d| = 0.68$ for Social interest and $|d| = 0.84$ for Realistic interest. Similar gender differences for all age groups for Realistic and Social interests were also reported in the meta-analysis by Hoff et al. (2018).

A similar pattern in gender differences can already be found during late childhood. Tracey (2002) reported gender differences for fifth-grade students, with boys scoring higher on Realistic and Investigative interests and girls higher on Artistic, Social, and Conventional interests. Similar results were reported by Päßler and Hell (2020). Although meta-analytic results (Hoff et al, 2018) have indicated that the gender gap between Social and Realistic interests widens over the course of late childhood and early adolescence, this pattern was not confirmed in the longitudinal study by Päßler and Hell (2020).

The Present Study

We investigated the development of vocational interests over the course of late childhood and early adolescence. We used large-scale longitudinal data ($N = 3,786$) assessed at four time points in grades 5, 6, 7, and 8. We used prior empirical and theoretical work to derive our three main research questions and to guide our expectations. We did not preregister the assumptions of the following study.

First, we investigated the stability of vocational interests. We computed retest correlations for each scale between the scales scores from all adjacent time points. On the basis of prior results, we expected that vocational interests would be moderately stable in terms of retest correlations (r around .50; see Low et al., 2005). In addition, on the basis of assumptions derived from Holland (1997), we expected that retest correlations would increase over the course of late childhood and early adolescence.

Second, we investigated state and trait variance components and how they change over time. We computed state and trait variance proportions for each scale at each time point. According to the assumption of Su et al. (2019), we assumed that vocational interests consist

of both, state and trait variance proportions. In addition, according to Holland (1997) as well as Su et al. (2019) we assumed that the trait variance proportions are more substantial than the state variance proportions, and that the trait variance proportion would increase over time.

Third, we investigated how mean levels in vocational interests develop from ages 11 to 14. Because current evidence based on multiwave data is scarce, we decided to provide comprehensive descriptive information about the yearly development of vocational interests on the basis of manifest mean levels. To account for measurement error and test for different types of growth, we also inspected latent mean-level trajectories. On the basis of the results from Hoff et al. (2018), Tracey (2002), and Päßler and Hell (2020) and the theoretical considerations derived from Gottfredson (1981), we expected a general decrease in mean levels over the course of late childhood and early adolescence. However, in line with the results from Hoff et al. (2018) and the general stability of vocational interests, we assumed that, over the 3 years, these decreases would be rather small ($d < 0.30$). No assumptions were made concerning the types of mean-level trajectories (i.e., linear or quadratic) because no prior evidence was available. We exploratorily tested which growth type fitted the data better.

Fourth, we investigated gender differences in vocational interests. In line with Su et al. (2009), we expected that boys would have higher mean levels in Realistic and Investigative interests and girls in Artistic, Social, and Conventional interests. In addition, according to the theoretical assumptions derived from Gottfredson (1981), an increase in gender differences over time could be assumed. However, because the empirical findings from Hoff et al. (2018) and Päßler and Hell (2020) were inconclusive, we made no assumptions about increases in gender differences over time, but investigated them exploratorily.

Method

Sample

We used data from the Tradition and Innovation (TRAIN; Jonkmann et al., 2013) study.¹ TRAIN is a large-scale longitudinal study in which students from lower, intermediate, and multitrack schools (a combination of the lower and intermediate tracks) were followed annually from fifth to eighth grade (T1, T2, T3, and T4). The study protocol and data protection measures of the TRAIN Study were reviewed and approved by the responsible departments and the independent data protection official of the Ministry of Culture, Youth, and Sports at Baden-Württemberg and the Saxon Ministry of State for Education and Culture. Participation was voluntary, and students could participate only with active parental consent.

The schools were chosen from the states of Baden-Württemberg and Saxony. From every school (99 overall), one to two classes (136 overall) participated in the study. The sample sizes were $n = 2,894$ (46% female) students at T1 (Grade 5), $n = 2,936$ (45% female) students at T2 (Grade 6), $n = 2,993$ (46% female) students at T3 (Grade 7), and $n = 3,060$ (46% female) students at T4 (Grade 8). The sample size increased slightly over time because additional students were included at later time points. The reasons were repetition, changes in a class, or the relocation of a participant's family. The overall number of students who participated at a minimum of one time point was $N = 3,876$, which was also the sample used in the current analysis (for details about the sample composition and dropout, see Supplement A). It should be noted that although TRAIN comprises a large longitudinal sample, it is not representative of all students in the German states of Baden-Württemberg and Saxony because it does not include students from the highest school track. TRAIN was designed to investigate the influence of learning environments from lower, intermediate, and multitrack

¹ This data set has already been used in several other publications. An overview is given here: <https://uni-tuebingen.de/en/43704>. None of these studies investigated the development of vocational interests, nor included vocational interests in the study.

schools on educational outcomes, and higher track students were therefore not part of the sample (Jonkmann et al., 2013).

We conducted two types of attrition analyses at each time point. First, we compared participants who dropped out of the study at a respective time point with the participants who remained in the study. Second, we compared participants who joined the study at a respective time point with the participants who were already participating before that time point. Differences in interest measures, sociodemographic variables, achievement measures, and personality characteristics (i.e. Big Five) were investigated. In general, differences in interest measures, sociodemographic variables, and personality characteristics were small and, in the majority of cases, not significant. Comparing participants who dropped out of the study with the remaining participants, the standardized mean differences ranged from $|d| = 0.00$ to $|d| = 0.39$ ($|Mdn| = 0.10$), such that the participants who dropped out generally had lower values—a finding that also applied to participants who joined the study late.

For achievement measures, the largest differences were found for school grades, which ranged from $|d| = 0.11$ to $|d| = 0.84$, indicating worse grades for participants who dropped out or joined the study late in comparison with the other participants in the sample. An explanation for these differences could be that participants who dropped out or joined the study late included students who repeated a grade, and poor performance is usually the major criterion for repeating a grade. Although differences in report-card grades were quite high, differences in standardized achievement were much lower. For participants who joined the study late, differences in math and German abilities were usually not significant and small in magnitude with standardized effect sizes ranging from $|d| = 0.01$ to $|d| = 0.22$ ($|Mdn| = 0.10$). Differences between participants who dropped out and the remaining participants were highest at the fourth time point with standardized effect sizes ranging from $|d| = 0.40$ to $|d| = 0.56$ —differences at the other time points were usually small (for detailed results, see Supplement A).

Instruments

Vocational interests were operationalized in accordance with the RIASEC framework. As there is currently no interest inventory that was designed for the transition from childhood to adolescence, two frequently-used and validated interest inventories were modified and combined. For adolescents older than 14, the Revised General Interest Structure-Test (AIST-R; Allgemeiner Interessen Strukturtest; Bergmann & Eder, 2005) is used most often in German-speaking countries (e.g., Germany, Austria, and Switzerland). For children, the German version of the Inventory of Children's Activities (ICA; Tracey & Ward, 1998; German version (ICA-D): von Maurice, 2006) is used. To ensure and enhance the comprehensibility of the interest inventory for the young age group of the TRAIN study, experts from the research field of vocational interests, selected items from the German version of the ICA, items from the AIST-R and constructed a few new items, focussing on activities that were familiar to children at age 11, but still suitable (i.e. not too childish) for adolescents at the age of 14. They followed the recommendations made by Tracey (2002) about measuring children's vocational interests by asking about "familiar activities, rather than unfamiliar occupations" (Tracey, 2002, p. 149). The final questionnaire consisted of 11 items from the AIST-R, 15 items from the ICA and 11 new items (see Supplement B).

Every RIASEC dimension was assessed with six items per time point. Students answered the question "How much do you like this activity?" on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very*). Sample items and reliability coefficients for all scales and every time point can be found in Table 1. Omega total (McNeish, 2018) ranged from $.77 < \omega < .89$. An overview of all items, their item-total correlations, as well as their respective factor loadings can be found in Supplement B. For every RIASEC dimension, a one-dimensional factor model represented the data adequately (for an overview of the model fit indices, see Supplement C). Evidence for the convergent and discriminant validity of the interest measure can be found in Supplement B.

Statistical Analyses

We provide all analysis scripts of the current study in an OSF repository (see: https://osf.io/tuys8/?view_only=9f05a36a29bd49e5b700a0eefb40eb78).

Measurement invariance

To adequately attribute latent mean-level differences to changes in the latent construct, strong measurement invariance is required. Therefore, we investigated measurement models with different degrees of invariance across time as well as across the Time $\times$ Gender interaction. Invariance across time implies that the meaning and interpretation of the construct does not change over time. Invariance across gender and time implies that boys and girls attribute the same meaning and interpretation to the construct and that its meaning and interpretation do not change over time. We investigated configural measurement invariance (i.e., structural invariance over time and the Time $\times$ Gender interaction), weak measurement invariance (i.e., factor loading invariance over time and the Time $\times$ Gender interaction) and strong measurement invariance (i.e., factor loading and intercept invariance over time and the Time $\times$ Gender interaction).

The following fit indices and values were used to judge whether the overall fit of the models was adequate: Incremental fit indices such as the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) with values of .90 or higher, the Standardized Root Mean Square Residual (SRMR) with a value of .08 or lower, as well as the Root Mean Square Error of Approximation (RMSEA) with a value of .06 or lower (Hu & Bentler, 1999).

For evaluating the changes in incremental fit indices (i.e., CFI, SRMR and RMSEA) between the respective models (i.e., configural, weak and strong invariance), we applied the recommendations made by Chen (2007). We used the recommended values to test for factor loading invariance with an adequate sample size, with values $\geq .010$ for Δ CFI, additionally accompanied by values of $\geq .015$ for Δ RMSEA or $\geq .030$ for Δ SRMR, indicating substantive changes in testing for factor loading invariance (Chen, 2007). To test for intercept invariance,

values of $\geq .010$ for ΔCFI , additionally accompanied by values of $\geq .015$ for $\Delta RMSEA$ or $\geq .010$ for $\Delta SRMR$ were assumed to be substantial.

According to the fit indices, all the longitudinal models with strong invariance provided an adequate fit (for fit indices, see Supplement C). However, for the models that indicated invariance across the Time $\times$ Gender interaction, only partial strong invariance could be applied. Partial strong invariance suggests that the majority of the respective item intercepts were invariant between boys and girls, but a few of them were not. Aiming for partial invariance is a suitable approach when invariance cannot be achieved on all items (Putnick & Bornstein, 2016).

To achieve partial strong invariance, intercepts of single items with large gender differences are freed in accordance with the weak measurement invariance model. To achieve partial strong invariance in our study, we freed one item intercept for Social, two item intercepts for Realistic, Investigative, Enterprising, and Conventional, and three item intercepts for Artistic. All other item intercepts were invariant across time and gender. The final partial strong invariance models indicated an adequate overall model fit (according to Chen, 2007). For a detailed description of the measurement invariance results see Supplement C.

Mean levels and retest correlations

To examine the manifest mean-level change and correlation coefficients, we specified a saturated path model that included all the manifest scale scores for the six RIASEC dimensions (see a depiction of the model in Supplement D). The six manifest scale scores were allowed to be freely correlated across all time points. Descriptive statistics, mean-level differences, and retest correlations for adjacent time points were derived from this model. To examine the mean-level differences with a standardized effect size, we computed Cohen's d for repeated measures (Lakens, 2013; for the formula, see Supplement C). With regard to the meta-analytic findings from Hoff et al. (2018) and the general stability of interests, we

considered the changes over the 3-year time period ranging from $d = 0.20$ to $d = 0.30$ to be substantial.

To estimate the model parameters, we used a maximum likelihood estimator that is robust against non-normality and nonindependence of data by choosing the analysis option TYPE = COMPLEX in Mplus 8 (Muthén & Muthén, 1998–2017). The estimator is labeled MLR (Maximum Likelihood Robust) in Mplus 8, and its χ^2 test statistic is asymptotically equivalent to the Yuan-Bentler T_2 test statistic (Muthén & Muthén, 1998–2017; Yuan & Bentler, 2000). For significance testing, we provided 95% confidence intervals for all parameters in the saturated path model and for all parameters in the subsequent models. Additionally, all subsequent models were also specified with the MLR estimator in Mplus 8 (Muthén & Muthén, 1998–2017).

Computing proportions of state and trait variance

To compute the proportions of state and trait variance, we specified a generalized second-order growth model (GSGM; Bishop, Geiser, & Cole, 2015) with time-invariant factor loadings and time-invariant intercepts for each interest dimension separately (for a depiction of the model, see Supplement D). The GSGM is a hybrid between a latent state-trait model (LST; Steyer et al., 1999) and a growth curve model (GCM; McArdle & Epstein, 1987). The GSGM consisted of three components that were represented by three latent variables: a component that is stable over time, representing initial trait levels; a component that captures growth over time, representing trait growth; and time-point-specific components, representing time-point-specific fluctuations (or state residuals). An advantage of the GSGM is the possibility of separating the model-implied variance components of the indicators that are due to the trait, trait growth, state residual, and measurement error (Geiser et al., 2015). We included the growth component in the model because, according to theory, vocational interests are dispositions that develop over time. Therefore, long-term changes such as trait growth should be accounted for and included as part of the proportion of reliable trait

variance. A model without a growth component would merely represent state variability that implies no trait development over time (Geiser et al., 2015). The intercept factor of the growth curve model part was identified by fixing the factor loading of the first item of each time point to 1 and the intercept to 0 (see Supplement D for a model depiction).

The model-implied variance components were used to calculate the consistency (CO), occasion specificity (OS), and reliability (REL; Geiser et al., 2015) of the interest constructs. CO represents the proportion of the variance of the indicators that is due to the trait and trait-growth components, whereas OS represents the proportion of the variance that is due to the state residual component (see Supplement D for the formulas). The state residual component OS represents the influences of the situation and the Person $\times$ Situation interactions that were not accounted for by the trait (Geiser et al., 2015). REL represents the reliable part of the variance that was not due to measurement error, consisting of the sum of CO and OS (Geiser et al., 2015).

The total model-implied variance of every item in the GSGM can therefore be segmented into the components OS, CO, and measurement error ($\varepsilon = 1 - \text{REL}$; Geiser et al., 2015). For a better understanding of how much of the model-implied variance was due to trait, trait growth, state residual, and measurement error, we averaged the coefficients across all items separately for every time point. CO, OS, and the proportion of measurement error were therefore depicted for every time point separately, but they were averaged across the items within a time point.

Specifying growth type

For every RIASEC dimension, we specified two GSGMs, one with linear and one with quadratic trait growth. To decide whether the model with the quadratic growth type fits the data substantively better, we determined whether the changes in the descriptive fit indices between the model that contained only the linear growth and the model that additionally contained the quadratic growth were substantial. If this was the case, we decided to choose

the model with a quadratic growth factor. To assess the changes in model fit, we used the values proposed by Chen (2007). Because these recommendations were explicitly given for measurement invariance testing, we used them with caution and only as approximate guides. As no assumptions about the growth type could be derived from current studies, our approach here was to investigate which growth type best described the data.

Analyzing gender differences

To examine gender differences in the mean levels, we used multigroup modeling. We specified a multigroup saturated path model to obtain manifest mean-level scores for boys and girls. For the GSGM multigroup models, we first specified an overall model, where both groups, boys and girls, had linear as well as quadratic growth components. We then determined whether the means of the respective quadratic growth factors were statistically significantly different from zero. If this was not the case, we specified another model in which we constrained the quadratic growth type for the respective group. If the change in the descriptive fit indices according to the values proposed by Chen (2007) was negligible, we decided to keep the constrained model. Due to missing prior evidence, the approach of choosing the appropriate growth type was again data driven.

Missing data

To deal with the occurrence of missing data, we used full information maximum likelihood estimation (FIML; see, e.g., Enders, 2001) in all models. To make the Missing at Random (MAR) assumption more plausible and to reduce possible selection bias due to attrition, we included multiple auxiliary variables that could explain the causes of the missing data, thus improving parameter estimation (Collins et al., 2001; Enders, 2008; Graham, 2003). The auxiliary variables were included in the estimation of the model in line with the saturated correlates model approach (Graham, 2003) through the Mplus 8 AUXILIARY command (Asparouhov & Muthen, 2008). In this approach, auxiliary variables are included in the analysis through correlations with variables that are part of the actual analysis, but these

auxiliary variables are not part of the structural model. All variables that indicated significant differences during the attrition analysis were included as auxiliary variables in all analyses (for an overview of these variables, see Supplement A).

Nested data structure

In the present data set, students were nested in classes, which led to a hierarchical data structure that could cause an underestimation of the standard errors. Because classes were not the focus of our analysis, we treated them as a nuisance (McNeish et al., 2017) and therefore relied on cluster-robust standard errors to correct the underestimation. We used the implemented analysis option in Mplus 8, TYPE = COMPLEX, which computes the standard errors on the basis of a sandwich estimator method that accounts for the violation of the independence of observations assumption (McNeish et al., 2017). The intraclass correlations of the RIASEC scales with class as the cluster variable ranged from .02 to .11. We decided not to include school as another cluster variable because only the intraclass correlations for Investigative, Enterprising, and Conventional at the first time point were noteworthy with an ICC of .09. The intraclass correlations of the majority of the variables were below .04 (see Supplement A for an overview of the intraclass correlations).

Results

The exact *p*-Values of all parameters depicted in the results section and a correlation matrix containing all scales can be found in the respective output files on the OSF repository (see: https://osf.io/tuys8/?view_only=9f05a36a29bd49e5b700a0eefb40eb78).

Stability of Vocational Interests

Retest correlations

To investigate the stability of vocational interests, we computed retest correlations for the vocational interest scales. In line with our assumptions, the 1-year retest correlations for all interest dimensions were moderate, ranging from $r = .41$ to $r = .64$ (see Table 2). The retest

correlations for the entire 3-year interval were lower, ranging from $r = .32$ to $r = .49$ for all interest dimensions.

Realistic, Investigative, Social, and Conventional showed significant increases in retest correlations from the first to the last interval, with increases ranging from $\Delta r = .06$ to $\Delta r = .08$ (see Table 2). From the first to the second interval, the retest correlations for these four interest dimensions showed significant increases that ranged from $\Delta r = .07$ to $\Delta r = .11$. From the second to the last interval, the retest correlations for Realistic ($\Delta r = .00$) and Social ($\Delta r = .00$) did not change and reached a plateau, whereas the retest correlations for Investigative ($\Delta r = -.03$) and Conventional ($\Delta r = -.05$) decreased but not statistically significant.

For Artistic and Enterprising, the retest correlations also increased from the first to the last interval (see Table 2), by $\Delta r = .03$ and $\Delta r = .04$, respectively, but not significantly (see Table 2). Whereas the retest correlations for Artistic hardly changed at all, the retest correlations for Enterprising showed a significant increase ($\Delta r = .12$) between the first two intervals and a significant decrease ($\Delta r = -.08$) between the last two intervals, resulting in the nonsignificant change ($\Delta r = .04$) from the first to the last interval.

Proportions of state and trait variance of vocational interests

To investigate vocational interest stability while accounting for trait development, we computed components of state and trait variance (see Table 3). In line with our assumptions, the CO coefficients (i.e., the proportion of the variance in the indicators due to the trait and trait-growth components) for Realistic, Artistic, Social, and Conventional significantly increased by 5% to 12% from T1 to T4 (see Figure 1).

From T1 to T4, the OS coefficients (i.e., the proportion of variance due to the state residual component, representing the influence of the situation and Person $\times$ Situation interactions) did not show significant change for Realistic, Artistic, or Social but showed a significant decrease for Conventional. In line with our assumption, at T4, the CO coefficients for Realistic, Artistic, Social, and Conventional were significantly higher than the OS

coefficients, indicated by nonoverlapping confidence intervals. A similar pattern was already present at T1, except for Conventional, for which differences between OS and CO were not significant ($\Delta = -.05$, 95% CI $[-.11, .01]$).

In contrast to our expectations, from T1 to T4, the CO coefficients for Investigative and Enterprising did not change significantly. In addition, from T1 to T4, the OS coefficient for Investigative showed a significant increase, whereas the OS coefficient for Enterprising did not change significantly. At T4, CO coefficients for Enterprising ($\Delta = .06$, 95% CI $[-.01, .13]$) and Investigative ($\Delta = .02$, 95% CI $[-.04, .07]$) did not differ significantly from the respective OS coefficients, a result that was not in line with our assumptions.

Mean-Level Development of Vocational Interests

To investigate the mean-level development of vocational interests, we examined the coefficients in the saturated path model (see Table 4) and the trajectories of the latent mean levels. In line with our assumptions, the mean levels of the majority of the interest dimensions decreased from T1 to T4 (Figure 2). The mean levels for Realistic, Investigative, Artistic, and Conventional decreased significantly over the 3-year time period, with effect sizes ranging from $d = -0.44$ to $d = -0.24$. The latent mean levels of these interest dimensions showed a significant linear decrease over time, and including a quadratic growth factor did not substantially improve the model fit according to the indices in Table 5 (for an overview of all model fit indices, see Supplement C).

By contrast, Social was the only interest dimension for which the mean levels increased slightly ($d = 0.07$), whereas the mean levels for Enterprising did not change ($d = -0.01$) from T1 to T4. The latent mean levels for Social and Enterprising showed a linear trend over time, and including a quadratic growth factor did not substantially improve the model fit. For Social, the mean levels of the latent growth factors indicated a significant increase, and for Enterprising, a nonsignificant decrease (see Table 6 and Supplement C).

Gender Differences in the Mean Levels of Vocational Interests

To investigate the mean-level differences between boys and girls, we examined the coefficients in the multigroup saturated path model (see Table 7) and the multigroup GSGM. In line with our assumptions, we found gender differences in the manifest mean levels for Realistic and Investigative, with boys having higher mean levels than girls. For boys and girls, manifest mean levels for Realistic and Investigative decreased significantly from T1 to T4 (see Tables 8 and 9), with standardized effect sizes ranging from $d = -0.44$ to $d = -0.54$ for girls and $d = -0.24$ to $d = -0.35$ for boys. For Realistic and Investigative, the gender differences in the manifest mean levels increased from T1 to T4 (see Figure 3). The latent mean levels for Realistic and the corresponding model fits (see Table 5) indicated a linear trajectory for boys and a quadratic trajectory for girls. For Investigative, the latent mean levels indicated a quadratic trajectory for girls and boys.

In line with our assumptions, we found gender differences in manifest mean levels for Artistic and Social (see Table 7), with girls having higher mean levels than boys. Both boys and girls showed significant decreases in their mean levels for Artistic, with effect sizes of $d = -0.30$ and $d = -0.36$, respectively. Their developmental pattern differed, however, for Social (see Figure 3), where boys did not show significant changes in their mean levels from T1 to T4, and girls showed a significant increase ($d = 0.22$). Differences between boys and girls in their manifest mean levels in Social interest increased over time. For Artistic, gender differences in the manifest mean levels did not increase over time (see Table 7). The latent mean levels for Artistic indicated a linear trajectory for boys and a quadratic trajectory for girls (see Table 5). For Social, the latent mean levels indicated a linear trajectory for girls and boys.

In contrast to our assumptions, for Conventional, boys demonstrated higher manifest mean levels than girls at T3 and T4. In addition, at T3 and T4, boys had higher mean levels than girls for Enterprising. From T1 to T4, boys and girls did not show significant changes in

manifest mean levels for Enterprising. However, both groups showed significant mean-level decreases in Conventional, with $d = -0.32$ for girls and $d = -0.17$ for boys. Despite having similar manifest mean-level change patterns, the manifest mean-level differences between boys and girls on both interest dimensions increased from T1 to T4 (see Figure 3). According to the fit indices (see Table 5), the latent mean levels for Conventional indicated a quadratic trajectory for boys and a linear trajectory for girls. For Enterprising, the latent mean levels indicated a quadratic trajectory for girls and boys.

Discussion

The current study used multiple indicators of continuity and change to examine the development of vocational interests over the course of late childhood and early adolescence (i.e., ages 11 to 14), in a sample in which the same participants were followed over four time points. The multiwave data made it possible to investigate mean-level trajectories and changes in stability coefficients as well as gender differences in vocational interests over time—information that is currently not available for the crucial period of late childhood and early adolescence. In addition, by investigating state and trait variance proportions new empirical evidence was generated that informs about the relative proportions of state and trait components in vocational interests.

Our study had three major findings: First, vocational interests showed moderate retest correlations (around $r = .50$) over the course of late childhood and early adolescence, and the retest correlations for the interest dimensions Realistic, Investigative, Social, and Conventional showed significant increases over time. In addition, the findings on state and trait variance proportions indicated that vocational interests generally possessed a substantial proportion of trait variance that further increased over time. Second, over the course of late childhood and early adolescence, Realistic, Investigative, Artistic, and Conventional, showed decreases in their mean levels. The effect sizes for these changes were small to moderate, and the latent mean-level trajectories indicated linear trends over time. Third, we found gender

differences in the mean levels of all interest dimensions that increased over the course of late childhood and early adolescence for all interest dimensions—except Artistic.

Increasing Stability in Interests during Late Childhood and Early Adolescence

The moderate ($.41 < r < .64$) retest correlations in our study are in line with the meta-analytic findings from Low et al. (2005), who reported an average retest correlation of $r = .51$. In addition, the majority of the interest dimensions possessed retest correlations that increased with age.

The proportions of state and trait variance in the current study indicate that the majority of vocational interests possess a substantial trait component that increases with age. Because no other studies have investigated state and trait variance proportions in vocational interests, we will compare them to constructs that have a similar dispositional nature. Rieger et al. (2017) reported proportions of trait variance for personality traits using the same data set, indicating that the proportions of trait variance in personality traits are similar in magnitude to the ones reported for vocational interests. Rieger et al. (2017) also reported proportions of trait variance for interests in school subjects that were averaged across all time points, with estimates ranging from .27 to .30. The proportions of trait variance found at T4 in the current study were similar in magnitude, ranging from .23 to .33, except for Realistic, which had a proportion of trait variance of .41.

Our results are in line with Holland's (1997) and the TSID model's (Su et al., 2019) theoretical assumptions. Holland (1997) stated that stability is fostered through cumulative learning on the basis of experiences, where preferences for single activities are gradually rewarded and reinforced. Similar assumptions are made by the TSID model, which implies that interests solidify through an accumulation of positive experiences or are altered by an accumulation of negative experiences.

This assumption would also be in line with Gottfredson (1981) because having experiences could help adolescents gain a better sense of their self-concept (i.e., their views of

who they are, what is suitable for them, and what their skills are). An improved understanding of one's self-concept could also lead to a further solidification of interests. If adolescents have a better sense of who they are, what they like, and what they are good at, they may also have a better sense of which activities seem suitable to them.

In line with these thoughts, we assume that the increase in stability and the increase in the proportions of trait variance could be explained by an increase in opportunities to have autonomous experiences that are in line with one's interests. During early adolescence, school (e.g., increased focus on vocational orientation) and peer group environments (Larson & Richards, 1991) as well as relationships with parents (Collins & Russell, 1991; Keijsers & Poulin, 2013; Larson & Richards, 1991) undergo noticeable changes. Accompanied by increased autonomy from their parents (Keijsers & Poulin, 2013), these changes can provide adolescents with a larger range of opportunities to experience new activities (e.g., extracurricular activities). In addition, adolescents become increasingly able to self-select suitable environments and to reengage in the activities they are interested in. In line with Holland (1997) and the TSID model (Su et al., 2019), such an increase in self-determination during the transition from childhood to adolescence should lead to a solidification of vocational interests (Ryan & Deci, 2000).

In addition to this general trend of interest solidification, we also found differences between the six interest dimensions. The Realistic, Investigative, Social, and Conventional dimensions increased in stability, but this was not the case for Artistic or Enterprising. These differences illustrate that not all interest dimensions solidify in the same way over the course of late childhood and early adolescence. The six RIASEC dimensions capture different categories of activities of which some might be more accessible to adolescents than others. If solidification is fostered by having experiences, it can be assumed that activities that are experienced less often or that are less accessible develop differently. For example, we found increases in stability for Realistic and Social but not for Enterprising. Realistic activities often

comprise practical tasks (i.e., building things out of wood, playing outside, or creating things with one's hands) that are already familiar to children and adolescents. Similarly, activities that are related to Social interests mainly describe interactions between people, indicating that Realistic and Social activities are more prominent in the lives of children and young adolescents. By contrast, Enterprising activities, such as leading a group, selling things, and organizing events, are less prominent in the lives of children and young adolescents. Consequently, adolescents might have less opportunities to experience these type of activities, the mental representation of Enterprising activities might be less developed in younger ages, and the respective interest dimension might therefore be less stable (Su et al., 2019).

Decreasing Mean Levels during Late Childhood and Early Adolescence

In line with our expectations, the majority of Holland's (1997) RIASEC dimensions decreased over the course of late childhood and early adolescence, a finding also reported by Hoff et al. (2018) and Päßler and Hell (2020). However, in comparison with Hoff et al. (2018), we found significant decreases in four instead of two RIASEC dimensions and larger effect sizes (Current study: $-0.44 < d < -0.01$; Hoff et al., 2018: $-0.30 < d < -0.02$). Päßler and Hell (2020) found results that were more similar to our study as they also reported significant mean-level decreases for four of the six RIASEC dimensions. In the current study, we found mean-level decreases in Realistic, Investigative, Artistic, and Conventional interests, whereas Päßler and Hell (2020) reported mean-level decreases in Realistic, Investigative, Artistic, and Social interests.

We argue that these overall mean-level decreases could indicate a differentiation process by which adolescents gradually figure out which activities and occupations they do not like—similar explanations were already provided by Tracey (2002) and Krapp (2002). The differentiation could be initiated on the basis of the process of circumscription (Gottfredson, 1981). Adolescents gradually figure out which activities they do not like by circumscribing possible occupational choices on the basis of how well the activities fit with

their developing self-concept. This implies that over time, fewer occupations seem suitable to them. This misfit between one's view of oneself and the view of possible occupations could lead to a decrease in interest intensity and consequently to a decrease in the mean levels of vocational interests.

A different explanation can be derived from personality research, where decreases in mean levels of conscientiousness, agreeableness, and openness have been reported over the course of late childhood and early adolescence (Denissen et al., 2013; Soto et al., 2011; Soto & Tackett, 2015; Van den Akker et al., 2014). The temporary declines in the otherwise increasing trajectories of personality traits during adolescence are described as a disruption period that is assumed to originate from the physiological, social, and normative changes that occur during that time (Soto & Tackett, 2015). Hoff et al. (2018) and Päßler and Hell (2020) argued that the disruption hypothesis should be extended to vocational interests. They stated that due to the challenges that occur during early adolescence, at least one of the basic needs of competence, autonomy, and relatedness—which are necessary for developing interest (Deci & Ryan, 2002)—cannot be regularly fulfilled, which results in a general decrease in interest.

In contrast to our assumptions, we found mean-level increases in Social interest for girls, a finding that was in line with Hoff et al. (2018) and that differed from Päßler and Hell (2020), where the mean levels of Social interest decreased over time. Although we had expected all interest dimensions to decrease, there might be plausible reasons for why Social interests, by contrast, increased in our sample for girls. People with higher scores on Social interests usually prefer activities such as listening to someone's problems, helping other people, or engaging in social situations (Holland, 1997). They also tend to be characterized as empathic, friendly, and sociable (Holland, 1997). There is evidence that similar behaviors and characteristics seem to be relevant in social interactions and especially for popularity in peer groups (Parkhurst & Hopmeyer, 1998). Late childhood and early adolescence are

characterized by an increase in the orientation toward (Berndt, 1979; Fuligni et al., 2001) and the time spent in peer groups (Larson & Richards, 1991). Therefore, it could be assumed that increases in peer-group importance are accompanied by increases in Social interests—which might be beneficial for integration into and socialization in peer groups. These increases in Social interests may also resemble general increases in people-oriented interests (i.e., Social, Artistic, and Enterprising interests) reported by Hoff et al. (2018) for late adolescence and older age groups. In returning to the multidimensionality of vocational interests, this suggests that differences in developmental patterns might also be influenced by the functions these interests can fulfill in adolescents or the outcomes that are associated with these interests.

Increasing Gender Differences during Late Childhood and Early Adolescence

We found gender differences for Realistic, Investigative, Social, and Artistic as early as fifth grade. Similar findings were reported by Tracey (2002) and Päßler and Hell (2020). These findings are in line with Gottfredson (1981), who proposed that gender differences begin to manifest at the age of 6. In addition, we also found increases in gender differences in all interest dimensions except Artistic. These findings were in line with Hoff et al. (2018), who reported increases in gender differences for Realistic and Social interests. However, the current study is the first to report increases in gender differences for a majority of interest dimensions. At T4, we found gender differences on all interest dimensions, with Realistic, Investigative, Enterprising, and Conventional demonstrating higher values for boys, and Artistic and Social demonstrating higher values for girls. These results were largely in line with the findings of the meta-analysis by Su et al. (2009), who reported higher mean levels for girls on Artistic, Social, and Conventional and higher mean levels for boys on Realistic, Investigative, and Enterprising.

Increases in gender differences over the course of late childhood and early adolescence are in line with the increased gender orientation in this life phase described by Gottfredson (1981). Children and adolescents incorporate gender as an important aspect of their self and

are consequently more drawn to activities and occupations that represent the matching gender. In addition, gender differences in vocational interests could be strengthened by an increase in peer-group orientation during late childhood and early adolescence (Berndt, 1979; Fuligni et al., 2001; Larson & Richards, 1991). There is evidence that peer groups during late childhood are either more female-dominant or male-dominant (Rubin et al., 2006; Wilson et al., 2011). Therefore, children and adolescents might not only incorporate gender into their self-concept, but they might also socialize within same-sex peer groups, which might in turn contribute to the development of more gendered interests.

Integrating Current Findings into the Life Course Development of Vocational Interests

The current study complements a recent trend of emerging multiwave studies in vocational interest research (Hoff et al., 2020; Päßler & Hell, 2020; Stoll, Rieger, et al., 2020). Taken together, the findings from these multiwave longitudinal studies provide information about the pattern of vocational interest development that spans an age range from late childhood and early adolescence (ages 10 to 12; Päßler & Hell, 2020), late adolescence to young adulthood (ages 16 to 24; Hoff et al., 2020), and a 10-year time period across young adulthood (ages 19 to 29; Stoll, Rieger, et al., 2020). The present study investigated the age range of 11 to 14 and therefore extends the existing longitudinal findings.

Regarding stabilities in vocational interests the current study is the first to demonstrate that the stability of vocational interests has already begun to increase at younger ages. This indicates that increases in stability are already beginning as early as late childhood, continue afterwards from late adolescence to young adulthood (Hoff et al., 2020; Stoll, Rieger, et al., 2020), and halt during young adulthood (Stoll, Rieger, et al., 2020). However, increases in stability during late childhood and early adolescence are relatively small in comparison with the increases that occur in later life stages (Hoff et al., 2020).

Regarding state and trait variance components of vocational interests, the current study provides first insights that trait variance proportions increase across late childhood and early

adolescence. However, as proposed by Su et al. (2019), also state variance proportions were substantial, especially during late childhood, suggesting that vocational interests can consist of both, state and trait components. Although empirical evidence is missing so far, according to Holland (1997), we would assume that trait variance proportions further increase over the life course, while state variance proportions further decrease. More research with older samples is needed to test these assumptions.

Regarding normative change in vocational interests, the current study supports previous findings for late childhood and early adolescence. Taken together, the longitudinal mean-level trajectories indicate that the mean levels of vocational interests decrease over the course of late childhood and early adolescence (Päbller & Hell, 2020), increase from late adolescence to young adulthood (Hoff et al., 2020; Stoll, Rieger, et al., 2020), and remain relatively stable during young adulthood (Stoll, Rieger, et al., 2020). This suggests that the disruption hypothesis, which was originally proposed in personality trait research, can also be applied to vocational interests (for a similar argumentation, see Hoff et al., 2018; Päbller & Hell, 2020).

Previous findings have indicated that gender differences are already present during late childhood and early adolescence (Päbller & Hell, 2020) and remain relatively stable across young adulthood (Stoll, Rieger, et al., 2020). However, the results of the current study suggest that gender differences in vocational interests increase during late childhood and early adolescence. This finding was very prominent as all interest dimensions, except Artistic, exhibited increases in gender differences over time.

In regards to the life span development of vocational interests, our study provides important information on the developmental pattern in late childhood and early adolescence. However, the picture is not yet complete and more longitudinal studies are needed, that focus on other relevant life phases—including for example the entrance in school or the transition from work life to retirement.

Limitations and Future Outlook

This study has several strengths such as a large multiwave longitudinal sample that captures an important—and so far, understudied—life phase, as well as the investigation of three different indicators of stability and change. However, there are some limitations that should be mentioned. First, the students included in our sample were from the low and intermediate school tracks in Germany, whereas academic track students were not part of the sample. This could limit the generalizability of our results. However, the general lower, intermediate, and higher tracks in Germany are not tracked by content type (e.g., Technical, Economic, or Nursing School), which indicates that although school tracks differ in their performance requirements, they do not differ in the content-related experiences they offer. In addition, the theory of vocational interests does not propose different developmental trajectories for students from different academic or school tracks. Nevertheless, future studies on interest development in younger age groups should also include students from the highest school track in order to capture the entire student population.

Second, only partial measurement invariance could be achieved across the Time $\times$ Gender interaction, indicating that some of the items were interpreted differentially by boys and girls (Putnick & Bornstein, 2016). For example, we found intercept differences between boys and girls on the item “studying the behavior of animals and plants”. This means that boys and girls do not attribute the same meaning and interpretation to this item, for example, girls could interpret this as an activity that focuses on reading a biology book, which would entail Artistic elements because reading is involved. Boys, on the other hand, could view the activity as physical because studying the behavior of animals and plants is usually done in nature. However, valid inferences about differences in latent means can still be drawn as long as two factor loadings and the intercepts of the respective factor model are invariant across groups (Byrne et al., 1989; van de Schoot et al., 2012). In addition, Schmitt et al. (2011) demonstrated only small differences in latent mean levels between the full and partial

measurement invariance models across groups—when partial invariance was applied. This indicates that partial measurement invariance should not have largely affected our results because the majority of the item intercepts were invariant across groups, indicating that, overall, boys and girls had the same understanding of the six dimensions of vocational interests.

Third, the goal of the current study was to investigate mean-level change, retest correlations and state-trait variance proportions of vocational interests in a descriptive way. We did not probe for the effects of specific factors that might have driven continuity and change in vocational interests. Accordingly, we can only speculate about the reasons and processes that led to the changes in mean levels, retest correlations, and proportions of state and trait variance. Future studies should focus on the factors that could influence vocational interest development. In the current study, we discussed several mechanisms that might influence vocational interest development. However, future research will need to investigate these mechanisms to provide further insights into the processes that drive vocational interest development.

Conclusion

The present study illustrates that vocational interest development over the course of late childhood and early adolescence can be characterized by an increase in stability, an increase in trait variance proportions, a decrease in mean levels, and an increase in gender differences. Our results demonstrate that longitudinal studies based on multiwave data can provide crucial descriptive information and improve the understanding of vocational interest development. These descriptive insights could lay the groundwork for future research that focuses on underlying processes and predictors of mean-level changes and stability in vocational interests.

Data Accessibility Statement

Because of reasons of data protection, the dataset used in the present investigation is not openly accessible, but the variance-covariance matrices as well as mean vectors of the variables can be found in the analysis scripts that are accessible through the following link:
https://osf.io/tuys8/?view_only=9f05a36a29bd49e5b700a0ee4b40eb78.

References

- Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, Personality, and Interests: Evidence for Overlapping Traits. *Psychological Bulletin*, 121(2), 219–245.
<https://doi.org/10.1037/0033-2909.121.2.219>
- Allen, J., & Robbins, S. B. (2008). Prediction of college major persistence based on vocational interests, academic preparation, and first-year academic performance. *Research in Higher Education*, 49, 62–79. <https://doi.org/10.1007/s11162-007-9064-5>
- Asparouhov, T., & Muthén, B. (2008). *Auxiliary variables predicting missing data*.
<https://www.statmodel.com/download/AuxM2.pdf>
- Bergmann, C., & Eder, F. (2005). *Allgemeiner Interessen-Struktur-Test mit Umwelt-Struktur-Test (UST-R)—Revision [General Interest Structure Test and Environmental Structure Test—Revision]*. Beltz.
- Berndt, T. J. (1979). Developmental changes in conformity to peers and parents. *Developmental Psychology*, 15(6), 608–616.
- Bishop, J., Geiser, C., & Cole, D. A. (2015). Modeling latent growth with multiple indicators: A comparison of three approaches. *Psychological Methods*, 20(1), 43–62.
<https://doi.org/10.1037/met0000018>
- Braun, L., Göllner, R., Rieger, S., Trautwein, U., & Spengler, M. (2020). How state and trait versions of self-esteem and depressive symptoms affect their interplay: A longitudinal experimental investigation. *Journal of Personality and Social Psychology*.
<https://doi.org/10.1037/pspp0000295>
- Byrne, B. M., Shavelson, R. J., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Methods*, 105(3), 456–466. <https://doi.org/10.1037/0033-2909.105.3.456>

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance.

Structural Equation Modeling: A Multidisciplinary Journal, 14(3), 464–504.

<https://doi.org/10.1080/10705510701301834>

Cole, D. A., Maxwell, S. E., Martin, J. M., Peeke, L. G., Seroczynski, A. D., Tram, J. M.,

Hoffman, K. B., Ruiz, M. D., Jacquez, F., & Maschman, T. (2001). The development of multiple domains of child and adolescent self-concept: A cohort sequential

longitudinal design. *Child Development*, 72(6), 1723–1746.

<https://doi.org/10.1111/1467-8624.00375>

Collins, L. M., Schafer, J. L., & Kam, C.-M. (2001). A comparison of inclusive and restrictive strategies in modern missing data procedures. *Psychological Methods*, 6(4), 330–351.

<https://doi.org/10.1037/1082-989X.6.4.330>

Collins, W. A., & Russell, G. (1991). Mother-child and father-child relationships in middle childhood and adolescence: A developmental analysis. *Developmental Review*, 11(2),

99–136. [https://doi.org/10.1016/0273-2297\(91\)90004-8](https://doi.org/10.1016/0273-2297(91)90004-8)

Denissen, J. J. A., van Aken, M. A. G., Penke, L., & Wood, D. (2013). Self-regulation underlies temperament and personality: An integrative developmental framework.

Child Development Perspectives, 7(4), 255–260. <https://doi.org/10.1111/cdep.12050>

Denissen, J. J. A., Zarrett, N. R., & Eccles, J. S. (2007). I like to do it, I'm able, and I know I am: Longitudinal couplings between domain-specific achievement, self-concept, and

interest. *Child Development*, 78(2), 430–447. <https://doi.org/10.1111/j.1467-8624.2007.01007.x>

Enders, C. K. (2001). The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychological Methods*,

6(4), 352–370. <https://doi.org/10.1037/1082-989X.6.4.352>

Enders, C. K. (2008). A note on the use of missing auxiliary variables in full information

maximum likelihood-based structural equation models. *Structural Equation Modeling:*

A Multidisciplinary Journal, 15(3), 434–448.

<https://doi.org/10.1080/10705510802154307>

- Fuligni, A. J., Eccles, J. S., Barber, B. L., & Clements, P. (2001). Early adolescent peer orientation and adjustment during high school. *Developmental Psychology*, 37(1), 28–36. <https://doi.org/10.1037/0012-1649.37.1.28>
- Gaspard, H., Häfner, I., Parrisius, C., Trautwein, U., & Nagengast, B. (2017). Assessing task values in five subjects during secondary school: Measurement structure and mean level differences across grade level, gender, and academic subject. *Contemporary Educational Psychology*, 48, 67–84. <https://doi.org/10.1016/j.cedpsych.2016.09.003>
- Gati, I., Levin, N., & Landman-Tal, S. (2019). Decision-Making Models and Career Guidance. In J. A. Athanasou & H. N. Perera (Eds.), *International Handbook of Career Guidance* (2nd ed.). Springer International Publishing.
- Geiser, C., Keller, B. T., Lockhart, G., Eid, M., Cole, D. A., & Koch, T. (2015). Distinguishing state variability from trait change in longitudinal data: The role of measurement (non)invariance in latent state-trait analyses. *Behavior Research Methods*, 47(1), 172–203. <https://doi.org/10.3758/s13428-014-0457-z>
- Gottfredson, L. S. (1981). Circumscription and compromise: A developmental theory of occupational aspirations. *Journal of Counseling Psychology*, 28(6), 545–579. <https://doi.org/10.1037/0022-0167.28.6.545>
- Graham, J. W. (2003). Adding missing-data-relevant variables to FIML-based structural equation models. *Structural Equation Modeling*, 10(1), 80–100. https://doi.org/10.1207/S15328007SEM1001_4
- Gysbers, N. C. (2005). Comprehensive school guidance programs in the United States: A career profile. *International Journal for Educational and Vocational Guidance*, 5(2), 203–215. <https://doi.org/10.1007/s10775-005-8800-7>

- Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist, 41*, 111–127. https://doi.org/10.1207/s15326985ep4102_4
- Hoff, K. A., Briley, D. A., Wee, C. J. M., & Rounds, J. (2018). Normative changes in interests from adolescence to adulthood: A meta-analysis of longitudinal studies. *Psychological Bulletin, 144*(4), 426–451. <https://doi.org/10.1037/bul0000140>
- Hoff, K. A., Song, Q. C., Einarsdóttir, S., Briley, D. A., & Rounds, J. (2020). Developmental structure of personality and interests: A four-wave, 8-year longitudinal study. *Journal of Personality and Social Psychology, 118*(5), 1044–1064. <https://doi.org/10.1037/pspp0000228>
- Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Jonkmann, K., Rose, N., & Trautwein, U. (2013). *Tradition und Innovation: Entwicklungsverläufe an Haupt- und Realschulen in Baden-Württemberg und Mittelschulen in Sachsen – Abschlussbericht für die Länder Baden-Württemberg und Sachsen [unpublished project report]*. Universität Tübingen.
- Keijsers, L., & Poulin, F. (2013). Developmental changes in parent–child communication throughout adolescence. *Developmental Psychology, 49*(12), 2301–2308. <https://doi.org/10.1037/a0032217>
- Knapp, R. R., & Knapp, L. (1984). *COPS Interest Inventory manual*. EdITS.
- Kracke, B. (1997). Parental behaviors and adolescents' career exploration. *The Career Development Quarterly, 45*, 341–350. <https://doi.org/10.1002/j.2161-0045.1997.tb00538.x>

- Krapp, A. (2002). Structural and dynamic aspects of interest development: Theoretical considerations from an ontogenetic perspective. *Learning and Instruction, 12*(4), 383–409. [https://doi.org/10.1016/S0959-4752\(01\)00011-1](https://doi.org/10.1016/S0959-4752(01)00011-1)
- Kuder, G. F. (1964). *Kuder General Interest Survey—Form E*. Science Research Associates.
- Kuder, G. F. (1975). *Kuder General Interest Survey manual*. Science Research Associates.
- Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4*, 1–12. <https://doi.org/10.3389/fpsyg.2013.00863>
- Larson, R., & Richards, M. H. (1991). Daily companionship in late childhood and early adolescence: Changing developmental contexts. *Child Development, 62*(2), 284–300. <https://doi.org/10.1111/j.1467-8624.1991.tb01531.x>
- Low, K. S. D., & Rounds, J. (2007). Interest change and continuity from early adolescence to middle adulthood. *International Journal for Educational and Vocational Guidance, 7*(1), 23–36. <https://doi.org/10.1007/s10775-006-9110-4>
- Low, K. S. D., Yoon, M., Roberts, B. W., & Rounds, J. (2005). The stability of vocational interests from early adolescence to middle adulthood: A quantitative review of longitudinal studies. *Psychological Bulletin, 131*(5), 713–737. <https://doi.org/10.1037/0033-2909.131.5.713>
- Lubinski, D., Benbow, C. P., & Ryan, J. (1995). Stability of vocational interests among the intellectually gifted from adolescence to adulthood: A 15-year longitudinal study. *Journal of Applied Psychology, 80*(1), 196–200. <https://doi.org/10.1037/0021-9010.80.1.196>
- McArdle, J. J., & Epstein, D. (1987). Latent growth curves within developmental structural equation models. *Child Development, 58*(1), 110–133. <https://doi.org/10.2307/1130295>

- McNeish, D. (2018). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*, 23(3), 412–433. <https://doi.org/10.1037/met0000144>
- McNeish, D., Stapleton, L. M., & Silverman, R. D. (2017). On the unnecessary ubiquity of hierarchical linear modeling. *Psychological Methods*, 22(1), 114–140. <https://doi.org/10.1037/met0000078>
- Mount, M. K., Barrick, M. R., Scullen, S. M., & Rounds, J. (2005). Higher Order Dimensions of the Big Five Personality Traits and the Big Six Vocational Interest Types. *Personnel Psychology*, 58(2), 447–478. <https://doi.org/10.1111/j.1744-6570.2005.00468.x>
- Muthén, B., & Muthén, L. K. (1998_2017). *Mplus User's Guide* (8th ed.). Muthén & Muthén.
- Noack, P., Kracke, B., Gniewosz, B., & Dietrich, J. (2010). Parental and school effects on students' occupational exploration: A longitudinal and multilevel analysis. *Journal of Vocational Behavior*, 77(1), 50–57. <https://doi.org/10.1016/j.jvb.2010.02.006>
- Nye, C. D., Su, R., Rounds, J., & Drasgow, F. (2012). Vocational interests and performance: A quantitative summary of over 60 years of research. *Perspectives on Psychological Science*, 7(4), 384–403. <https://doi.org/10.1177/1745691612449021>
- Nye, C. D., Su, R., Rounds, J., & Drasgow, F. (2017). Interest congruence and performance: Revisiting recent meta-analytic findings. *Journal of Vocational Behavior*, 98, 138–151. <https://doi.org/10.1016/j.jvb.2016.11.002>
- Parkhurst, J. T., & Hopmeyer, A. (1998). Sociometric popularity and peer-perceived popularity: Two distinct dimensions of peer status. *The Journal of Early Adolescence*, 18(2), 125–144. <https://doi.org/10.1177/0272431698018002001>
- Päßler, K., & Hell, B. (2012). Do interests and cognitive abilities help explain college major choice equally well for women and men? *Journal of Career Assessment*, 20(4), 479–496. <https://doi.org/10.1177/1069072712450009>

- Päßler, K., & Hell, B. (2020). Stability and change in vocational interests from late childhood to early adolescence. *Journal of Vocational Behavior*, 121, 103462.
<https://doi.org/10.1016/j.jvb.2020.103462>
- Petersen, A. C. (1987). The nature of biological-psychosocial interactions: The sample case of early adolescence. In R. M. Lerner & T. T. Foch (Eds.), *Child psychology. Biological-psychosocial interactions in early adolescence* (pp. 35–61). Lawrence Erlbaum Associates, Inc.
- Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental Review*, 41, 71–90. <https://doi.org/10.1016/j.dr.2016.06.004>
- Renninger, K. A., & Hidi, S. (2011). Revisiting the Conceptualization, Measurement, and Generation of Interest. *Educational Psychologist*, 46, 168–184.
<https://doi.org/10.1080/00461520.2011.587723>
- Rieger, S., Göllner, R., Spengler, M., Trautwein, U., Nagengast, B., & Roberts, B. W. (2017). Social Cognitive Constructs Are Just as Stable as the Big Five Between Grades 5 and 8. *AERA Open*, 3(3), 1–9. <https://doi.org/10.1177/2332858417717691>
- Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, 132(1), 1–25. <https://doi.org/10.1037/0033-2909.132.1.1>
- Rounds, J., & Su, R. (2014). The nature and power of interests. *Current Directions in Psychological Science*, 23(2), 98–103. <https://doi.org/10.1177/0963721414522812>
- Rubin, K. H., Bukowski, W. M., & Parker, J. G. (2006). Peer interactions, relationships, and groups. In N. Eisenberg, W. Damon, & R. M. Lerner (Eds.), *Handbook of Child Psychology* (pp. 571–645). John Wiley & Sons, Inc.
<https://doi.org/10.1002/9780470147658.chpsy0310>

- Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, 25(1), 54–67.
<https://doi.org/10.1006/ceps.1999.1020>
- Schmitt, N., Golubovich, J., & Leong, F. T. L. (2011). Impact of measurement invariance on construct correlations, mean differences, and relations with external correlates: An illustrative example using Big Five and RIASEC measures. *Assessment*, 18(4), 412–427. <https://doi.org/10.1177/1073191110373223>
- Schmukle, S. C., & Egloff, B. (2005). A Latent State-Trait Analysis of Implicit and Explicit Personality Measures. *European Journal of Psychological Assessment*, 21(2), 100–107. <https://doi.org/10.1027/1015-5759.21.2.100>
- Silvia, P. J. (2001). Interest and Interests: The Psychology of Constructive Capriciousness. *Review of General Psychology*, 5(3), 270–290. <https://doi.org/10.1037/1089-2680.5.3.270>
- Soto, C. J., John, O. P., Gosling, S. D., & Potter, J. (2011). Age differences in personality traits from 10 to 65: Big Five domains and facets in a large cross-sectional sample. *Journal of Personality and Social Psychology*, 100(2), 330–348.
<https://doi.org/10.1037/a0021717>
- Soto, C. J., & Tackett, J. L. (2015). Personality Traits in Childhood and Adolescence: Structure, Development, and Outcomes. *Current Directions in Psychological Science*, 24(5), 358–362. <https://doi.org/10.1177/0963721415589345>
- Steyer, R., Schmitt, M., & Eid, M. (1999). Latent state-trait theory and research in personality and individual differences. *European Journal of Personality*, 13(5), 389–408.
[https://doi.org/10.1002/\(SICI\)1099-0984\(199909/10\)13:5<389::AID-PER361>3.0.CO;2-A](https://doi.org/10.1002/(SICI)1099-0984(199909/10)13:5<389::AID-PER361>3.0.CO;2-A)
- Stoll, G., Einarsdóttir, S., Chelsea Song, Q., Ondish, P., Sun, J.-T., & Rounds, J. (2020). The Roles of Personality Traits and Vocational Interests in Explaining What People Want

out of Life. *Journal of Research in Personality*, 86, 103939.

<https://doi.org/10.1016/j.jrp.2020.103939>

Stoll, G., Rieger, S., Lüdtke, O., Nagengast, B., Trautwein, U., & Roberts, B. W. (2017).

Vocational interests assessed at the end of high school predict life outcomes assessed 10 years later over and above IQ and Big Five personality traits. *Journal of Personality and Social Psychology*, 113(1), 167–184.

<https://doi.org/10.1037/pspp0000117>

Stoll, G., Rieger, S., Nagengast, B., Trautwein, U., & Rounds, J. (2020). Stability and change in vocational interests after graduation from high school: A six-wave longitudinal study. *Journal of Personality and Social Psychology*.

<https://doi.org/10.1037/pspp0000359>

Su, R. (2012). *Power of vocational interests and interest congruence in predicting career success [unpublished doctoral dissertation]*.

https://www.ideals.illinois.edu/bitstream/handle/2142/34329/Su_Rong.pdf?sequence=1&isAllowed=y

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, 135(6), 859–884.

<https://doi.org/10.1037/a0017364>

Su, R., Stoll, G., & Rounds, J. (2019). The nature of interests: Toward a unifying theory of trait-situation interest dynamics. In C. D. Nye & J. Rounds (Eds.), *Vocational interests: Rethinking their role in understanding workplace behavior and practice* (pp. 11–38). Taylor & Francis/Routledge. <https://doi.org/10.4324/9781315678924-2>

Tracey, T. J. G. (2002). Development of interests and competency beliefs: A 1-year longitudinal study of fifth- to eighth-grade students using the ICA-R and structural equation modeling. *Journal of Counseling Psychology*, 49(2), 148–163.

<https://doi.org/10.1037//0022-0167.49.2.148>

- Tracey, T. J. G., & Ward, C. C. (1998). The structure of children's interests and competence perceptions. *Journal of Counseling Psychology, 45*(3), 290–303.
<https://doi.org/10.1037/0022-0167.45.3.290>
- Usslepp, N., Hübner, N., Stoll, G., Spengler, M., Trautwein, U., & Nagengast, B. (2020). RIASEC interests and the Big Five personality traits matter for life success—But do they already matter for educational track choices? *Journal of Personality, 88*(5), 1007–1024. <https://doi.org/10.1111/jopy.12547>
- van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology, 9*(4), 486–492.
<https://doi.org/10.1080/17405629.2012.686740>
- Van den Akker, A. L., Deković, M., Asscher, J., & Prinzie, P. (2014). Mean-level personality development across childhood and adolescence: A temporary defiance of the maturity principle and bidirectional associations with parenting. *Journal of Personality and Social Psychology, 107*(4), 736–750. <https://doi.org/10.1037/a0037248>
- Van Iddekinge, C. H., Roth, P. L., Putka, D. J., & Lanivich, S. E. (2011). Are you interested? A meta-analysis of relations between vocational interests and employee performance and turnover. *Journal of Applied Psychology, 96*(6), 1167–1194.
<https://doi.org/10.1037/a0024343>
- von Maurice, J. (2006). *ICA-D. Deutschsprachige Version des Inventory of Children's Activities – Revised (ICA-R, Tracey & Ward, 1998)[unpublished instrument]*. Otto-Friedrich-Universität Bamberg.
- Whiston, S. C., & Keller, B. K. (2004). The influences of the family of origin on career development: A review and analysis. *The Counseling Psychologist, 32*(4), 493–568.
<https://doi.org/10.1177/0011000004265660>
- Wille, E., Stoll, G., Gfrörer, T., Cambria, J., Nagengast, B., & Trautwein, U. (2020). It takes two: Expectancy-value constructs and vocational interests jointly predict STEM major

choices. *Contemporary Educational Psychology*, 61, 101858.

<https://doi.org/10.1016/j.cedpsych.2020.101858>

Wilson, T., Karimpour, R., & Rodkin, P. C. (2011). African American and European American students' peer groups during early adolescence: Structure, status, and academic achievement. *The Journal of Early Adolescence*, 31(1), 74–98.

<https://doi.org/10.1177/0272431610387143>

Yuan, K.-H., & Bentler, P. M. (2000). Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data. *Sociological Methodology*, 30(1), 165–200. <https://doi.org/10.1111/0081-1750.00078>

Zytowski, D. G. (1976). Long-term profile stability of the Kuder Occupational Interest Survey. *Educational and Psychological Measurement*, 36(3), 689–692.

<https://doi.org/10.1177/001316447603600315>

Table 1
Reliability Coefficients and Item Examples

Interests	Items	Sample items (wording)	Preferred activities	ω (T1, T2, T3, T4)
		“Are you interested in the following things?”		
R	6	“building something”	Practical activities	.85, .86, .87, .89
I	6	“experimenting in a lab”	Problem solving activities and analytical thinking	.80, .81, .83, .84
A	6	“drawing pictures”	Creative activities	.77, .80, .81, .79
S	6	“helping others”	Teaching, caring, and informing	.83, .86, .86, .85
E	6	“leading a group”	Manipulating and leading others	.81, .80, .78, .79
C	6	“organizing things”	Structured tasks such as organizing and sorting	.81, .83, .83, .81

Note. ω = Omega Total (coefficient was computed in the framework of confirmatory factor analysis, and as required, the factor variances of the measurement models were constrained to one); R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

Table 2*Manifest Retest Correlations of RIASEC Scales and their Change over Time*

Int.	Time Interval	<i>r</i> [95% CI]	Time Interval Change	Δr [95% CI]
R	1 to 2	.55 [.51, .59]		
	2 to 3	.64 [.60, .67]	1 to 2 and 2 to 3	.08 [.04, .13]
	3 to 4	.64 [.60, .67]	2 to 3 and 3 to 4	.00 [-.05, .05]
	1 to 4	.49 [.45, .53]	1 to 2 and 3 to 4	.08 [.03, .13]
I	1 to 2	.43 [.38, .47]		
	2 to 3	.54 [.50, .58]	1 to 2 and 2 to 3	.11 [.06, .17]
	3 to 4	.51 [.47, .55]	2 to 3 and 3 to 4	-.03 [-.08, .02]
	1 to 4	.33 [.28, .38]	1 to 2 and 3 to 4	.08 [.02, .14]
A	1 to 2	.53 [.49, .57]		
	2 to 3	.58 [.54, .62]	1 to 2 and 2 to 3	.05 [.00, .11]
	3 to 4	.56 [.52, .60]	2 to 3 and 3 to 4	-.02 [-.07, .03]
	1 to 4	.42 [.38, .46]	1 to 2 and 3 to 4	.03 [-.02, .09]
S	1 to 2	.49 [.44, .53]		
	2 to 3	.56 [.51, .60]	1 to 2 and 2 to 3	.07 [.01, .12]
	3 to 4	.55 [.51, .59]	2 to 3 and 3 to 4	-.00 [-.05, .05]
	1 to 4	.41 [.36, .46]	1 to 2 and 3 to 4	.07 [.01, .12]
E	1 to 2	.43 [.38, .47]		
	2 to 3	.55 [.51, .58]	1 to 2 and 2 to 3	.12 [.07, .17]
	3 to 4	.47 [.43, .51]	2 to 3 and 3 to 4	-.08 [-.13, -.03]
	1 to 4	.34 [.29, .39]	1 to 2 and 3 to 4	.04 [-.02, .10]
C	1 to 2	.41 [.36, .46]		
	2 to 3	.52 [.47, .56]	1 to 2 and 2 to 3	.11 [.06, .17]
	3 to 4	.47 [.43, .51]	2 to 3 and 3 to 4	-.05 [-.11, .01]
	1 to 4	.32 [.27, .38]	1 to 2 and 3 to 4	.06 [.00, .12]

Note. $N = 3,875$; Int. = RIASEC interest dimensions; r = retest correlation between two time intervals; Δr = difference between adjacent retest correlations; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

Table 3*Consistency and Occasion Specificity of RIASEC Dimensions per Time Point*

Int.	TL	CO [95% CI]	Δ [95% CI]	OS [95% CI]	Δ [95% CI]
R _L	1	.29 [.26, .32]		.19 [.16, .22]	
	2	.32 [.30, .34]	.03 [.01, .06]	.18 [.16, .21]	-.01 [-.04, .03]
	3	.36 [.33, .38]	.04 [.02, .05]	.16 [.14, .19]	-.02 [-.05, .01]
	4	.41 [.37, .44]	.05 [.02, .08]	.17 [.14, .21]	.01 [-.03, .05]
	14		.12 [.08, .16]		-.02 [-.06, .03]
I _L	1	.26 [.23, .28]		.19 [.16, .21]	
	2	.21 [.19, .23]	-.05 [-.07, -.03]	.24 [.22, .27]	.05 [.03, .08]
	3	.22 [.19, .24]	.01 [-.01, .02]	.23 [.20, .25]	-.02 [-.04, .01]
	4	.27 [.24, .30]	.06 [.04, .07]	.26 [.22, .29]	.03 [.00, .06]
	14		.02 [-.02, .05]		.07 [.03, .11]
A _L	1	.23 [.20, .25]		.17 [.14, .19]	
	2	.22 [.21, .24]	.00 [-.02, .01]	.17 [.15, .20]	.01 [-.02, .04]
	3	.24 [.22, .26]	.01 [.00, .03]	.18 [.16, .21]	.01 [-.01, .04]
	4	.28 [.26, .30]	.04 [.03, .06]	.15 [.13, .18]	-.03 [-.06, .00]
	14		.06 [.03, .08]		-.01 [-.05, .02]
S _L	1	.26 [.23, .29]		.21 [.18, .24]	
	2	.25 [.22, .28]	-.01 [-.03, .01]	.24 [.22, .27]	.04 [.01, .07]
	3	.27 [.24, .30]	.02 [.00, .03]	.23 [.20, .26]	-.01 [-.04, .01]
	4	.33 [.31, .36]	.07 [.04, .09]	.19 [.15, .23]	-.04 [-.08, -.01]
	14		.07 [.04, .11]		-.02 [-.06, .03]
E _L	1	.20 [.18, .23]		.21 [.18, .24]	
	2	.22 [.20, .23]	.01 [-.01, .03]	.18 [.16, .20]	-.03 [-.07, .00]
	3	.22 [.20, .23]	.00 [-.02, .02]	.17 [.15, .19]	-.01 [-.04, .02]
	4	.23 [.20, .27]	.02 [-.01, .05]	.17 [.14, .21]	.00 [-.04, .05]
	14		.03 [-.01, .07]		-.04 [-.09, .01]
C _L	1	.20 [.17, .23]		.25 [.21, .28]	
	2	.20 [.18, .23]	.00 [-.02, .02]	.25 [.23, .28]	.01 [-.02, .04]
	3	.22 [.20, .24]	.02 [.00, .03]	.22 [.20, .25]	-.03 [-.06, .00]
	4	.26 [.23, .29]	.04 [.02, .07]	.18 [.15, .21]	-.04 [-.08, -.01]
	14		.06 [.02, .10]		-.07 [-.11, -.02]

Note. Int. = RIASEC interest dimensions; TL = time lag; CO = consistency coefficient; Δ = differences in the consistency and occasion specificity coefficient over time; OS = occasion specificity coefficient; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; _L = linear growth factor; _Q = quadratic growth factor; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table 4*Descriptive Statistics and Mean-Level Change in the RIASEC Scales in the Overall Sample*

Int.	TL	<i>M</i> [95% CI]	<i>SD</i> [95% CI]	Δ [95% CI]	<i>d</i>
R	1	3.07 [3.00, 3.14]	1.16 [1.14, 1.19]		
	2	3.00 [2.94, 3.05]	1.13 [1.10, 1.15]	-0.07 [-0.13, -0.01]	-0.06
	3	2.88 [2.83, 2.93]	1.12 [1.10, 1.15]	-0.12 [-0.17, -0.07]	-0.11
	4	2.73 [2.68, 2.78]	1.13 [1.10, 1.15]	-0.15 [-0.19, -0.11]	-0.13
	14			-0.34 [-0.41, -0.27]	-0.30
I	1	3.11 [3.04, 3.19]	1.08 [1.05, 1.10]		
	2	2.99 [2.94, 3.04]	1.03 [1.00, 1.06]	-0.13 [-0.19, -0.06]	-0.12
	3	2.87 [2.82, 2.91]	0.99 [0.96, 1.02]	-0.12 [-0.17, -0.08]	-0.12
	4	2.66 [2.62, 2.71]	0.99 [0.96, 1.02]	-0.20 [-0.25, -0.16]	-0.20
	14			-0.45 [-0.53, -0.37]	-0.44
A	1	3.22 [3.16, 3.28]	1.02 [0.99, 1.05]		
	2	3.16 [3.12, 3.21]	0.98 [0.96, 1.01]	-0.05 [-0.11, 0.00]	-0.05
	3	3.05 [3.00, 3.09]	0.98 [0.95, 1.00]	-0.12 [-0.16, -0.07]	-0.12
	4	2.91 [2.87, 2.95]	0.96 [0.93, 0.98]	-0.14 [-0.18, -0.09]	-0.14
	14			-0.31 [-0.37, -0.25]	-0.31
S	1	3.19 [3.12, 3.25]	1.04 [1.01, 1.07]		
	2	3.22 [3.17, 3.28]	1.02 [0.99, 1.05]	0.04 [-0.02, 0.09]	0.03
	3	3.22 [3.17, 3.27]	0.98 [0.96, 1.01]	0.00 [-0.04, 0.04]	0.00
	4	3.26 [3.21, 3.30]	0.96 [0.94, 0.99]	0.03 [-0.01, 0.08]	0.03
	14			0.07 [0.01, 0.13]	0.07
E	1	2.89 [2.82, 2.97]	1.07 [1.04, 1.10]		
	2	2.97 [2.92, 3.01]	0.97 [0.95, 1.00]	0.08 [0.01, 0.14]	0.07
	3	2.95 [2.91, 3.00]	0.92 [0.89, 0.94]	-0.02 [-0.06, 0.03]	-0.02
	4	2.89 [2.84, 2.93]	0.89 [0.87, 0.91]	-0.06 [-0.10, -0.02]	-0.07
	14			-0.01 [-0.08, 0.07]	-0.01
C	1	2.87 [2.80, 2.94]	1.04 [1.01, 1.07]		
	2	2.81 [2.76, 2.86]	1.00 [0.98, 1.03]	-0.06 [-0.12, 0.00]	-0.06
	3	2.73 [2.68, 2.77]	0.96 [0.93, 0.99]	-0.09 [-0.15, -0.04]	-0.09
	4	2.64 [2.59, 2.68]	0.92 [0.89, 0.95]	-0.09 [-0.13, -0.05]	-0.09
	14			-0.24 [-0.30, -0.17]	-0.24

Note. $N = 3,875$; Int. = RIASEC interest dimensions; TL = time lag; M = mean level, SD = standard deviation; Δ = mean-level differences between the time points; d = Cohen's d for repeated measurement; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table 5*Fit Indices for Single and Multigroup Generalized Second-Order Growth Model*

Int.	Model	Growth	CFI	TLI	RMSEA	SRMR	χ^2	df
R	Overall	L	0.963	0.963	0.030	0.044	1228.52*	270
		Q	0.965	0.964	0.030	0.046	1183.61*	266
	Multigroup	QQ	0.942	0.941	0.033	0.051	1541.80*	545
		QL	0.939	0.939	0.033	0.052	1591.82*	549
I	Overall	L	0.911	0.909	0.041	0.086	1998.54*	270
		Q	0.926	0.923	0.037	0.080	1709.17*	266
	Multigroup	QQ	0.907	0.906	0.041	0.074	2098.53*	545
		QQ	0.907	0.906	0.041	0.074	2098.53*	545
A	Overall	L	0.919	0.917	0.038	0.067	1798.12*	270
		Q	0.926	0.923	0.037	0.065	1659.15*	266
	Multigroup	QQ	0.900	0.899	0.039	0.064	1946.27*	544
		QL	0.896	0.895	0.040	0.065	2010.69*	548
S	Overall	L	0.934	0.933	0.037	0.068	1728.05*	270
		Q	0.945	0.943	0.034	0.080	1490.88*	266
	Multigroup	QQ	0.927	0.926	0.036	0.073	1773.64*	546
		LL	0.913	0.914	0.039	0.069	2004.72*	554
E	Overall	L	0.955	0.954	0.026	0.047	980.29*	270
		Q	0.955	0.953	0.026	0.047	975.92*	266
	Multigroup	QQ	0.941	0.941	0.030	0.048	1358.64*	545
		QQ	0.941	0.941	0.030	0.048	1358.64*	545
C	Overall	L	0.966	0.965	0.024	0.061	876.90*	270
		Q	0.968	0.966	0.024	0.057	838.85*	266
	Multigroup	QQ	0.947	0.946	0.030	0.052	1362.34*	545
		LQ	0.946	0.946	0.030	0.053	1381.48*	549

Note. Int. = RIASEC interest dimensions; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; χ^2 = Chi-Square Statistic; *df* = Degrees of Freedom; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; L = linear growth; Q = quadratic growth; QL = growth type of the respective group, the first letter refers to girls, the second to boys.

* $p < .01$.

Table 6*Intercept and Slope of Single and Multigroup Generalized Second-Order Growth Models*

Group	Int.	Intercept		Slope		$r(I,S)$
		M	σ^2	M	σ^2	
		[95% CI]	[95% CI]	[95% CI]	[95% CI]	[95% CI]
O	R _L	3.37	0.46	-0.10	0.02	-.20
		[3.30, 3.43]	[0.39, 0.52]	[-0.12, -0.08]	[0.01, 0.04]	[-.34, -.07]
	I _L	3.64	0.89	-0.16	0.11	-.60
		[3.56, 3.72]	[0.79, 0.99]	[-0.19, -0.13]	[0.09, 0.13]	[-.66, -.55]
	A _L	3.63	0.64	-0.11	0.06	-.38
		[3.57, 3.70]	[0.56, 0.72]	[-0.14, -0.09]	[0.04, 0.07]	[-.46, -.31]
	S _L	3.19	0.68	0.06	0.07	-.46
B		[3.12, 3.26]	[0.57, 0.79]	[0.03, 0.08]	[0.04, 0.10]	[-.56, -.36]
	E _L	2.87	0.18	-0.01	0.01	-.47
		[2.81, 2.92]	[0.13, 0.22]	[-0.03, 0.00]	[0.00, 0.01]	[-.58, -.36]
	C _L	3.10	0.61	-0.14	0.05	-.40
		[3.02, 3.19]	[0.51, 0.72]	[-0.17, -0.10]	[0.02, 0.07]	[-.53, -.28]
	R _L	3.66	0.31	-0.07	0.02	-.38
		[3.59, 3.72]	[0.23, 0.39]	[-0.09, -0.05]	[0.01, 0.04]	[-.53, -.22]
G	I _Q	3.68	1.01	-0.04	0.10	.34
		[3.58, 3.78]	[0.88, 1.15]	[-0.07, -0.01]	[0.08, 0.12]	[.23, .45]
	A _L	3.47	0.82	-0.17	0.08	-.54
		[3.39, 3.56]	[0.68, 0.96]	[-0.20, -0.13]	[0.05, 0.10]	[-.63, -.45]
	S _L	2.99	0.69	0.02	0.07	-.53
		[2.91, 3.07]	[0.56, 0.82]	[-0.01, 0.05]	[0.04, 0.11]	[-.63, -.42]
	E _Q	3.00	0.28	-0.02	0.01	-.11
		[2.91, 3.10]	[0.18, 0.39]	[-0.04, -0.01]	[-0.01, 0.04]	[-.93, .72]
	C _Q	2.99	0.51	0.03	0.04	-.21
		[2.89, 3.09]	[0.29, 0.73]	[0.01, 0.06]	[0.01, 0.07]	[-.76, .33]
	R _Q	2.96	0.41	-0.03	0.03	.28
		[2.88, 3.03]	[0.31, 0.51]	[-0.05, -0.01]	[0.02, 0.05]	[.10, .47]
	I _Q	3.48	1.09	-0.04	0.10	.38
		[3.37, 3.59]	[0.95, 1.24]	[-0.07, -0.01]	[0.08, 0.13]	[.29, .47]
	A _Q	3.94	0.57	-0.04	0.04	.32
		[3.85, 4.04]	[0.43, 0.70]	[-0.06, -0.02]	[0.02, 0.06]	[.15, .48]
	S _L	3.41	0.58	0.11	0.07	-.53
		[3.33, 3.50]	[0.46, 0.70]	[0.08, 0.15]	[0.04, 0.09]	[-.65, -.41]
	E _Q	2.93	0.37	-0.03	0.02	.11
		[2.85, 3.02]	[0.18, 0.55]	[-0.05, -0.01]	[0.00, 0.04]	[-.31, .52]
	C _L	2.95	0.59	-0.18	0.06	-.44
		[2.87, 3.04]	[0.46, 0.72]	[-0.22, -0.15]	[0.03, 0.08]	[-.60, -.28]

Note. Int. = RIASEC interest dimensions; M = mean of intercept or slope factor; σ^2 = variance of intercept or slope factor; $r(I,S)$ = correlation between intercept and slope; O = overall sample; B = boys; G = girls; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; L = linear growth; Q = quadratic growth.

Table 7*Differences in Means, Standard Deviations, and Mean-Level Changes between Boys and Girls*

Int.	TL	ΔM [95% CI]	d	ΔSD [95% CI]	δ [95% CI]	d
R	1	0.92 [0.82, 1.01]	0.86	0.01 [-0.06, 0.07]		
	2	0.86 [0.78, 0.94]	0.83	0.04 [-0.01, 0.10]	-0.05 [-0.16, 0.06]	-0.05
	3	1.01 [0.92, 1.10]	1.01	0.00 [-0.06, 0.06]	0.15 [0.05, 0.25]	0.15
	4	1.11 [1.04, 1.19]	1.14	0.06 [0.01, 0.12]	0.10 [0.00, 0.20]	0.11
	14				0.20 [0.08, 0.32]	0.20
I	1	0.21 [0.11, 0.31]	0.20	0.03 [-0.03, 0.08]		
	2	0.23 [0.16, 0.31]	0.23	0.04 [-0.01, 0.09]	0.02 [-0.09, 0.13]	0.02
	3	0.35 [0.27, 0.44]	0.36	0.01 [-0.03, 0.06]	0.12 [0.03, 0.21]	0.12
	4	0.39 [0.31, 0.47]	0.40	0.05 [0.00, 0.09]	0.04 [-0.05, 0.13]	0.05
	14				0.18 [0.06, 0.30]	0.19
A	1	-0.65 [-0.75, -0.55]	-0.68	0.10 [0.04, 0.16]		
	2	-0.72 [-0.79, -0.64]	-0.79	0.14 [0.10, 0.19]	-0.07 [-0.17, 0.03]	-0.07
	3	-0.68 [-0.77, -0.60]	-0.75	0.08 [0.03, 0.13]	0.04 [-0.05, 0.12]	0.06
	4	-0.62 [-0.71, -0.53]	-0.69	0.04 [-0.01, 0.09]	0.07 [-0.01, 0.14]	0.08
	14				0.03 [-0.09, 0.16]	0.06
S	1	-0.48 [-0.59, -0.37]	-0.47	0.05 [-0.01, 0.11]		
	2	-0.58 [-0.66, -0.50]	-0.59	0.11 [0.06, 0.17]	-0.10 [-0.22, 0.01]	-0.11
	3	-0.59 [-0.68, -0.50]	-0.63	0.06 [0.00, 0.12]	-0.01 [-0.09, 0.07]	-0.01
	4	-0.73 [-0.81, -0.64]	-0.82	0.06 [0.00, 0.11]	-0.14 [-0.23, -0.04]	-0.15
	14				-0.25 [-0.37, -0.13]	-0.27
E	1	0.05 [-0.06, 0.15]	0.04	0.03 [-0.03, 0.08]		
	2	0.04 [-0.04, 0.11]	0.04	0.04 [-0.01, 0.09]	-0.01 [-0.12, 0.10]	-0.01
	3	0.10 [0.02, 0.19]	0.11	0.03 [-0.02, 0.08]	0.07 [-0.02, 0.16]	0.07
	4	0.17 [0.09, 0.25]	0.19	0.01 [-0.04, 0.06]	0.07 [-0.03, 0.16]	0.07
	14				0.12 [0.00, 0.24]	0.12
C	1	0.06 [-0.03, 0.16]	0.06	0.06 [0.00, 0.11]		
	2	-0.02 [-0.11, 0.06]	-0.02	0.06 [0.00, 0.11]	-0.09 [-0.20, 0.03]	-0.08
	3	0.12 [0.04, 0.20]	0.12	0.03 [-0.02, 0.08]	0.14 [0.05, 0.23]	0.15
	4	0.20 [0.13, 0.28]	0.22	0.02 [-0.03, 0.07]	0.09 [0.00, 0.17]	0.10
	14				0.14 [0.03, 0.26]	0.15

Note. Positive values imply higher values for boys. Int. = RIASEC interest dimensions; TL = time lag; ΔM = mean-level differences between boys and girls; d = Cohen's d for the mean-level differences between boys and girls; ΔSD = differences in standard deviations between boys and girls; δ = differences in mean-level differences between boys and girls; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table 8*Descriptive Statistics and Mean-Level Change in RIASEC Scales in the Sample of Girls*

Int.	TL	<i>M</i> [95% CI]	<i>SD</i> [95% CI]	Δ [95% CI]	<i>d</i>
R	1	2.57 [2.48, 2.65]	1.07 [1.02, 1.11]		
	2	2.52 [2.46, 2.59]	1.01 [0.97, 1.05]	-0.04 [-0.12, 0.04]	-0.04
	3	2.33 [2.26, 2.39]	1.01 [0.96, 1.05]	-0.20 [-0.27, -0.13]	-0.20
	4	2.12 [2.06, 2.18]	0.95 [0.90, 0.99]	-0.21 [-0.27, -0.14]	-0.21
	14			-0.45 [-0.54, -0.36]	-0.44
I	1	2.99 [2.90, 3.09]	1.06 [1.02, 1.10]		
	2	2.86 [2.81, 2.92]	1.00 [0.96, 1.04]	-0.13 [-0.23, -0.04]	-0.13
	3	2.68 [2.61, 2.74]	0.97 [0.93, 1.01]	-0.19 [-0.25, -0.12]	-0.19
	4	2.45 [2.39, 2.51]	0.95 [0.91, 0.98]	-0.23 [-0.29, -0.16]	-0.24
	14			-0.54 [-0.65, -0.43]	-0.54
A	1	3.57 [3.49, 3.65]	0.91 [0.86, 0.96]		
	2	3.56 [3.51, 3.61]	0.84 [0.81, 0.88]	-0.01 [-0.08, 0.06]	-0.01
	3	3.42 [3.36, 3.48]	0.87 [0.83, 0.91]	-0.14 [-0.20, -0.08]	-0.16
	4	3.25 [3.19, 3.31]	0.88 [0.85, 0.91]	-0.17 [-0.23, -0.12]	-0.20
	14			-0.32 [-0.41, -0.23]	-0.36
S	1	3.44 [3.36, 3.53]	0.98 [0.94, 1.03]		
	2	3.54 [3.48, 3.60]	0.92 [0.88, 0.95]	0.10 [0.01, 0.19]	0.10
	3	3.55 [3.48, 3.62]	0.90 [0.86, 0.95]	0.01 [-0.05, 0.07]	0.01
	4	3.65 [3.58, 3.72]	0.86 [0.82, 0.91]	0.10 [0.04, 0.16]	0.11
	14			0.21 [0.11, 0.30]	0.22
E	1	2.87 [2.78, 2.96]	1.06 [1.01, 1.10]		
	2	2.95 [2.89, 3.01]	0.95 [0.92, 0.99]	0.08 [-0.01, 0.17]	0.08
	3	2.89 [2.83, 2.95]	0.90 [0.86, 0.94]	-0.06 [-0.12, 0.01]	-0.06
	4	2.79 [2.73, 2.85]	0.88 [0.85, 0.91]	-0.10 [-0.17, -0.03]	-0.11
	14			-0.08 [-0.18, 0.02]	-0.08
C	1	2.83 [2.75, 2.92]	1.01 [0.97, 1.05]		
	2	2.83 [2.76, 2.89]	0.97 [0.94, 1.01]	-0.01 [-0.10, 0.08]	-0.01
	3	2.66 [2.60, 2.73]	0.94 [0.90, 0.98]	-0.17 [-0.23, -0.10]	-0.17
	4	2.52 [2.46, 2.59]	0.90 [0.87, 0.94]	-0.14 [-0.20, -0.07]	-0.15
	14			-0.31 [-0.40, -0.22]	-0.32

Note. $n = 1,726$; Int. = RIASEC interest dimensions; TL = time lag; *M* = mean level, *SD* = standard deviation; Δ = mean-level differences between the time points; *d* = Cohen's *d* for repeated measurement; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table 9*Descriptive Statistics and Mean-Level Change of RIASEC Scales in the Sample of Boys*

Int.	TL	<i>M</i> [95% CI]	<i>SD</i> [95% CI]	Δ [95% CI]	<i>d</i>
R	1	3.48 [3.40, 3.57]	1.07 [1.03, 1.11]		
	2	3.39 [3.32, 3.45]	1.06 [1.02, 1.10]	-0.09 [-0.17, -0.01]	-0.09
	3	3.34 [3.27, 3.40]	1.01 [0.97, 1.04]	-0.05 [-0.12, 0.02]	-0.05
	4	3.23 [3.17, 3.29]	1.01 [0.97, 1.04]	-0.10 [-0.16, -0.05]	-0.10
	14			-0.25 [-0.34, -0.16]	-0.24
I	1	3.21 [3.12, 3.29]	1.09 [1.05, 1.12]		
	2	3.09 [3.02, 3.16]	1.04 [1.01, 1.08]	-0.11 [-0.20, -0.03]	-0.11
	3	3.03 [2.96, 3.09]	0.98 [0.95, 1.02]	-0.07 [-0.13, 0.00]	-0.07
	4	2.84 [2.78, 2.90]	0.99 [0.95, 1.03]	-0.19 [-0.25, -0.12]	-0.19
	14			-0.37 [-0.46, -0.28]	-0.35
A	1	2.92 [2.84, 3.00]	1.01 [0.97, 1.05]		
	2	2.84 [2.78, 2.90]	0.98 [0.95, 1.02]	-0.08 [-0.16, -0.01]	-0.08
	3	2.74 [2.68, 2.80]	0.95 [0.91, 0.99]	-0.10 [-0.16, -0.04]	-0.10
	4	2.63 [2.57, 2.69]	0.92 [0.88, 0.95]	-0.11 [-0.17, -0.05]	-0.12
	14			-0.29 [-0.37, -0.21]	-0.30
S	1	2.97 [2.89, 3.05]	1.04 [0.99, 1.08]		
	2	2.96 [2.89, 3.03]	1.03 [0.99, 1.07]	-0.01 [-0.09, 0.07]	-0.01
	3	2.96 [2.89, 3.02]	0.97 [0.93, 1.00]	-0.01 [-0.06, 0.05]	-0.01
	4	2.92 [2.86, 2.98]	0.92 [0.88, 0.96]	-0.04 [-0.10, 0.03]	-0.04
	14			-0.05 [-0.12, 0.03]	-0.05
E	1	2.92 [2.82, 3.01]	1.08 [1.04, 1.12]		
	2	2.98 [2.92, 3.04]	0.99 [0.96, 1.03]	0.07 [-0.02, 0.15]	0.07
	3	3.00 [2.94, 3.06]	0.93 [0.90, 0.96]	0.01 [-0.05, 0.08]	0.02
	4	2.96 [2.90, 3.02]	0.89 [0.86, 0.93]	-0.04 [-0.09, 0.02]	-0.04
	14			0.05 [-0.04, 0.13]	0.05
C	1	2.90 [2.81, 2.98]	1.07 [1.03, 1.11]		
	2	2.80 [2.74, 2.87]	1.03 [1.00, 1.07]	-0.09 [-0.17, -0.02]	-0.09
	3	2.78 [2.72, 2.84]	0.97 [0.93, 1.00]	-0.02 [-0.09, 0.04]	-0.02
	4	2.73 [2.67, 2.79]	0.93 [0.89, 0.97]	-0.05 [-0.11, 0.00]	-0.05
	14			-0.17 [-0.25, -0.09]	-0.17

Note. $n = 2,098$; Int. = RIASEC interest dimensions; TL = time lag; *M* = mean level, *SD* = standard deviation; Δ = mean-level differences between the time points; *d* = Cohen's *d* for repeated measurement; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Figure 1

Time-point-specific proportions of state and trait variance in the overall sample.

Note. Consistency, occasion specificity and measurement error are depicted.

Figure 2*Manifest Mean Levels of the Scale scores for the RIASEC Dimensions*

Note. 95% confidence intervals are depicted; T₁₋₄ = time points 1–4; $n = 3,875$.

Figure 3*Manifest Mean Levels of the Scale Scores for the RIASEC Dimensions for Girls and Boys*

Note. 95% confidence intervals are depicted; T₁₋₄ = time points 1–4; $n_{girls} = 1,726$; $n_{boys} = 2,098$.

Supplement Material

Table of Contents:

Supplement A: Additional Sample Information.....	60
Sample Composition.....	60
Attrition Analysis	61
Clustering Information: School and Class Level.....	64
Supplement B: Interest Inventory.....	65
Item Wording and Item Scale Correlations.....	65
Factor Loadings of Factor Models.....	67
Convergent and Discriminant Validity	68
Supplement C: Information about Model Fit and Model Parameters	71
Measurement Invariance	71
Fit Indices for Generalized Second-Order Growth Models	78
Parameters for Generalized Second-Order Growth Models	81
Supplement D: Model Depictions and Formulas	89
Depiction of the Saturated Path Model.....	89
Depiction of the Generalized Second-Order Growth Models.....	90
Formulas for Consistency and Occasion Specificity for the Linear Models	92
Formulas for Consistency and Occasion Specificity for the Quadratic Models	92
Formula for Cohen's d for Repeated Measures.....	92

Supplement A: Additional Sample Information***Sample Composition***

The number of participants who attended lower track schools was $n = 1,678$ (43.2% of participants who participated in the study at a minimum of one time point) and the number of participants who attended intermediate track schools was $n = 881$ (22.7% of participants who participated in the study at a minimum of one time point). Both school tracks—lower and intermediate—came from the state of Baden-Württemberg. The number of participants who attended multitrack schools (a combination of the lower and intermediate tracks) was $n = 1,321$ (34.0% of participants who participated in the study at a minimum of one time point). All of the participants from multitrack schools were from the state of Saxony because the format of multitrack schools did not exist in the state of Baden-Württemberg during that time. Participants who attended the highest school track in Germany were not included in the study.

For 87.6% of the participants who participated in the study at a minimum of one time point, background information was available on where they were born. A total of 93.4% of these participants were born in Germany. For 86.0% of the participants who participated in the study at a minimum of one time point, information about their migration status was available. Of these participants, 66.7% had no migration background, 11.8% reported that at least one parent was not born in Germany, 16.0% reported that both parents were not born in Germany but the participant was, and 5.5% reported that both parents and the participant were not born in Germany.

To investigate differences between participants who joined the study late and those who dropped out of the study, we compared joiners with the participants who were already in the study and dropouts with the participants who continued to participate in the study. This was done for every time point separately. Information about participants who joined and dropped out of the study can be found in Table A1.

Table A1*Information about Participants who Joined the Study Late and Dropped out of the Study*

	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	3,876
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%)	
Other / no information		93 (34.7%)	225 (54.0%)	127 (42.1%)	

Note. Rieger et al. (2017) provide similar information.

Attrition Analysis

In Table A2, mean-level differences in terms of effect sizes (Cohen's *d*) between participants who dropped out of the study and participants who continued to participate in the study at the subsequent time point are reported. In terms of effect sizes, achievement-related variables showed high to moderate differences, school motivation constructs showed small to moderate differences, and personality characteristics showed small differences. A similar picture could be found for differences between participants who joined the study late and participants who were already part of the study. All variables that indicated significant differences in terms of effect sizes were included as auxiliary variables in all analyses.

Table A2*Differences (Cohen's d) between Students who Dropped Out and Continued*

	T1 » T2	T2 » T3	T3 » T4
Dropouts			
Gender (male = 1)	OR = 1.015	OR = 1.087	OR = 1.134
Socioeconomic status (HISEI)	0.02	-0.18	0.03
migration	OR = 3.023	OR = 1.965	OR = 2.563
Math grade	0.20	0.48	0.69
German grade	0.11	0.58	0.70
English grade	0.16	0.31	0.61
Math achievement	-0.22	-0.34	-0.56
German achievement	-0.21	-0.23	-0.40
Vocational interests			
Realistic	0.01	0.00	-0.04
Investigative	0.11	-0.10	-0.12
Artistic	0.36	-0.05	-0.19
Social	0.20	-0.02	-0.12
Enterprising	0.14	0.09	0.02
Conventional	0.30	0.00	-0.05
Big Five			
Conscientiousness	0.17	-0.11	-0.32
Neuroticism	0.17	0.09	0.27
Openness	0.21	-0.07	-0.27
Agreeableness	0.18	0.02	-0.21
Extraversion	0.12	0.01	-0.17
Other constructs			
Self-concept in math	0.00	-0.15	-0.39
Self-concept in German	0.13	-0.14	-0.01
Self-concept in English	0.10	0.00	-0.28
Interest in math	0.20	-0.09	-0.21
Interest in German	0.20	0.07	0.05
Interest in English	0.12	0.05	-0.15
Effort in math	0.08	-0.23	-0.35
Effort in German	0.06	-0.08	-0.14
Effort in English	-0.03	-0.05	-0.29

Note. Bold parameters are significantly different from zero at $p < .05$, two-tailed. Positive values imply higher values for the participants who dropped out of the study, significant variables were included as auxiliaries in the main analysis; OR = Odds Ratio.

Table A3

Differences (Cohen's d) between Students who Joined Late and those who were already in the Study

	T1 » T2	T2 » T3	T3 » T4
Joined the study late			
Gender (male = 1)	OR = 1.362	OR = 0.995	OR = 1.093
Socioeconomic status (HISEI)	-0.14	0.14	0.11
migration	OR = 1.191	OR = 1.122	OR = 1.312
Math grade	0.68	0.29	0.84
German grade	0.60	0.37	0.65
English grade	0.64	0.38	0.64
Math achievement	-0.22	0.10	-0.01
German achievement	-0.18	0.10	0.02
Vocational interests			
Realistic	0.00	-0.07	-0.11
Investigative	0.00	-0.16	-0.14
Artistic	-0.05	-0.05	-0.19
Social	0.00	0.03	0.01
Enterprising	0.00	0.09	0.04
Conventional	0.00	0.00	-0.19
Big Five			
Conscientiousness	-0.10	-0.01	-0.31
Neuroticism	0.14	0.15	0.10
Openness	-0.08	0.03	-0.13
Agreeableness	-0.12	0.05	-0.30
Extraversion	-0.07	0.01	-0.06
Other constructs			
Self-concept in math	-0.12	0.00	-0.25
Self-concept in German	-0.15	-0.15	-0.09
Self-concept in English	-0.06	-0.18	0.03
Interest in math	0.03	-0.01	-0.23
Interest in German	0.04	-0.03	-0.18
Interest in English	0.07	-0.11	-0.13
Effort in math	-0.10	-0.09	-0.37
Effort in German	-0.24	-0.10	-0.34
Effort in English	-0.09	-0.18	-0.18

Note. Bold parameters are significantly different from zero at $p < .05$, two-tailed. Positive values imply higher values for the participants who joined the study late, significant variables were included as auxiliaries in the main analysis; OR = Odds Ratio.

Clustering Information: School and Class Level**Table A4***Intraclass Correlations of RIASEC Scale Scores*

Cluster Variable	Interests	T1	T2	T3	T4
Class	Realistic	.08	.04	.03	.03
	Investigative	.10	.03	.03	.02
	Artistic	.07	.03	.02	.02
	Social	.08	.04	.04	.04
	Enterprising	.10	.03	.03	.03
	Conventional	.11	.04	.04	.04
School	Realistic	.07	.03	.02	.02
	Investigative	.09	.03	.03	.01
	Artistic	.05	.02	.01	.02
	Social	.07	.04	.04	.03
	Enterprising	.09	.03	.03	.03
	Conventional	.09	.04	.03	.04

Note. $N = 3,351$; T1–T4 = time points 1 to 4; The ICCs were computed in a saturated multilevel path model (TYPE = TWOLEVEL) in Mplus 8; Missing data were treated with FIML.

Supplement B: Interest Inventory***Item Wording and Item Scale Correlations***

Note: The item wording was translated by the authors. The information of item wording is only for the reviewers. Because of copyright restrictions, a request to the original publisher of some of the items will be necessary before printing these items. It is guaranteed that the authors will provide readers the full set of items on demand.

Table B1*Items, their Origins, and their Item-Scale Correlations*

Scale	Item	Item: "How much do you like this activity?"	Origin	r _{it1}	r _{it2}	r _{it3}	r _{it4}
R	01		ICA-R	.52	.56	.59	.58
	07		ICA-R	.63	.66	.67	.73
	13		AISTR (altered)	.59	.61	.57	.63
	19		AISTR	.70	.72	.73	.80
	25		New	.63	.70	.71	.71
	31		AISTR	.67	.69	.73	.77
I	02		AISTR	.55	.52	.56	.58
	08		AISTR	.53	.54	.49	.54
	14		ICA-R	.53	.56	.58	.64
	20		ICA-R	.67	.64	.68	.70
	26		ICA-R	.59	.60	.61	.61
	32		New	.49	.58	.58	.62
A	03		ICA-R	.54	.54	.55	.56
	09		AISTR	.60	.62	.63	.61
	15		ICA-R	.54	.50	.54	.50
	21		New	.49	.51	.54	.53
	27		New	.51	.49	.49	.45
	33		AISTR	.52	.59	.61	.59
S	04		AISTR	.53	.61	.63	.63
	10		AISTR	.60	.66	.64	.65
	16		ICA-R	.65	.69	.69	.68
	22		ICA-R	.65	.68	.65	.66
	28		New	.58	.59	.60	.58
	34		AISTR	.63	.65	.66	.65
E	05		ICA-R	.43	.38	.36	.39
	11		ICA-R	.66	.64	.60	.65
	17		ICA-R	.52	.50	.51	.55
	23		New	.61	.53	.54	.51
	29		New	.64	.68	.66	.66
	35		New	.53	.56	.51	.47

	06	ICA-R	.44	.48	.50	.52
	12	AISTR	.65	.66	.62	.60
		(altered)				
C	18	ICA-R	.69	.71	.69	.69
	24	ICA-R	.64	.63	.61	.57
	30	New	.54	.56	.57	.55
	36	New	.52	.57	.56	.51

Note. r_{it} = Correlation of the item with the scale when the respective item is dropped; the items were translated by the authors of the study.

Factor Loadings of Factor Models**Table B2***Factor Loadings for the Configural Invariance Measurement RIASEC Models*

Constructs	Item	Loading T1 (se)	Loading T2 (se)	Loading T3 (se)	Loading T4 (se)
R	01	0.76(0.03)	0.76(0.02)	0.79(0.02)	0.79(0.02)
	07	1.03(0.02)	1.00(0.02)	1.00(0.02)	1.03(0.02)
	13	0.90(0.02)	0.91(0.02)	0.81(0.02)	0.80(0.02)
	19	1.14(0.03)	1.13(0.02)	1.14(0.02)	1.20(0.01)
	25	1.02(0.03)	1.07(0.02)	1.07(0.02)	1.01(0.02)
	31	1.15(0.02)	1.14(0.02)	1.19(0.02)	1.17(0.02)
I	02	0.98(0.03)	0.88(0.03)	0.92(0.03)	0.95(0.03)
	08	0.95(0.03)	0.94(0.03)	0.88(0.03)	0.90(0.02)
	14	0.92(0.03)	1.00(0.03)	0.98(0.03)	1.00(0.02)
	20	1.25(0.03)	1.14(0.03)	1.18(0.02)	1.17(0.02)
	26	1.11(0.03)	1.09(0.03)	1.11(0.02)	1.07(0.03)
	32	0.78(0.04)	0.95(0.03)	0.93(0.03)	0.91(0.03)
A	03	0.97(0.03)	0.95(0.03)	0.95(0.03)	1.03(0.03)
	09	1.11(0.03)	1.12(0.03)	1.14(0.03)	1.22(0.03)
	15	1.01(0.03)	0.94(0.03)	0.94(0.03)	0.88(0.03)
	21	0.98(0.03)	1.03(0.03)	1.04(0.03)	1.05(0.03)
	27	0.96(0.03)	0.90(0.03)	0.85(0.03)	0.75(0.03)
	33	0.97(0.03)	1.06(0.03)	1.09(0.02)	1.09(0.02)
S	04	0.86(0.03)	0.96(0.02)	0.97(0.02)	1.01(0.03)
	10	0.98(0.03)	1.02(0.02)	1.01(0.02)	1.03(0.02)
	16	1.04(0.03)	1.03(0.02)	1.04(0.02)	1.04(0.02)
	22	1.09(0.02)	1.02(0.02)	1.00(0.02)	1.00(0.02)
	28	0.99(0.03)	0.96(0.02)	0.96(0.02)	0.92(0.03)
	34	1.05(0.03)	1.09(0.02)	1.02(0.02)	1.01(0.03)
E	05	0.74(0.04)	0.66(0.03)	0.64(0.04)	0.67(0.03)
	11	1.20(0.03)	1.19(0.02)	1.19(0.03)	1.23(0.02)
	17	0.90(0.03)	0.87(0.03)	0.91(0.03)	1.01(0.03)
	23	1.01(0.03)	0.90(0.03)	0.95(0.03)	0.89(0.03)
	29	1.22(0.03)	1.33(0.02)	1.34(0.03)	1.31(0.03)
	35	0.93(0.03)	1.04(0.03)	0.97(0.03)	0.90(0.03)
C	06	0.78(0.03)	0.83(0.03)	0.88(0.02)	0.91(0.03)
	12	1.11(0.03)	1.09(0.02)	1.04(0.02)	1.06(0.02)
	18	1.21(0.03)	1.18(0.02)	1.14(0.02)	1.22(0.02)
	24	1.11(0.03)	1.06(0.02)	1.06(0.02)	1.00(0.03)
	30	0.93(0.03)	0.92(0.02)	0.95(0.02)	0.95(0.03)
	36	0.86(0.03)	0.92(0.03)	0.93(0.03)	0.85(0.03)

Note. se = Standard Error.

Convergent and Discriminant Validity

In addition to structural and reliability information, we provide evidence on the convergent and discriminant validity of our interest measure. We correlated vocational interests with personality traits, self-concepts and competencies. We measured the Big Five personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism. In line with the meta-analysis by (Mount et al., 2005), the highest correlations are assumed to be between Investigative and Openness ($r = .25$), Artistic and Openness ($r = .41$), Social and Extraversion ($r = .29$), Enterprising and Extraversion ($r = .40$), as well as Conventional and Conscientiousness ($r = .19$). Smaller correlations are assumed between Social and Openness ($r = .13$) as well as Social and Agreeableness ($r = .17$).

Intercorrelations are depicted in Tables B3 and B4 such that the dark grey areas indicate the strong relationships and the light grey areas the weak relationships that Mount et al. (2005) proposed. At the first time point, the relationships that Mount et al. (2005) proposed were present. In addition, the proposed relationships showed the strongest correlations between personality traits and vocational interests (except Enterprising). However, at the first time point, all the personality traits were moderately correlated. At the fourth time point, the pattern of intercorrelations was close to the one reported by Mount et al. (2005).

Self-concept was measured for two school subjects: math and German. In line with the study by Ackerman et al. (1995), vocational interests and self-concept should be correlated in the following way: math self-concept and Realistic ($r = .38$), math self-concept and Investigative ($r = .22$), math self-concept and Conventional ($r = .61$), verbal self-concept and Artistic ($r = .40$), as well as verbal self-concept and Social ($r = .16$). At both time points, we found the proposed intercorrelations for math self-concept, although they were a little bit lower than they were in Ackerman et al. (1995). Similar results were found for German self-concept.

Expectations of the relationships between vocational interests and competencies were derived from Ackerman and Heggstad (1997). On the basis of evidence from various studies, Investigative and Realistic interests' relationships with math abilities were incorporated into the math/science trait complex. The relationships between verbal abilities and Artistic interests were incorporated into the intellectual/cultural trait complex. For math competencies, we found the respective pattern at both time points such that there were positive correlations with Investigative interests and negative correlations with Artistic and Social interests. However, we did not find positive correlations between Artistic interests and verbal competencies at either time point.

In summary, these results support the convergent and discriminant validity of our interest measure. The majority of vocational interests' proposed relationships with personality traits, self-concepts, and competencies were reflected in our data. The pattern improved over time, such that the correlations were more in line with the expected correlational pattern at the fourth time point.

Table B3*Manifest Correlations between RIASEC Scales and Associated Constructs at T1*

	R	I	A	S	E	C
O	.28 [.24, .33]	.35 [.30, .39]	.40 [.36, .44]	.37 [.33, .41]	.36 [.31, .41]	.35 [.31, .40]
C	.23 [.18, .28]	.27 [.23, .31]	.32 [.27, .36]	.31 [.26, .35]	.29 [.24, .34]	.35 [.30, .40]
E	.21 [.16, .25]	.24 [.19, .28]	.29 [.24, .33]	.31 [.26, .35]	.33 [.28, .38]	.26 [.21, .30]
A	.13 [.07, .18]	.23 [.19, .28]	.32 [.28, .36]	.38 [.33, .43]	.25 [.19, .30]	.27 [.22, .32]
N	.16 [.11, .21]	.11 [.06, .16]	.12 [.07, .18]	.17 [.12, .22]	.20 [.15, .25]	.20 [.15, .26]
SK. M	.20 [.16, .25]	.13 [.09, .16]				.17 [.14, .21]
SK. G		.16 [.13, .19]	.25 [.21, .28]	.18 [.15, .21]	.15 [.11, .18]	.15 [.12, .18]
Co. M		.10 [.04, .17]	-.12 [.17, -.06]	-.12 [.18, -.07]		-.11 [.17, -.04]
Co. G		.10 [.05, .16]			-.15 [.21, -.09]	-.19 [.25, -.14]

Note. O = Openness; C = Conscientiousness; E = Extraversion; A = Agreeableness; N = Neuroticism; SK. M = Self-concept Math; SK. G = Self-concept German; SK. E = Self-

concept English; Co. M = Competencies Math; Co. G = Competencies German; Co. E = Competencies English; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; Dark grey implies strong correlations, light grey implies weak correlations. Assumptions of the intercorrelations between the Big Five and RIASEC scales were derived from the meta-analysis of Mount et al. (2005); Assumptions of the intercorrelations between the Competence and RIASEC scales were derived from the meta-analytic evidence about trait-complexes from Ackerman and Heggestad (1997); Assumptions of the intercorrelations between Self-Concept and RIASEC scales were derived from Ackerman et al. (1995).

Table B4

Manifest Correlations between RIASEC Scales and Associated Constructs at T4

	R	I	A	S	E	C
O	.11 [.07, .15]	.21 [.18, .25]	.30 [.27, .33]	.20 [.16, .23]	.20 [.17, .24]	.16 [.13, .20]
C	.15 [.10, .19]	.18 [.14, .21]	.17 [.14, .20]	.20 [.16, .24]	.17 [.14, .20]	.21 [.18, .24]
E		.10 [.06, .14]	.19 [.15, .22]	.22 [.18, .26]	.24 [.21, .28]	.12 [.08, .15]
A			.17 [.13, .20]	.26 [.23, .30]	.11 [.08, .14]	
N						
SK. M	.28 [.24, .33]	.14 [.11, .17]				.20 [.16, .23]
SK. G			.15 [.12, .17]	.14 [.12, .17]		
Co. M	.14 [.07, .21]	.10 [.04, .15]		-.13 [.18, -.07]		
Co. G	-.17 [.26, -.09]					-.23 [.29, -.16]

Note. O = Openness; C = Conscientiousness; E = Extraversion; A = Agreeableness; N = Neuroticism; SK. M = Self-concept Math; SK. G = Self-concept German; SK. E = Self-concept English; Co. M = Competencies Math; Co. G = Competencies German; Co. E = Competencies English; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; Dark grey implies strong correlations, light grey implies weak correlations. Assumptions of the intercorrelations between the Big Five and RIASEC scales were derived from the meta-analysis of Mount et al. (2005); Assumptions of the intercorrelations between the Competence and RIASEC scales were derived from the meta-analytic evidence about trait-complexes from Ackerman and Heggestad (1997); Assumptions of the intercorrelations between Self-Concept and RIASEC scales were derived from Ackerman et al. (1995).

Supplement C: Information about Model Fit and Model Parameters***Measurement Invariance***

In the present study, the following fit indices and values were used to judge whether the overall fit was adequate: incremental fit indices such as the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) with values of .90 or higher, the Standardized Root Mean Square Residual (SRMR) with a value of .08 or lower, as well as the Root Mean Square Error of Approximation with a value of .06 or lower (Hu & Bentler, 1999). To judge changes in the descriptive fit indices, we used the following values proposed by Chen (2007): values $\geq .010$ for ΔCFI , additionally accompanied by a value of $\geq .015$ for ΔRMSEA or ≥ 0.030 for ΔSRMR , indicated substantive changes in tests for factor loading invariance. To test for intercept invariance, a value of $\geq .010$ for ΔCFI , additionally accompanied by a value of $\geq .015$ for ΔRMSEA or ≥ 0.010 for ΔSRMR , seemed substantial.

For each RIASEC dimension, we specified the following models and compared them to each other. First, we specified configural measurement invariance models, where only the structure of the factor models was invariant over time and the Time $\times$ Gender interaction (i.e., invariant between boys, girls and over time). Second, we specified weak measurement invariance models, where the factor loadings of the factor models were invariant over time and the Time $\times$ Gender interaction (i.e., invariant between boys, girls and over time). Third, we specified strong measurement invariance models, where the factor loadings and the intercepts of the factor models were invariant over time and the Time $\times$ Gender interaction (i.e., invariant between boys, girls and over time). We compared the weak and the strong measurement invariance models to the configural measurement invariance models to investigate if substantive changes in fit indices occurred after adding more constraints to the models (the results can be found in Table C1 and C2).

For Realistic interest, strong measurement invariance applied over time, with adequate overall fit for the strong measurement invariance model and negligible changes in descriptive

fit indices when more constraints were applied. However, for invariance across time and group, two intercepts had to be freed (Item 1: “XXX”; Item 2: “XXX”) that would otherwise be invariant between boys and girls. Although $\Delta CFI = 0.012$ between the configural and partial strong measurement invariance model was slightly above the proposed value, the accompanying $\Delta RMSEA$ and $\Delta SRMR$ values were below the proposed values. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

For Investigative interest, strong measurement invariance applied over time, with adequate overall fit for the strong measurement invariance model and negligible changes (although ΔCFI was equal to .01, the $\Delta RMSEA$ and $\Delta SRMR$ values were below their proposed values) in descriptive fit indices when more constraints were applied. However, for invariance across time and group, two intercepts had to be freed (Item 1: “XXX”; Item 2: “XXX”) that would otherwise be invariant between boys and girls. Although $\Delta CFI = 0.021$ between the configural and partial strong measurement invariance model was slightly above the proposed value, the accompanying $\Delta RMSEA$ and $\Delta SRMR$ values were below the proposed values. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

For Artistic interest, strong measurement invariance applied over time, with adequate overall fit for the strong measurement invariance model and negligible changes (although ΔCFI was above .01, $\Delta RMSEA$ and $\Delta SRMR$ values were below their proposed values) in descriptive fit indices when more constraints were applied. However, for invariance across time and group, three intercepts had to be freed (Item 1: “XXX”; Item 2: “XXX”; Item 3: “XXX”) that would otherwise be invariant between boys and girls. Although $\Delta CFI = 0.039$ between the configural and partial strong measurement invariance model was above the proposed value, the accompanying $\Delta RMSEA$ and $\Delta SRMR$ values were below the proposed values. In addition, the overall model fit was adequate with the CFI and TLI near .90 and the

RMSEA and SRMR under the proposed values. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

For Social interest, strong measurement invariance applied over time, with an adequate overall fit for the strong measurement invariance model and negligible changes (although the ΔCFI was slightly above .01, the $\Delta RMSEA$ and $\Delta SRMR$ values were below their proposed values) in the descriptive fit indices when more constraints were applied. However, for invariance across time and group, one intercept had to be freed (Item 1: “XXX”) that would otherwise be invariant between boys and girls. Although $\Delta CFI = 0.021$ between the configural and partial strong measurement invariance model was above the proposed value, the accompanying $\Delta RMSEA$ and $\Delta SRMR$ values were below the proposed values. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

For Enterprising interest, strong measurement invariance applied over time, with adequate overall fit for the strong measurement invariance model and negligible changes (although the ΔCFI was above .01, the $\Delta RMSEA$ and $\Delta SRMR$ values were below their proposed values) in the descriptive fit indices when more constraints were applied. However, for invariance across time and group, two intercepts had to be freed (Item 1: “XXX”; Item 2: “XXX”) that would otherwise be invariant between boys and girls. In addition to a $\Delta CFI = 0.021$ between the configural and partial strong measurement invariance model, the value of the $\Delta SRMR$ was slightly higher than the proposed values. However, because of the adequate overall model fit, we decided to free only two of the respective intercepts overall. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

For Conventional interest, strong measurement invariance applied over time, with adequate overall fit for the strong measurement invariance model and negligible changes (although the ΔCFI was above .01, the $\Delta RMSEA$ and $\Delta SRMR$ values were below their proposed values) in the descriptive fit indices when more constraints were applied. However,

for invariance across time and group, two intercepts had to be freed (Item 1: “XXX”; Item 2: “XXX”) that would otherwise be invariant between boys and girls. In addition to a $\Delta\text{CFI} = 0.035$ between the configural and partial strong measurement invariance model, the value for the ΔSRMR was slightly higher than the proposed values. However, because of the adequate overall model fit, we decided to free only two of the respective intercepts overall. This indicates that for the Time $\times$ Gender interaction, only partially strong measurement invariance applies.

Table C1*Measurement Models with Different Types of Invariance Over Time and Group*

Int.	Model	CFI	TLI	RMSEA	SRMR	χ^2	df
R	MICT	0.964	0.958	0.031	0.030	1005.68*	240
	MIWT	0.962	0.959	0.030	0.033	1060.13*	255
	MIST	0.957	0.956	0.032	0.035	1187.51*	270
	MICG ^a	0.951	0.944	0.032	0.039	1321.98*	480
	MIWG	0.947	0.944	0.032	0.044	1418.07*	515
	MISG	0.928	0.928	0.036	0.051	1779.43*	550
	MISGp	0.939	0.938	0.034	0.047	1597.88*	548
I	MICT	0.903	0.889	0.045	0.049	1885.78*	240
	MIWT	0.901	0.893	0.044	0.050	1939.03*	255
	MIST	0.893	0.890	0.045	0.052	2095.91*	270
	MICG ^a	0.901	0.886	0.045	0.053	2147.53*	480
	MIWG	0.895	0.888	0.045	0.055	2273.33*	515
	MISG	0.865	0.864	0.049	0.060	2814.75*	550
	MISGp	0.880	0.880	0.046	0.057	2522.36*	548
A	MICT	0.921	0.909	0.040	0.048	1521.34*	240
	MIWT	0.918	0.911	0.039	0.050	1586.54*	255
	MIST	0.896	0.893	0.043	0.055	1959.32*	270
	MICG ^a	0.925	0.914	0.036	0.047	1535.95*	480
	MIWG	0.918	0.912	0.036	0.055	1667.14*	515
	MISG	0.817	0.817	0.052	0.079	3116.86*	550
	MISGp	0.886	0.885	0.041	0.059	2143.51*	547
S	MICT	0.938	0.929	0.038	0.034	1391.22*	240
	MIWT	0.937	0.931	0.037	0.036	1435.63*	255
	MIST	0.923	0.921	0.040	0.037	1706.29*	270
	MICG ^a	0.932	0.922	0.037	0.039	1610.26*	480
	MIWG	0.929	0.924	0.037	0.043	1694.94*	515
	MISG	0.900	0.899	0.042	0.056	2224.91*	550

	MISGp	0.911	0.910	0.040	0.046	2043.17*	549
E	MICT	0.970	0.966	0.022	0.031	651.70*	240
	MIWT	0.967	0.965	0.023	0.034	704.84*	255
	MIST	0.950	0.949	0.027	0.037	961.57*	270
	MICG ^a	0.967	0.962	0.024	0.038	935.10*	480
	MIWG	0.962	0.959	0.025	0.043	1042.99*	515
	MISG	0.915	0.914	0.036	0.055	1736.15*	550
	MISGp	0.941	0.940	0.030	0.047	1372.06*	548
C	MICT	0.972	0.968	0.023	0.033	660.57*	240
	MIWT	0.971	0.968	0.023	0.034	700.82*	255
	MIST	0.955	0.954	0.027	0.040	949.60*	270
	MICG ^a	0.976	0.972	0.021	0.035	850.06*	480
	MIWG	0.974	0.972	0.021	0.038	918.69*	515
	MISG	0.925	0.925	0.035	0.052	1706.96*	550
	MISGp	0.941	0.940	0.031	0.047	1462.24*	548

Note. Int. = RIASEC interest dimensions; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; χ^2 = Chi-Square Statistic, *df* = Degrees of Freedom; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; MICT = configural measurement invariance over time; MIWT = weak measurement invariance over time; MIST = strong measurement invariance over time; MICG = configural measurement invariance over time and gender; MIWG = weak measurement invariance over time and gender; MISG = strong measurement invariance over time and gender; MISGp = partial strong measurement invariance over time and gender.

^aThe standard errors in the model might not be trustworthy, which is most likely due to having more free parameters than clusters (the error message vanished when we did not compute cluster robust standard errors).

* $p < .01$

Table C2*Differences in Fit Indices*

Int.	Model	CFI	Δ CFI	RMSEA	Δ RMSEA	SRMR	Δ SRMR
R	MICT	0.964		0.031		0.030	
	MIWT	0.962	0.002	0.030	0.001	0.033	0.003
	MIST	0.957	0.007	0.032	0.001	0.035	0.002
	MICG	0.951		0.032		0.039	
	MIWG	0.947	0.004	0.032	0.000	0.044	0.005
	MISG	0.928	0.023	0.036	0.004	0.051	0.012
	MISGp	0.939	0.012	0.034	0.002	0.047	0.008
I	MICT	0.903		0.045		0.049	
	MIWT	0.901	0.002	0.044	0.001	0.050	0.001
	MIST	0.893	0.010	0.045	0.000	0.052	0.003
	MICG	0.901		0.045		0.053	
	MIWG	0.895	0.006	0.045	0.000	0.055	0.002
	MISG	0.865	0.036	0.049	0.004	0.060	0.007
	MISGp	0.880	0.021	0.046	0.001	0.057	0.004
A	MICT	0.921		0.040		0.048	
	MIWT	0.918	0.003	0.039	0.001	0.050	0.002
	MIST	0.896	0.025	0.043	0.003	0.055	0.007
	MICG	0.925		0.036		0.047	
	MIWG	0.918	0.007	0.036	0.000	0.055	0.008
	MISG	0.817	0.118	0.052	0.016	0.079	0.032
	MISGp	0.886	0.039	0.041	0.005	0.059	0.012
S	MICT	0.938		0.038		0.034	
	MIWT	0.937	0.001	0.037	0.001	0.036	0.002
	MIST	0.923	0.015	0.040	0.002	0.037	0.003
	MICG	0.932		0.037		0.039	
	MIWG	0.929	0.003	0.037	0.000	0.043	0.004
	MISG	0.900	0.032	0.042	0.005	0.056	0.017
	MISGp	0.911	0.021	0.040	0.003	0.046	0.007
E	MICT	0.970		0.022		0.031	
	MIWT	0.967	0.003	0.023	0.001	0.034	0.003
	MIST	0.950	0.020	0.027	0.005	0.037	0.006
	MICG	0.967		0.024		0.038	
	MIWG	0.962	0.005	0.025	0.001	0.043	0.005
	MISG	0.915	0.052	0.036	0.012	0.055	0.017
	MISGp	0.941	0.026	0.030	0.006	0.047	0.011
C	MICT	0.972		0.023		0.033	
	MIWT	0.971	0.001	0.023	0.000	0.034	0.001
	MIST	0.955	0.017	0.027	0.004	0.040	0.007
	MICG	0.976		0.021		0.035	
	MIWG	0.974	0.002	0.021	0.000	0.038	0.003

MISG	0.925	0.051	0.035	0.014	0.052	0.017
MISGp	0.941	0.035	0.031	0.010	0.047	0.012

Note. Int. = RIASEC interest dimensions; Δ CFI = Change in Comparative Fit Index; Δ TLI = Change in Tucker-Lewis Index; Δ RMSEA = Change in Root Mean Square Error of Approximation; Δ SRMR = Change in Standardized Root Mean Square Residual; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; MICT = configural measurement invariance over time; MIWT = weak measurement invariance over time; MIST = strong measurement invariance over time; MICG = configural measurement invariance over time and gender; MIWG = weak measurement invariance over time and gender; MISG = strong measurement invariance over time and gender; MISGp = partial strong measurement invariance over time and gender.

* $p < .01$.

Fit Indices for Generalized Second-Order Growth Models

For model selection, we used the same values that were proposed for measurement invariance testing. For the overall models, when a latent factor representing quadratic growth was included, the model fit did not improve substantially according to the fit indices. Although ΔCFI values for Investigative ($\Delta CFI = 0.017$) and Social ($\Delta CFI = 0.012$) were higher than the proposed value of .01, both of their $\Delta RMSEA$ and $\Delta SRMR$ values were under the proposed values. Therefore, we decided to specify models with a latent factor that implied linear growth only. Models with a latent linear growth factor possessed adequate model fit according to their descriptive fit indices.

Table C3***Fit Indices for Generalized Second-Order Growth Models***

Int.	Model	CFI	TLI	RMSEA	SRMR	χ^2	df
R	GSGML	0.955	0.954	0.032	0.039	1212.21*	270
	GSGMQ	0.958	0.956	0.031	0.040	1161.68*	266
	GSGML _{AUX}	0.963	0.963	0.030	0.044	1228.52*	270
	GSGMQ _{AUX}	0.965	0.964	0.030	0.046	1183.61*	266
I	GSGML	0.901	0.899	0.043	0.079	1943.91*	270
	GSGMQ	0.918	0.915	0.039	0.072	1659.18*	266
	GSGML _{AUX}	0.911	0.909	0.041	0.086	1998.54*	270
	GSGMQ _{AUX}	0.926	0.923	0.037	0.080	1709.17*	266
A	GSGML	0.906	0.904	0.041	0.057	1793.73*	270
	GSGMQ	0.914	0.911	0.039	0.056	1655.30*	266
	GSGML _{AUX}	0.919	0.917	0.038	0.067	1798.12*	270
	GSGMQ _{AUX}	0.926	0.923	0.037	0.065	1659.15*	266
S	GSGML	0.923	0.921	0.039	0.064	1702.47*	270
	GSGMQ	0.935	0.933	0.036	0.072	1469.97*	266
	GSGML _{AUX}	0.934	0.933	0.037	0.068	1728.05*	270
	GSGMQ _{AUX}	0.945	0.943	0.034	0.080	1490.88*	266
E	GSGML	0.947	0.946	0.028	0.040	995.83*	270
	GSGMQ	0.950	0.948	0.028	0.041	951.84*	266
	GSGML _{AUX}	0.955	0.954	0.026	0.047	980.29*	270
	GSGMQ _{AUX}	0.955	0.953	0.026	0.047	975.92*	266
C	GSGML	0.960	0.959	0.026	0.049	875.04*	270
	GSGMQ	0.962	0.961	0.025	0.045	842.15*	266

GSGML _{AUX}	0.966	0.965	0.024	0.061	876.90*	270
GSGMQ _{AUX}	0.968	0.966	0.024	0.057	838.85*	266

Note. Int. = RIASEC interest dimensions; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; χ^2 = Chi-Square Statistic; *df* = Degrees of Freedom; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; GSGML = GSGM with linear growth; GSGMQ = GSGM with quadratic growth; GSGML_{AUX} = GSGM with linear growth and auxiliaries; GSGMQ_{AUX} = GSGM with quadratic growth and auxiliaries.

* $p < .01$.

For the GSGM multigroup models, we first specified an overall model in which both groups (i.e., boys and girls) had linear as well as quadratic growth components. We then investigated whether the means of the respective quadratic growth factors were statistically significantly different from zero. If this was not the case, we specified another model in which we constrained the quadratic growth type for the respective group. If the change in the descriptive fit indices according to the values proposed by Chen (2007) was negligible, we decided to keep the constrained model.

For Realistic and Artistic interests, we kept the constrained model with quadratic growth for girls and linear growth for boys because the mean level of the latent quadratic growth factor for boys was not statistically significantly different from zero. Changes in the descriptive fit indices between the overall and constrained models were negligible and under the values proposed by Chen (2007). A similar procedure was applied for Conventional interests, with the only difference that girls had a linear growth factor, and boys had a quadratic growth factor.

For Investigative and Enterprising interests, we kept the overall model in which girls and boys both had a quadratic growth factor component. Both boys and girls had significant mean levels on the latent quadratic growth factor.

For Social interest, we specified a constrained model in which both the girls and boys had a linear growth factor. For both groups, the latent mean level of the quadratic growth factor was not statistically significantly different from zero. Although Δ CFI between the

overall and the constrained value was above .01, the accompanying Δ RMSEA and Δ SRMR values were below the proposed values. We consequently chose the more parsimonious model, which was the one with linear growth factors.

Table C4*Fit Indices for Multigroup Generalized Second-Order Growth Models*

Int.	Model	Growth Type	CFI	TLI	RMSEA	SRMR	χ^2	df
R	Ov	QQ	0.942	0.941	0.033	0.051	1541.80*	545
	Con	QL	0.939	0.939	0.033	0.052	1591.82*	549
	Aux	QL	0.948	0.948	0.032	0.060	1629.13*	549
I	Ov	QQ	0.907	0.906	0.041	0.074	2098.53*	545
	Con	QQ	0.907	0.906	0.041	0.074	2098.53*	545
	Aux	QQ	0.918	0.917	0.040	0.084	2170.97*	545
A	Ov	QQ	0.900	0.899	0.039	0.064	1946.27*	544
	Con	QL	0.896	0.895	0.040	0.065	2010.69*	548
	Aux	QL	0.908	0.907	0.038	0.076	2052.77*	548
S	Ov	QQ	0.927	0.926	0.036	0.073	1773.64*	546
	Con	LL	0.913	0.914	0.039	0.069	2004.72*	554
	Aux	LL	0.925	0.925	0.038	0.077	2055.76*	554
E	Ov	QQ	0.941	0.941	0.030	0.048	1358.64*	545
	Con	QQ	0.941	0.941	0.030	0.048	1358.64*	545
	Aux	QQ	0.951	0.951	0.028	0.056	1347.53*	545
C	Ov	QQ	0.947	0.946	0.030	0.052	1362.34*	545
	Con	LQ	0.946	0.946	0.030	0.053	1381.48*	549
	Aux	LQ	0.956	0.956	0.028	0.064	1372.19*	549

Note. Int. = RIASEC interest dimensions; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; χ^2 = Chi-Square Statistic; *df* = Degrees of Freedom; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; Ov. = Overall model; Con = constrained Model; Aux = Constrained model with auxiliaries; L = linear growth factor; Q = quadratic growth factor; QL = the growth factor type of the respective group, the first letter refers to girls, the second to boys.

* $p < .01$.

*Parameters for Generalized Second-Order Growth Models***Table C5***Model Parameters for Generalized Second-Order Growth Models*

Growth Type	Int.	Intercept		Slope		$r(I,S)$
		M [95% CI]	σ^2 [95% CI]	M [95% CI]	σ^2 [95% CI]	
Linear	R	3.37 [3.30, 3.43]	0.46 [0.39, 0.52]	-0.10 [-0.12, -0.08]	0.02 [0.01, 0.04]	-0.20 [-0.34, -0.07]
	I	3.64 [3.56, 3.72]	0.89 [0.79, 0.99]	-0.16 [-0.19, -0.13]	0.11 [0.09, 0.13]	-0.60 [-0.66, -0.55]
	A	3.63 [3.57, 3.70]	0.64 [0.56, 0.72]	-0.11 [-0.14, -0.09]	0.06 [0.04, 0.07]	-0.38 [-0.46, -0.31]
	S	3.19 [3.12, 3.26]	0.68 [0.57, 0.79]	0.06 [0.03, 0.08]	0.07 [0.04, 0.10]	-0.46 [-0.56, -0.36]
	E	2.87 [2.81, 2.92]	0.18 [0.13, 0.22]	-0.01 [-0.03, 0.00]	0.01 [0.00, 0.01]	-0.47 [-0.58, -0.36]
	C	3.10 [3.02, 3.19]	0.61 [0.51, 0.72]	-0.14 [-0.17, -0.10]	0.05 [0.02, 0.07]	-0.40 [-0.53, -0.28]
Quadratic	R	3.36 [3.29, 3.42]	0.58 [0.49, 0.68]	-0.01 [-0.03, 0.00]	0.04 [0.03, 0.06]	0.27 [0.17, 0.37]
	I	3.59 [3.50, 3.68]	1.05 [0.93, 1.17]	-0.04 [-0.06, -0.02]	0.10 [0.08, 0.12]	0.36 [0.28, 0.43]
	A	3.59 [3.52, 3.67]	0.73 [0.64, 0.82]	-0.03 [-0.05, -0.01]	0.05 [0.04, 0.07]	0.24 [0.16, 0.33]
	S	3.19 [3.12, 3.26]	0.82 [0.73, 0.91]	0.00 [-0.02, 0.02]	0.10 [0.08, 0.12]	0.23 [0.14, 0.32]
	E	2.82 [2.74, 2.91]	0.19 [-0.04, 0.41]	-0.02 [-0.04, 0.00]	0.01 [-0.02, 0.05]	0.10 [-0.77, 0.97]
	C*	3.12 [3.03, 3.21]	0.49 [0.25, 0.73]	0.01 [-0.01, 0.03]	0.03 [0.00, 0.06]	-0.30 [-0.95, 0.34]

Note. Int. = RIASEC interest dimensions; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; M = mean of intercept or slope factor; σ^2 = variance of intercept or slope factor; $r(I,S)$ = correlation between intercept and slope factor.

Table C6*Model Parameters for Multigroup Generalized Second-Order Growth Models*

		Intercept		Slope		
	Int.	<i>M</i> [95% CI]	σ^2 [95% CI]	<i>M</i> [95% CI]	σ^2 [95% CI]	<i>r</i> (I,S) [95% CI]
Boys	R	3.71 [3.64, 3.77]	0.40 [0.29, 0.51]	0.01 [-0.01, 0.03]	0.04 [0.03, 0.05]	.29 [.16, .41]
	I	3.70 [3.59, 3.80]	1.01 [0.87, 1.14]	-0.03 [-0.06, 0.00]	0.11 [0.08, 0.13]	.39 [.30, .48]
	A	3.44 [3.35, 3.53]	0.97 [0.82, 1.13]	-0.02 [-0.05, 0.01]	0.09 [0.06, 0.12]	.30 [.17, .43]
	S	2.97 [2.88, 3.06]	0.83 [0.70, 0.96]	-0.01 [-0.04, 0.03]	0.11 [0.09, 0.14]	.23 [.12, .34]
	E	2.92 [2.83, 3.01]	0.34 [0.16, 0.52]	-0.03 [-0.05, -0.01]	0.02 [0.01, 0.04]	.11 [-.32, .53]
	C	3.01 [2.90, 3.12]	0.52 [0.27, 0.78]	0.03 [0.00, 0.06]	0.04 [0.002, 0.08]	-.15 [-.73, .43]
	R _L	3.66 [3.59, 3.72]	0.31 [0.23, 0.39]	-0.07 [-0.09, -0.05]	0.02 [0.01, 0.04]	-.38 [-.53, -.22]
	I _Q	3.68 [3.58, 3.78]	1.01 [0.88, 1.15]	-0.04 [-0.07, -0.01]	0.10 [0.08, 0.12]	.34 [.23, .45]
	A _L	3.47 [3.39, 3.56]	0.82 [0.68, 0.96]	-0.17 [-0.20, -0.13]	0.08 [0.05, 0.10]	-.54 [-.63, -.45]
	S _L	2.99 [2.91, 3.07]	0.69 [0.56, 0.82]	0.02 [-0.01, 0.05]	0.07 [0.04, 0.11]	-.53 [-.63, -.42]
	E _Q	3.00 [2.91, 3.10]	0.28 [0.18, 0.39]	-0.02 [-0.04, -0.01]	0.01 [-0.01, 0.04]	-.11 [-.93, .72]
	C _Q	2.99 [2.89, 3.09]	0.51 [0.29, 0.73]	0.03 [0.01, 0.06]	0.04 [0.01, 0.07]	-.21 [-.76, .33]
Girls	R	2.97 [2.89, 3.04]	0.44 [0.36, 0.53]	-0.04 [-0.06, -0.02]	0.04 [0.03, 0.06]	.27 [.14, .40]
	I	3.50 [3.40, 3.61]	1.09 [0.94, 1.23]	-0.04 [-0.07, -0.01]	0.10 [0.08, 0.12]	.32 [.21, .43]
	A	3.95 [3.87, 4.04]	0.62 [0.49, 0.75]	-0.04 [-0.06, -0.02]	0.05 [0.03, 0.07]	.32 [.19, .45]
	S	3.43 [3.34, 3.52]	0.72 [0.60, 0.85]	0.01 [-0.02, 0.04]	0.09 [0.06, 0.11]	.26 [.14, .39]
	E	3.00 [2.89, 3.11]	0.29 [0.18, 0.40]	-0.02 [-0.05, 0.00]	0.02 [-0.01, 0.05]	.04 [-.84, .91]
	C	2.93 [2.84, 3.03]	0.46 [0.20, 0.71]	-0.02 [-0.05, 0.00]	0.01 [-0.03, 0.04]	-.86 [-3.92, 2.20]
	R _Q	2.96 [2.88, 3.03]	0.41 [0.31, 0.51]	-0.03 [-0.05, -0.01]	0.03 [0.02, 0.05]	.28 [.10, .47]
	I _Q	3.48 [3.37, 3.59]	1.09 [0.95, 1.24]	-0.04 [-0.07, -0.01]	0.10 [0.08, 0.13]	.38 [.29, .47]
	A _Q	3.94 [3.85, 4.04]	0.57 [0.43, 0.70]	-0.04 [-0.06, -0.02]	0.04 [0.02, 0.06]	.32 [.15, .48]
	S _L	3.41 [3.33, 3.50]	0.58 [0.46, 0.70]	0.11 [0.08, 0.15]	0.07 [0.04, 0.09]	-.53 [-.65, -.41]
	E _Q	2.93	0.37	-0.03	0.02	.11

	[2.85, 3.02]	[0.18, 0.55]	[-0.05, -0.01]	[0.00, 0.04]	[-.31, .52]
	2.95	0.59	-0.18	0.06	-.44
C _L	[2.87, 3.04]	[0.46, 0.72]	[-0.22, -0.15]	[0.03, 0.08]	[-.60, -.28]

Note. Ov. = Overall model; Con = constrained Model; Int. = RIASEC interest dimensions; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; M = mean of intercept or slope factor; σ^2 = variance of intercept or slope factor; $r(I,S)$ = correlation between intercept and slope factor.

Table C7*Consistency and Occasion Specificity per Time Point for Generalized Second-Order Growth Models with Linear Growth*

Int.	TL	CO [95% CI]	Δ [95% CI]	OS [95% CI]	Δ [95% CI]	ε [95% CI]	Δ [95% CI]	ΔCOOS [95% CI]
R	1	.29 [.26, .32]		.19 [.16, .22]		.52 [.51, .54]		.10 [.05, .15]
	2	.32 [.30, .34]	.03 [.01, .06]	.18 [.16, .21]	-.01 [-.04, .03]	.50 [.48, .52]	-.03 [-.05, .00]	.14 [.10, .18]
	3	.36 [.33, .38]	.04 [.02, .05]	.16 [.14, .19]	-.02 [-.05, .01]	.48 [.46, .50]	-.01 [-.04, .01]	.19 [.15, .24]
	4	.41 [.37, .44]	.05 [.02, .08]	.17 [.14, .21]	.01 [-.03, .05]	.42 [.40, .44]	.06 [.04, .08]	.23 [.16, .30]
	14		.12 [.08, .16]		-.02 [-.06, .03]		-.10 [-.13, -.08]	
I	1	.26 [.23, .28]		.19 [.16, .21]		.55 [.53, .58]		.07 [.03, .11]
	2	.21 [.19, .23]	-.05 [-.07, -.03]	.24 [.22, .27]	.05 [.03, .08]	.55 [.53, .57]	-.01 [-.03, .02]	-.04 [-.07, .00]
	3	.22 [.19, .24]	.01 [-.01, .02]	.23 [.20, .25]	-.02 [-.04, .01]	.55 [.54, .58]	.01 [-.02, .03]	-.01 [-.06, .03]
	4	.27 [.24, .30]	.06 [.04, .07]	.26 [.22, .29]	.03 [.00, .06]	.47 [.45, .50]	.09 [.06, .12]	.02 [-.04, .07]
	14		.02 [-.02, .05]		.07 [.03, .11]		-.09 [-.12, -.05]	
A	1	.23 [.20, .25]		.17 [.14, .19]		.60 [.59, .63]		.06 [.02, .10]
	2	.22 [.21, .24]	.00 [-.02, .01]	.17 [.15, .20]	.01 [-.02, .04]	.61 [.58, .63]	-.01 [-.03, .02]	.05 [.02, .08]
	3	.24 [.22, .26]	.01 [.00, .03]	.18 [.16, .21]	.01 [-.01, .04]	.58 [.56, .60]	-.03 [-.05, .00]	.05 [.02, .09]
	4	.28 [.26, .30]	.04 [.03, .06]	.15 [.13, .18]	-.03 [-.06, .00]	.57 [.54, .59]	.01 [-.01, .04]	.13 [.09, .17]
	14		.06 [.03, .08]		-.01 [-.05, .02]		-.04 [-.08, -.01]	
S	1	.26 [.23, .29]		.21 [.18, .24]		.53 [.51, .56]		.06 [.00, .11]
	2	.25 [.22, .28]	-.01 [-.03, .01]	.24 [.22, .27]	.04 [.01, .07]	.51 [.49, .53]	-.03 [-.06, .00]	.01 [-.05, .06]
	3	.27 [.24, .30]	.02 [.00, .03]	.23 [.20, .26]	-.01 [-.04, .01]	.50 [.48, .52]	-.01 [-.03, .02]	.04 [-.02, .09]
	4	.33 [.31, .36]	.07 [.04, .09]	.19 [.15, .23]	-.04 [-.08, -.01]	.48 [.44, .51]	.02 [-.01, .06]	.15 [.08, .21]
	14		.07 [.04, .11]		-.02 [-.06, .03]		-.06 [-.09, -.02]	
E	1	.20 [.18, .23]		.21 [.18, .24]		.58 [.56, .61]		-.01 [-.06, .04]
	2	.22 [.20, .23]	.01 [-.01, .03]	.18 [.16, .20]	-.03 [-.07, .00]	.60 [.58, .62]	.02 [-.01, .05]	.03 [.00, .07]
	3	.22 [.20, .23]	.00 [-.02, .02]	.17 [.15, .19]	-.01 [-.04, .02]	.62 [.59, .64]	.01 [-.01, .04]	.04 [.01, .08]
	4	.23 [.20, .27]	.02 [-.01, .05]	.17 [.14, .21]	.00 [-.04, .05]	.59 [.58, .61]	.02 [-.01, .05]	.06 [-.01, .13]

	14		.03 [-.01, .07]		-.04 [-.09, .01]		.01 [-.02, .04]
	1	.20 [.17, .23]		.25 [.21, .28]		.56 [.53, .58]	-.05 [-.11, .01]
	2	.20 [.18, .23]	.00 [-.02, .02]	.25 [.23, .28]	.01 [-.02, .04]	.55 [.53, .56]	-.01 [-.04, .02]
C	3	.22 [.20, .24]	.02 [.00, .03]	.22 [.20, .25]	-.03 [-.06, .00]	.56 [.54, .58]	.02 [-.01, .04]
	4	.26 [.23, .29]	.04 [.02, .07]	.18 [.15, .21]	-.04 [-.08, -.01]	.56 [.54, .58]	.00 [-.03, .03]
	14		.06 [.02, .10]		-.07 [-.11, -.02]		.01 [-.02, .04]

Note. Int. = RIASEC interest dimensions; TL = time lag; CO = consistency coefficient; Δ = differences in the consistency, occasion specificity and residual coefficient; OS = occasion specificity coefficient; ε = residual variance; Δ COOS = difference between consistency coefficient and occasion specificity coefficient, positive values indicate higher values for the consistency coefficient; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table C8*Consistency and Occasion Specificity per Time Point for Generalized Second-Order Growth Models with Quadratic Growth*

Int.	TL	CO [95% CI]	Δ [95% CI]	OS [95% CI]	Δ [95% CI]	ε [95% CI]	Δ [95% CI]	Δ COOS [95% CI]
R	1	.37 [.33, .40]		.11 [.07, .14]		.53 [.51, .55]		.26 [.19, .33]
	2	.36 [.34, .39]	-.01 [-.04, .03]	.16 [.13, .18]	.05 [.00, .10]	.48 [.47, .50]	-.04 [-.07, -.02]	.21 [.16, .25]
	3	.40 [.37, .43]	.04 [.02, .06]	.13 [.10, .15]	-.03 [-.06, .00]	.47 [.45, .49]	-.01 [-.04, .01]	.27 [.23, .32]
	4	.48 [.44, .52]	.08 [.04, .13]	.09 [.05, .13]	-.04 [-.08, .01]	.42 [.40, .44]	.05 [.02, .07]	.39 [.31, .47]
	14		.12 [.07, .17]		-.01 [-.06, .04]		-.11 [-.13, -.08]	
I	1	.32 [.30, .35]		.15 [.12, .17]		.53 [.51, .56]		.18 [.13, .22]
	2	.26 [.24, .28]	-.06 [-.09, -.04]	.20 [.18, .23]	.06 [.03, .08]	.54 [.51, .56]	.01 [-.03, .04]	.06 [.02, .10]
	3	.29 [.26, .32]	.03 [.01, .05]	.18 [.15, .21]	-.02 [-.05, .00]	.53 [.51, .55]	-.01 [-.03, .02]	.11 [.06, .16]
	4	.33 [.30, .36]	.04 [.01, .06]	.21 [.19, .24]	.04 [.01, .06]	.46 [.44, .48]	.07 [.05, .10]	.11 [.06, .17]
	14		.01 [-.03, .04]		.07 [.04, .10]		-.07 [-.11, -.04]	
A	1	.26 [.24, .29]		.14 [.11, .16]		.60 [.57, .62]		.13 [.08, .17]
	2	.26 [.24, .28]	.00 [-.02, .02]	.15 [.12, .17]	.01 [-.02, .03]	.59 [.57, .61]	-.01 [-.04, .03]	.12 [.08, .15]
	3	.28 [.26, .30]	.02 [.00, .03]	.16 [.13, .18]	.01 [-.01, .04]	.56 [.54, .58]	-.03 [-.06, .01]	.12 [.08, .16]
	4	.31 [.29, .33]	.03 [.01, .05]	.14 [.12, .16]	-.02 [-.05, .00]	.55 [.53, .58]	.01 [-.02, .04]	.18 [.14, .21]
	14		.05 [.02, .08]		.00 [-.03, .03]		-.05 [-.08, .01]	
S	1	.31 [.27, .34]		.17 [.13, .20]		.53 [.51, .56]		.14 [.07, .21]
	2	.32 [.29, .35]	.01 [-.01, .04]	.20 [.17, .22]	.03 [.00, .05]	.49 [.47, .51]	-.04 [-.07, -.01]	.12 [.07, .18]
	3	.34 [.31, .38]	.02 [.00, .04]	.18 [.16, .21]	-.01 [-.03, .01]	.47 [.45, .50]	-.01 [-.03, .01]	.16 [.10, .22]
	4	.38 [.35, .41]	.04 [.01, .07]	.18 [.16, .21]	.00 [-.03, .03]	.44 [.41, .47]	.04 [.00, .07]	.20 [.15, .25]
	14		.07 [.04, .11]		.02 [-.02, .05]		-.09 [-.12, -.06]	
E	1	.22 [.04, .40]		.19 [.03, .34]		.59 [.56, .63]		.03 [-.30, .37]
	2	.25 [.23, .28]	.03 [-.14, .20]	.15 [.13, .17]	-.04 [-.20, .13]	.60 [.57, .62]	.00 [-.03, .03]	.10 [.07, .14]
	3	.26 [.24, .28]	.01 [-.01, .02]	.14 [.11, .18]	-.01 [-.05, .03]	.60 [.56, .64]	.00 [-.03, .04]	.12 [.08, .16]
	4	.28 [.07, .49]	.02 [-.18, .23]	.11 [-.10, .33]	-.03 [-.26, .21]	.60 [.59, .62]	-.01 [-.05, .03]	.17 [-.26, .59]

	14		.06 [-.01, .13]		-.07 [-.17, .02]		.01 [-.03, .05]	
	1	.16 [.10, .22]		.27 [.21, .33]		.57 [.55, .59]		-.11 [-.23, .01]
	2	.25 [.21, .28]	.08 [.02, .15]	.22 [.19, .25]	-.05 [-.12, .02]	.53 [.51, .55]	-.04 [-.06, -.01]	.02 [-.04, .08]
C	3	.26 [.23, .29]	.02 [.00, .04]	.19 [.16, .22]	-.04 [-.07, .00]	.55 [.53, .57]	.02 [-.01, .04]	.08 [.02, .13]
	4	.28 [.24, .32]	.02 [-.02, .05]	.15 [.12, .19]	-.03 [-.07, .01]	.57 [.55, .59]	-.02 [-.04, .01]	.13 [.05, .20]
	14		.12 [.05, .18]		-.12 [-.18, -.05]		.00 [-.03, .03]	

Note. Int. = RIASEC interest dimensions; TL = time lag; CO = consistency coefficient; Δ = differences in the consistency, occasion specificity and residual coefficient; OS = occasion specificity coefficient; ε = residual variance; Δ COOS = difference between consistency coefficient and occasion specificity coefficient, positive values indicate higher values for the consistency coefficient; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional; 1–4 = time points 1 to 4; 14 = lag between T1 to T4.

Table C9*Consistency and Occasion Specificity Averaged across All Time Points*

Growth Type	Int.	CO [95% CI]	OS [95% CI]	ε [95% CI]	Δ COOS [95% CI]
Linear	R	.34 [.32, .36]	.18 [.16, .19]	.48 [.47, .49]	.17 [.13, .20]
	I	.24 [.22, .26]	.23 [.21, .25]	.53 [.52, .55]	.01 [-.03, .05]
	A	.24 [.23, .26]	.17 [.15, .18]	.59 [.58, .60]	.07 [.05, .10]
	S	.28 [.25, .30]	.22 [.19, .24]	.50 [.49, .52]	.06 [.01, .11]
	E	.22 [.20, .23]	.19 [.17, .20]	.60 [.59, .61]	.03 [.002, .06]
	C	.22 [.20, .2]	.23 [.21, .25]	.56 [.54, .57]	-.01 [-.05, .03]
Quadratic	R	.40 [.38, .42]	.12 [.10, .14]	.48 [.46, .49]	.28 [.24, .3]
	I	.30 [.28, .32]	.19 [.17, .21]	.51 [.50, .53]	.12 [.07, .16]
	A	.28 [.26, .30]	.14 [.13, .16]	.58 [.56, .59]	.14 [.11, .17]
	S	.34 [.31, .37]	.18 [.16, .21]	.48 [.47, .50]	.15 [.10, .21]
	E	.25 [.15, .36]	.15 [.06, .23]	.60 [.58, .62]	.11 [-.08, .29]
	C	.24 [.21, .27]	.21 [.18, .23]	.55 [.54, .57]	.03 [-.02, .08]

Note. Int. = RIASEC interest dimensions; CO = consistency coefficient; OS = occasion specificity coefficient; ε = residual variance; Δ COOS = difference between consistency coefficient and occasion specificity coefficient, positive values indicate higher values for the consistency coefficient; R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

Supplement D: Model Depictions and Formulas***Depiction of the Saturated Path Model*****Figure D1***Depiction of the saturated path model*

Note. Only the retest correlations are depicted. However, all possible correlations between all manifest RIASEC scales were estimated. For simplicity, the other correlations are not depicted in the model.

Depiction of the Generalized Second-Order Growth Models**Figure D2***Depiction of the GSGM with linear growth.*

Note. Correlated uniqueness is not depicted. Intercept factors were identified by fixing the first factor loading to 1 and the first intercept to 0.

Figure D3

Depiction of the GSGM with quadratic growth.

Note. Correlated uniqueness is not depicted. Intercept factors were identified by fixing the first factor loading to 1 and the first intercept to 0.

Formulas for Consistency and Occasion Specificity for the Linear Models

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

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

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

Formulas for Consistency and Occasion Specificity for the Quadratic Models

$$\begin{aligned} \text{var}(Y_{it}) = & \lambda_{it}^2 \text{var}(\xi_{\text{int}}) + \lambda_{it}^2 \text{var}(\xi_{\text{lin}}) + \Upsilon_{it}^2 \text{var}(\xi_{\text{quad}}) + \\ & 2\lambda_{it}^2 \text{cov}(\xi_{\text{int}}, \xi_{\text{lin}}) + 2(\lambda_{it} \Upsilon_{it} \text{cov}(\xi_{\text{int}}, \xi_{\text{quad}})) + 2(\lambda_{it} \Upsilon_{it} \text{cov}(\xi_{\text{lin}}, \xi_{\text{quad}})) + \\ & \gamma_{it}^2 \text{var}(\zeta_t) + \text{var}(\varepsilon_{it}) \end{aligned} \quad (\text{S4})$$

$$CO(Y_{it}) = \frac{\lambda_{it}^2 \text{var}(\xi_{\text{int}}) + \lambda_{it}^2 \text{var}(\xi_{\text{lin}}) + \Upsilon_{it}^2 \text{var}(\xi_{\text{quad}}) + 2\lambda_{it}^2 \text{cov}(\xi_{\text{int}}, \xi_{\text{lin}}) + 2(\lambda_{it} \Upsilon_{it} \text{cov}(\xi_{\text{int}}, \xi_{\text{quad}})) + 2(\lambda_{it} \Upsilon_{it} \text{cov}(\xi_{\text{lin}}, \xi_{\text{quad}}))}{\text{var}(Y_{it})} \quad (\text{S5})$$

$$OS(Y_{it}) = \frac{\gamma_{it}^2 \text{var}(\zeta_t)}{\text{var}(Y_{it})} \quad (\text{S6})$$

Formula for Cohen's d for Repeated Measures

$$\text{Cohen's } d_{rm} = \frac{M_{\text{diff}}}{\sqrt{SD_1^2 + SD_2^2 + 2rSD_1SD_2}} \sqrt{2(1-r)} \quad (\text{S7})$$