Talent Development in Academic Domains:

A Follow-Up of Former Junior Students at

Julius-Maximilians-Universität Würzburg

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To my family, especially to my parents and my sister

The chance to pursue one's own interests comes from

having the kind of support that is not tied to expectations.

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Zusammenfassung

Der Bereich der (Hoch-)Begabung und Begabtenförderung galt aufgrund inkonsistenter Definitionen von Kernkonzepten lange Zeit als intern zersplittert (z.B., Ambrose et al., 2010; Coleman, 2006; McBee et al., 2012). Erst in den letzten Jahren sind vermehrt Bemühungen entstanden, bestehende Forschungsbefunde zu ordnen und dem Bereich der (Hoch-)Begabung und Begabtenförderung wieder zu mehr Einheitlichkeit zu verhelfen. Das Integrative Talententwicklungsmodell von Preckel et al. (2020) vereint beispielsweise theoretische Perspektiven und empirisches Wissen aus verschiedenen Teilen des Forschungsbereichs. Es ist allgemein konzipiert und kann auf eine Vielzahl von Leistungsdomänen angewendet werden. Durch eine gezielte Konzentration auf messbare psychologische Konstrukte sowie deren Relevanz auf unterschiedlichen Stufen der Talententwicklung, ist das Integrative Talententwicklungsmodell von Preckel et al. (2020) gut als Ausgangspunkt für die Generierung domänenspezifischer Talententwicklungsmodelle geeignet.

Die vorliegende Arbeit stellt einen der ersten Versuche dar, die Gültigkeit des Integrativen Talententwicklungsmodells von Preckel et al. (2020) in akademischen Domänen anhand längsschnittlicher Daten empirisch zu überprüfen. Die längsschnittlichen Daten stammten dabei aus einer Stichprobe ehemaliger Frühstudierender der Julius-Maximilians-Universität (JMU) Würzburg, die nachweislich über eine hohe akademische Leistungsfähigkeit verfügten.

Es wurden zwei zusammenhängende Forschungsfragen betrachtet: Forschungsfrage 1 verfolgte zunächst das Ziel, die Bildungsverläufe ehemaliger Frühstudierender in den Jahren nach ihrem Abitur ausführlich zu dokumentieren. Dazu wurde eine Nachbefragung unter 208 jungen Erwachsenen durchgeführt, die im Zeitraum von Wintersemester 2004/2005 bis Sommersemester 2011 am Frühstudium der JMU Würzburg teilgenommen hatten. Die

Gestaltung des Fragebogens für die Nachbefragung orientierte sich an einer Reihe von Fragestellungen, die sich aus der einschlägigen Literatur zum Frühstudium in Deutschland ergeben hatte. Der Erhebungszeitraum der Nachbefragung erstreckte sich von Oktober 2019 bis Februar 2020. Die Daten wurden in erster Linie deskriptiv ausgewertet und in Berichtsform dargestellt. Die Ergebnisse von Forschungsfrage 1 zeigten, dass die ehemaligen Frühstudierenden weit über ihre Schulzeit hinaus herausragende (akademische und berufliche) Leistungen erbrachten. So hatten zum Zeitpunkt der Nachbefragung beinahe alle Ehemaligen einen Bachelor- und Masterabschluss, meist mit beachtlichen akademischen Erfolgen (z.B. Stipendium, Auszeichnungen/Preise), erworben. Mehr als die Hälfte der ehemaligen Frühstudierenden hatte darüber hinaus eine Promotion begonnen oder bereits abgeschlossen und dabei ebenfalls außerordentliche akademische Erfolge (z.B. Publikationen, Stipendien) erzielt. Ein wesentlicher Teil der ehemaligen Frühstudierenden war zum Befragungszeitpunkt bereits ins Berufsleben eingetreten. Ein Blick auf ihre aktuelle berufliche Situation zeigte eine überdurchschnittliche Ausprägung von Erfolgsindikatoren (z.B. Einkommen, beruflicher Status). Die deutliche Mehrheit der ehemaligen Frühstudierenden gab an, dass sie sich auch rückblickend wieder für eine Teilnahme am Frühstudium der JMU Würzburg entscheiden würde.

Forschungsfrage 2 untersuchte schließlich, inwieweit sich die Struktur des Integrativen Talententwicklungsmodells von Preckel et al. (2020) für akademische Domänen empirisch validieren lässt. Als Datengrundlage dienten die Bildungsverläufe von 84 ehemaligen Frühstudierenden der JMU Würzburg, die im Regelstudium ein Fach aus derselben Fächergruppe wie im Frühstudium belegt hatten. Die Bildungsverläufe wurden aus den Daten der Nachbefragung und aus den Daten des Auswahlverfahrens für das Frühstudium an der JMU Würzburg gewonnen. Eine Kombination der strukturellen Annahmen des Integrativen Talententwicklungsmodells von Preckel et al. (2020) mit relevanten Erkenntnissen aus der

Talentforschung zu einzelnen Studienfächern machte es möglich, Hypothesen über potenzielle Prädiktoren und Indikatoren der Talententwicklungsstufen *Begabung*, *Kompetenz* und *Expertise* für akademische Domänen aufzustellen. Zur Datenanalyse wurden Strukturgleichungsmodelle herangezogen. Die Ergebnisse von Forschungsfrage 2 ließen darauf schließen, dass die Talententwicklungsstufen *Begabung*, *Kompetenz* und *Expertise* anhand modellkonformer Indikatoren in akademischen Domänen zufriedenstellend abgebildet werden können und sich in ihrer chronologischen Reihenfolge gegenseitig vorhersagen. Die Talententwicklungsstufe *transformatorische Leistung* konnte dagegen auf Basis der Daten (noch) nicht modelliert werden. Unter den potenziellen Prädiktoren sagten das forschungsbezogene Interesse sowie die metakognitiven Fähigkeiten der ehemaligen Frühstudierenden die Talententwicklungsstufen *Kompetenz* und *Expertise* verlässlich vorher. Die restlichen Prädiktoren leisteten keinen signifikanten Beitrag.

Insgesamt weisen die Ergebnisse der vorliegenden Arbeit darauf hin, dass sich die Gültigkeit des Integrativen Talententwicklungsmodells von Preckel et al. (2020) in akademischen Domänen nur zum Teil bestätigen lässt. Im Gegensatz zu den postulierten Indikatoren scheinen die Prädiktoren des Integrativen Talententwicklungsmodells von Preckel et al. (2020) nicht einfach auf akademische Domänen übertragbar zu sein, sondern unter Umständen eine hohe Spezifität in Bezug auf die betrachtete Domäne der Talententwicklung aufzuweisen. Eine sinnvolle Fortsetzung der vorliegenden Arbeit würde somit darin bestehen, die Struktur des Integrativen Talententwicklungsmodells von Preckel et al. (2020) beispielsweise auf der untergeordneten Ebene von Fächergruppen oder sogar auf der Ebene einzelner Studienfächer zu untersuchen.

Abstract

The field of giftedness and gifted education has long been characterized by internal fragmentation and inconsistent definitions of core concepts (e.g., Ambrose et al., 2010; Coleman, 2006; McBee et al., 2012). It was only in recent years that increased efforts have been made to organize available research findings and thereby bring back greater uniformity to the field of giftedness and gifted education. For example, Preckel et al.'s (2020) *Talent Development in Achievement Domains* (TAD) framework integrates theoretical perspectives and empirical knowledge from different parts of the field. It is general in concept and can be applied to a wide range of achievement domains. By specifically focusing on measurable psychological constructs as well as their relevance at different stages of the talent development process, Preckel et al.'s (2020) TAD framework is well suited as a starting point for generating more domain-specific talent development models.

The present thesis represents one of the first attempts to empirically test the validity of Preckel et al.'s (2020) TAD framework in academic domains using longitudinal data. The longitudinal data came from a sample of former junior students at Julius-Maximilians-Universität (JMU) Würzburg who showed high academic achievement potential.

There were two related research issues: Research Issue 1 first aimed to document in detail how the educational trajectories of former junior students unfold in the years following their Abitur. To this end, a follow-up was conducted among 208 young adults who had participated in the junior study program at JMU Würzburg between the winter semester of 2004/2005 and the summer semester of 2011. The design of the follow-up questionnaire was based on a series of research questions that had emerged from the relevant literature on junior study programs in Germany. The follow-up ran from October 2019 to February 2020. The data were analyzed descriptively and documented as a detailed report. The results of Research

Issue 1 revealed that the former junior students continued to be academically (and later professionally) successful long after their school years. For example, at the time of the follow-up, almost all former junior students had earned a bachelor's and a master's degree, most often with notable academic successes (e.g., scholarships, awards/prizes). In addition, more than half of those who responded had begun or already completed a doctoral degree, also recording special academic accomplishments (e.g., scientific publications, scholarships). A significant proportion of the former junior students had already entered the workforce at the time of their response. A look at their current professional situation revealed an above-average expression of success indicators (e.g., income, professional status). The clear majority of the former junior students reported that, even in retrospect, they would choose to take part in the junior study program at JMU Würzburg again.

Research Issue 2 aimed to determine the extent to which the structure of Preckel et al.'s (2020) TAD framework could be empirically validated in academic domains. The educational trajectories of 84 former junior students at JMU Würzburg who had chosen a subject from the same subject field in their regular studies as in their junior studies, served as the data basis. The educational trajectories were compiled from the former junior students' follow-up data and from their data on the selection process for the junior study program at JMU Würzburg. Combining the structural assumptions of Preckel et al.'s (2020) TAD framework with relevant insights from individual academic disciplines made it possible to derive hypotheses regarding potential predictors and indicators of the talent development stages *aptitude*, *competence*, and *expertise* in academic domains. Structural equation models were used for data analysis. The results of Research Issue 2 suggested that the talent development stages *aptitude*, *competence*, and *expertise*, while being predictive of each other in their chronological order, could be satisfactorily modeled using framework-compliant indicators in academic domains. In comparison, the talent development stage *transformational achievement* could not (yet) be

modeled based on the longitudinal data. Among the hypothesized predictors, former junior students' investigative interests and their metacognitive abilities reliably determined the talent development stages *competence* and *expertise*, whereas the remaining predictors did not make significant contributions.

Taken together, the results of the present thesis suggest that the validity of Preckel et al.'s (2020) TAD framework can only be partially confirmed in academic domains. Unlike the postulated indicators, the predictors in Preckel et al.'s (2020) TAD framework do not seem to be easily generalizable to academic domains but to be highly specific with regard to the talent achievement under consideration. Therefore, a natural progression of the present thesis would be to examine the structure of Preckel et al.'s (2020) TAD framework at the subordinate level of subject fields or even at the level of individual academic disciplines, for example.

1 Introduction

Due to inconsistent definitions of core concepts as well as other theoretical disagreements, the field of giftedness and gifted education has long been considered internally fragmented and contested (e.g., Ambrose et al., 2010; Coleman, 2006; McBee et al., 2012). In particular, following the widespread rejection of the so-called *gifted child paradigm*, which equated giftedness with exceptional cognitive abilities, researchers have lacked a unified theoretical framework on which to base their efforts (McBee et al., 2012). Instead, they found themselves confronted with a multitude of competing models originating from different interest groups and each promoting their own conceptions of giftedness. Often, this situation has contributed to high levels of frustration among researchers and has eventually led them to consider theoretical aspects less frequently when designing studies with gifted samples (Ambrose et al., 2010; McBee et al., 2012).

In recent years, increased efforts have been made to sift through the available evidence and to help the field of giftedness and gifted education regain more uniformity. For example, based on a comprehensive review of the relevant literature, Subotnik et al. (2011, 2018b) put forward an integrated model of giftedness and talent development, the *Talent Development Megamodel* (TDMM), which combines the most compelling components of already established models and aims to outline the emergence of exceptional performance across all domains of human endeavor. Another example of an integrated model of giftedness and talent development is Preckel et al.’s (2020) *Talent Development in Achievement Domains* (TAD) framework. Like Subotnik et al.’s (2011, 2018b) TDMM, the TAD framework describes the talent development process as a sequence of several qualitatively distinct stages, over the course of which general cognitive abilities gradually turn into more specific skills and competencies. Moreover, the TAD framework conceptualizes talent development as dependent on a large number of factors whose relative importance varies with the level of talent development. However, while Subotnik et al.'s (2011, 2018b) TDMM grew from a purely descriptive summary of the literature, the intent behind Preckel et al.'s (2020) TAD framework was primarily to reduce complexity and to make talent development more accessible for empirical investigations and more readily usable for cross-domain applications. In order to meet this intent, the TAD framework explicitly focuses on measurable, person-related variables as well as internal psychological processes that lead to interest and success in a domain. At the same time, it specifically suggests important predictors and indicators for the different stages of the talent development process (Preckel et al., 2020).

In psychological research, there are no studies to date that have empirically examined the validity of these integrated models of giftedness and talent development, neither that of Subotnik et al.'s (2011, 2018b) TDMM nor that of Preckel et al.'s (2020) TAD framework. Surprisingly, this is true even for research in academic domains, where numerous studies have been conducted on the importance of general intellectual abilities for success in school and in higher education. As Subotnik et al. (2019) clearly point out, there is virtually no scientific work in academic domains on what psychological variables are important for predicting exceptional achievement. At the same time, unlike established performance domains such as Sports or Music, academic domains also lack traditional indicators to show whether children and adolescents are making adequate talent development progress (Subotnik et al., 2017). As a result, academic domains lag far behind performance domains on both theoretical and practical levels, and there is much work to be done before, for example, sustainable talent development programs can be created that give gifted and motivated young people the chance to access needed knowledge, skills, and opportunities (Worrell et al., 2012).

The present thesis makes one of the first attempts to empirically test the validity of Preckel et al.'s (2020) TAD framework in academic domains. To this end, it draws on longitudinal data obtained from the selection process for the junior study program at JMU

Würzburg and from a follow-up of former junior students. Structural equation models (SEMs) are used for data analysis. On the one hand, the aim is to identify indicators of academic talent development at different stages of the talent development process. On the other hand, the present thesis tries to distinguish psychological variables that predict whether children and adolescents are meeting the expectations placed on them at their age-appropriate talent development stages. If these indicators and predictors turn out to be specific enough, they can eventually be used to develop interventions and curricula that promote talent development in academic domains.

The longitudinal data for the present thesis were collected in the selection process for the junior study program at JMU Würzburg and in a follow-up of former junior students. The junior study program at JMU Würzburg was initiated in the winter semester of 2004/2005, making it the first junior study program at a higher education institution in Bavaria (Christ, 2014). It is organized by the Begabungspsychologische Beratungsstelle (BYB) [Psychological Counseling Center for Giftedness], a central scientific institution at JMU Würzburg. Besides the formal administration of the program, the BYB is also responsible for the routine implementation and scientific evaluation of a multi-stage selection process, which is conducted twice a year at the beginning of each semester in order to admit qualified applicants. The scientific goal of the selection process is to identify admission criteria that are associated with successful participation in the junior study program and then to take these criteria into account when refining the selection process in the future (Stumpf et al., 2011; Stumpf & Schneider, 2010, 2013).

At the time the junior study program at JMU Würzburg was initiated, there was hardly any research on junior study programs in Germany, so robust admission criteria for the gifted education measure were widely lacking (Stumpf & Schneider, 2010). For this reason, the team of the BYB decided to base admission decisions at JMU Würzburg on as broad a picture of applicants as possible, taking into account various measures such as performance-related, psychological, motivational, and socio-demographic variables. In addition, it was specified that rejection rates should be kept at a low level and that applicants for the junior study program at JMU Würzburg should only be dismissed if their overall diagnostic findings were severe (e.g., critical school performance, no more than average cognitive abilities, or relatively low levels of motivation; Stumpf et al., 2011; Stumpf & Schneider, 2010, 2013). As a result of this generous selection process, there are now extensive data sets available in the archives of the BYB, especially from those junior students who applied for the junior study program at JMU Würzburg in the early semesters. Moreover, due to the deliberately low rejection rate, the data sets are largely unselected; that is, despite the presumably high average academic potential of the sample, the variables collected in the selection process should have fairly high variance. Overall, therefore, it can be expected that the data sets are ideally suited as a baseline sample for a longitudinal investigation of possible factors influencing the development of exceptional performance in academic domains (cf. Trost, 2000).

An extensive search of the relevant literature did not reveal any studies that have investigated the long-term educational (and professional) development of former junior students after their participation in the program. Although there are some studies that have asked active junior students about their education-related plans after school (e.g., Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007), due to their prospective nature, these studies do not allow for any reliable conclusions to be drawn about the long-term academic development of former participants. A similar point can be made about studies that have looked into former junior students' transition from Gymnasium[1] to university (e.g., Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et

[1] Type of school covering both lower and upper secondary level (Grades 5 to 13 or 5 to 12) and providing in-depth general education. In the last few years, in almost all German states, there has been a change from the 9-year (G9) to the 8-year (G8) Gymnasium (European Education and Culture Executive Agency, 2017).

al., 2011). While these studies certainly provide some information about the immediate effects of junior study programs on the educational choices and experiences of former participants, they do not reveal more than a vague idea of former junior students' long-term educational trajectories.

In light of this, the present thesis appears to be the first to comprehensively document the educational trajectories of former junior students beyond their transition from school to university. In particular, it focuses on the experiences, academic credentials, and special accomplishments that former junior students typically acquire in their regular studies, their doctoral studies, and in the initial stages of their professional careers. Additionally, the present thesis examines for the first time how former junior students evaluate their participation in the gifted education measure after a distance of several years. Thus, it contributes to a better understanding of what the long-term impacts of participation in junior study programs are on the academic (and professional) development of former participants and what aspects of the junior study program are perceived as particularly relevant in retrospect.

Structure of the Present Thesis. Besides the introduction, the present thesis is composed of six further chapters. The second chapter provides the theoretical background of the present thesis. It traces the historical trends in the literature on giftedness and gifted education over the past 100 years, placing particular emphasis on the conceptual shift from the *gifted child* to the *talent development paradigm*. To illustrate this shift, some well-established giftedness and talent development models are outlined. The series culminates in the presentation of Preckel et al.'s (2020) TAD framework, which was specifically designed to make talent development more accessible for empirical investigations and which thus provides the starting point for the present thesis. At the end of the chapter, comparative comments are made concerning practical implications of the *gifted child* versus the *talent development paradigm*.

Moving from the theoretical to the practical background of the present thesis, the third chapter introduces the concept of junior study programs as measures of gifted education. Specifically, it discusses how junior study programs are commonly implemented in Germany as well as in neighboring countries and what experiences junior students typically have during their participation in the program. In a short excursus, the organization of the junior study program at JMU Würzburg is described. The chapter ends with a compilation of studies that have dealt either pro- or retrospectively with former junior students' transition from school to university after their Abitur[2].

The fourth chapter takes up relevant insights from both the theoretical and the practical background, while expanding on them to allow for a specification of the two central research issues of the present thesis. In the first part of the chapter, relevant findings from previous investigations on junior study programs in Germany are reviewed, and a set of research questions that have guided the follow-up of former junior students at JMU Würzburg (Research Issue 1) are generated. The second part of the chapter then combines the structural assumptions of Preckel et al.'s (2020) TAD framework with relevant insights into the determinants and manifestations of exceptional performance in individual academic disciplines and formulates hypotheses on possible predictors and indicators regarding the first three talent development stages (Research Issue 2).

The fifth chapter focuses exclusively on Research Issue 1. In its methodological sections, the chapter provides a comprehensive account of how the follow-up of former junior students at JMU Würzburg was conducted and briefly touches upon relevant aspects of data analysis. The results of Research Issue 1 are then presented as a descriptive report, constituting a meticulous documentation of the educational trajectories of former junior students into their

[2] German high school qualification obtained at the upper secondary level after 12 or 13 years of schooling (European Education and Culture Executive Agency, 2017).

early adulthood. The chapter concludes with a thorough discussion of the results of Research Issue 1.

In the sixth chapter, Research Issue 2 is addressed. Complementing the methodological sections of Research Issue 1, the chapter explains how the selection process for the junior study program at JMU Würzburg is routinely carried out and what measures are typically collected throughout this process. In a brief outline, issues of data analysis are discussed. The results of Research Issue 2 are reported sequentially for the indicators and for the predictors of the first three talent development stages of Preckel et al.'s (2020) TAD framework. A discussion concerning the results of Research Issue 2 is provided at the end of the chapter.

The seventh chapter finally summarizes and rediscusses the main results of both Research Issue 1 and Research Issue 2. Its function is to consider the results in a broader context and to connect them back to the starting point for their examination. Moreover, the chapter reflects on the theoretical and practical relevance of the results. General limitations and directions for future research ultimately round off the present thesis.

2 Theoretical Background

The following chapter provides the theoretical background for the present thesis. The first subchapter takes a look at the historical trends that have shaped the field of giftedness and gifted education over the past 100 years. The goal is to give a basic idea of how the field has changed, from the initial pervasiveness of the *gifted child paradigm* to the current popularity of the *talent development paradigm*. The second subchapter then revisits and briefly discusses some giftedness and talent development models that have stood out from these historical trends. In each case, particular attention is paid to the model's conception of giftedness and to the mechanism that is used to explain exceptional performance. In the third subchapter, the series finally culminates in the presentation of Preckel et al.'s (2020) TAD framework, an integrative talent development model that is applicable to a wide range of achievement domains and that provides the starting point for the present thesis. Finally, to complete the theoretical background and to prepare for the transition to the following chapter, the last subchapter offers some comparative comments on the *gifted child* versus the *talent development paradigm*, focusing on their implications for practical purposes such as the identification and education of gifted individuals.

2.1 Historical Trends

The field of giftedness and gifted education now looks back on a history of about 100 years of systematic research. Its origins are often credited to Lewis Terman, who at the beginning of the 20th century launched the first longitudinal study into giftedness. Terman (1925) held the view that giftedness manifests itself exclusively in high cognitive abilities. In his Genetic Studies of Genius, he identified a total of 1,528 children with IQ scores above 140 and documented their lives well into adulthood. Overall, his longitudinal study yielded a number of valuable insights into cognitive abilities as well as their relationships to academic, vocational, and psychological criteria. Among these insights was, first, the validation of a fundamental link between exceptional cognitive abilities in childhood and high, but not necessarily outstanding, achievement in adulthood (Terman & Oden, 1959). A second finding was that, contrary to popular belief at the time, highly gifted children were not socially inept, mentally fragile, and prone to health problems; rather, the results showed that highly gifted children were generally quite normal, except for their outstanding academic capacity (Feldhusen, 2005). Regarding some psychological variables, such as perseverance, self-confidence, and motivation, gifted children even had a tendency to outperform children of average intelligence. The same was true for some physiological variables such as maturity, height, and health (Olszewski-Kubilius et al., 2015; Schneider & Mönks, 2015).

Leta Hollingworth (1942) shared Terman's (1925) view that giftedness can be defined exclusively in terms of above-average cognitive abilities. In the first half of the 20th century, she was the first to conduct in-depth studies of children whose intellectual abilities were clearly at the top of their age group (i.e., IQ scores greater than 180). Among the greatest merits of her research was the documentation of some specialized needs that typically characterize such extremely gifted children. These needs included, first, progressive educational environments such as special schools that provide gifted children with diverse options to skip grade levels and to learn from enriched curricula. Second, Hollingworth's (1942) studies also demonstrated that extremely gifted children require special attention and assistance to address the unique issues resulting from the discrepancy between their intellectual proficiency and their age-typical social and emotional development, such as emotional vulnerability or social isolation (Morelock & Feldman, 2003; Olszewski-Kubilius et al., 2015).

From a historical perspective, Terman and Hollingworth can both be regarded as leading figures who laid a solid foundation for what has later been called the *gifted child paradigm* (Dai, 2018; Dai & Chen, 2013). Essentially, this paradigm comprises two main assumptions: First, according to the *gifted child paradigm*, giftedness is considered genetically determined, categorically setting children who are identified as gifted apart from the rest of their age group. Of particular note, this distinction does not only apply to gifted children's high cognitive potential but rather to their entire personality, including their specialized social and emotional characteristics, their extraordinary educational needs, as well as their unique developmental trajectories (Dai, 2018; Dai & Chen, 2013). Although Terman later recognized that, in addition to cognitive abilities, there are also individual differences in the motivational and emotional characteristics of highly gifted children that have a determining influence on their achievement in adulthood (see Terman & Oden, 1959), he did not abandon the assumption that intellectually gifted individuals form a homogeneous group that is clearly distinct from the rest of the population (Dai, 2018; Terman, 1954). The second main assumption of the *gifted child paradigm* posits that giftedness is a permanent trait that is stable across situations and constant over time (Dai, 2018; Dai & Chen, 2013). From this, it follows that children who are identified as highly gifted are supposed to maintain their exceptional cognitive abilities throughout their lives (Dai, 2018). In other words, it is believed that gifted children form a cognitive elite in adulthood, capable of making significant contributions to society in all domains of human endeavor (Dai, 2010). However, even if gifted children do not demonstrate exceptional achievement as adults, their gifted status according to the *gifted child paradigm* remains intact (Dai, 2018; Subotnik et al., 2011).

Then, in the second half of the 20th century, the field of giftedness and gifted education saw a gradual shift in its main assumptions, eventually resulting in a widespread rejection of the *gifted child paradigm* (Dai, 2018). In retrospect, at least four factors can be identified that most likely contributed to this shift: First, researchers began to advocate for a broader conception of giftedness than the narrow definition of the *gifted child paradigm*, with its exclusive focus on exceptional cognitive abilities, allowed. Their efforts stemmed primarily from the observation that there were undeniably children or adolescents who, despite the fact that their cognitive abilities did not clearly differ from those of their age group, demonstrated remarkable achievement in a particular domain. From this observation, it was concluded that the causes of exceptional performance can be overly complex and that the importance of cognitive abilities in conceptualizing giftedness according to the *gifted child paradigm* was largely overestimated, while non-cognitive factors, such as motivation or interest, were decidedly underestimated. A representative example of this broader, multidimensional view of giftedness is Renzulli's (1978) *Three-Ring Model of Giftedness*. In this model, motivational and creative factors, in addition to cognitive abilities, are articulated as integral parts of exceptional performance (Dai, 2018). Second, a shift away from the *gifted child paradigm* also occurred in the sense that researchers gradually started to move the criteria for defining giftedness from abstract psychological constructs, such as cognitive and non-cognitive potential, to actual achievement (Dai, 2018; see also DeHaan & Havighurst, 1957). As a result, it was increasingly recognized that giftedness manifests itself not only in intellectual excellence but that it can equally be expressed, for example, in artistic or social endeavors, making room for the acknowledgement of talent manifestations in domains other than academics. Bloom's (1982) interview studies with eminent researchers (e.g., mathematicians and neurologists), athletes (e.g., Olympic swimmers and tennis champions), and artists (e.g., concert pianists and sculptors) can be considered prime examples in this regard (Dai, 2018). A third concern that caused growing discontent with the *gifted child paradigm* in the second half of the 20th century was the introduction of a theoretical reformulation and conceptual delineation of the relationship between giftedness and talent. In particular, Gagné (1985) promoted an explicit distinction between giftedness on the one hand and talent on the other hand, defining talents as specific competencies that progressively emerge from natural abilities or gifts (Feldhusen, 2005). This distinction was most significant because it recognized for the first time the dynamic nature of the talent development process, thereby bringing a developmental perspective into the field of giftedness and gifted education (Sternberg et al., 2011). In addition to Gagné's (1985) account, there were also efforts by the proponents of the categorical assumptions of giftedness to integrate the traditional approaches with the emerging developmental perspective. For example, Perleth and Ziegler (1997) expanded Heller's (1992, 2001) *Munich Model of Giftedness* (MMG) into the so-called *Munich Process Model of Giftedness* (MPMG) by defining giftedness as a tipping point in talent development at which conditions are optimal to allow some individuals to demonstrate exceptional performance (Dai, 2018). Fourth, in recent years, researchers have finally begun to move beyond the traditional construct of giftedness and to adopt a more holistic perspective to fully understand how children and adolescents develop into eminent adults, such as great scientists, artists, inventors, or social leaders, and how individuals and the environment interact in this process to generate exceptional achievement. For example, with the presentation of their TDMM, Subotnik et al. (2011, 2018b) have provided a useful framework to better understand the stages, processes, and timing of successful talent development (Dai, 2018).

Taken together, the historical trends of the past 50 years have contributed to a view of giftedness which has recently been referred to as the *talent development paradigm* (Dai, 2018; Dai & Chen, 2013). In contrast to the *gifted child paradigm*, giftedness from this perspective is not understood as an innate quality but rather as a malleable set of developing potentials and capabilities that is formed through person-environment interaction and becomes increasingly differentiated over time (Dai, 2018; Dai & Chen, 2013; Feldman, 2003; Sternberg, 1999; Subotnik et al., 2011). Although this assumption does not exclude the possibility that general cognitive abilities are relevant in the emergence of outstanding performance, the *talent development paradigm* adopts a broader psychological basis that encompasses both cognitive and non-cognitive factors. In addition, it stresses the domain-specific nature of giftedness and acknowledges the need for differential trajectories, pathways, and niches in the talent development process (Bloom, 1985; Dai & Chen, 2013; Feldman, 2003; Subotnik et al., 2011). In summary, according to the *talent development paradigm*, giftedness manifests itself as excellent performance when conditions are favorable, with timely opportunities and deliberate practice playing significant roles (Dai & Chen, 2013).

2.2 Classical Models of Giftedness and Talent Development

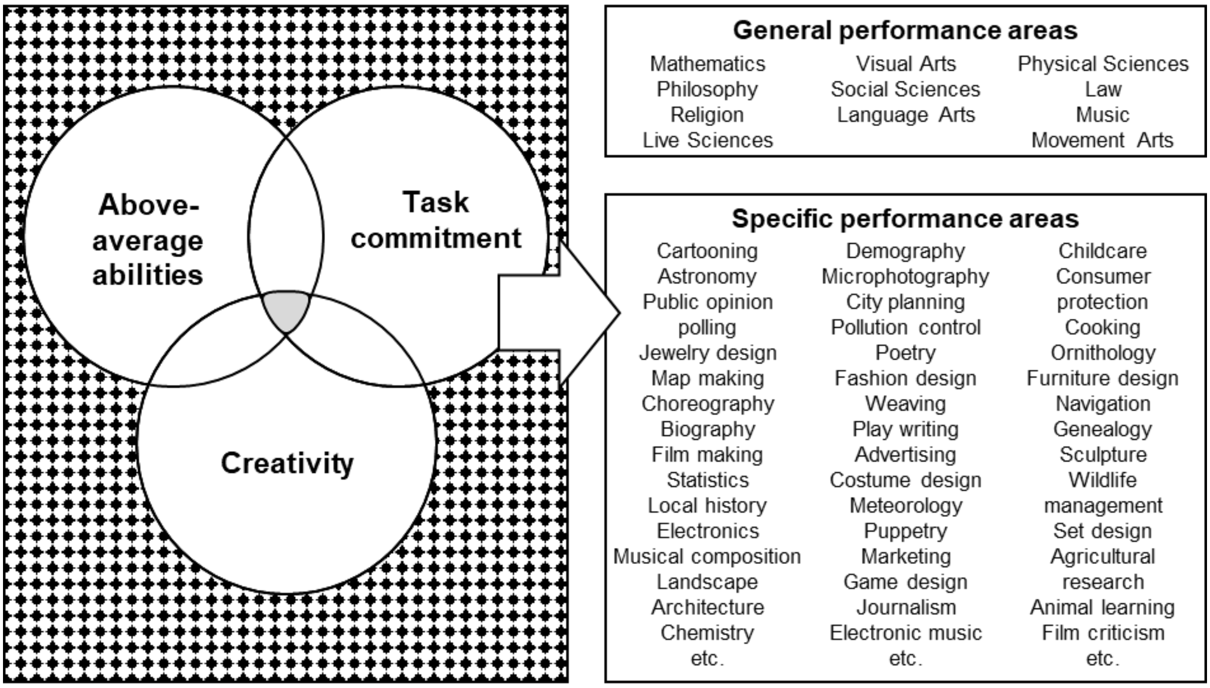
The next sections revisit and discuss some of the giftedness and talent development models that have clearly distinguished themselves from the historical trends described above. The purpose is not to describe the selected models in minute detail or to critically examine their assumptions, but rather to briefly outline their central ideas and thus to illustrate the evolution of the concept of talent development over the years. To make it easier to follow along, only models that have already been mentioned in the previous subchapter are used, including Renzulli's (1978) *Three-Ring Model of Giftedness*, Bloom's (1982) *Three-Phase Model of Talent Development*, Gagné's (1985) *Differentiated Model of Giftedness and Talent* (DMGT), Perleth and Ziegler's (1997) MPMG, as well as Subotnik et al.'s (2011, 2018b) TDMM.

2.2.1 Three-Ring Model of Giftedness (Renzulli, 1978)

Renzulli's (1978) *Three-Ring Model of Giftedness* is a representative example of the broader, multidimensional view that has increasingly characterized the field of giftedness and gifted education since the second half of the 20th century. The core idea of the model is that giftedness results from an interaction among three basic clusters of human traits: above-average abilities, task commitment, and creativity (Renzulli, 1978, 2005; Renzulli & Reis, 2018). Highly gifted individuals, according to Renzulli's (1978) *Three-Ring Model of Giftedness*, are those who, on the one hand, exhibit high scores in these three clusters and, on the other hand, demonstrate an interaction among the clusters. Furthermore, highly gifted individuals must manage to apply this interaction to potentially valuable domains of human performance. To achieve this, following Renzulli (1978, 2005), they require a wide range of educational opportunities, resources, and encouragement that is well above what is commonly provided through regular school curricula or teaching programs (see also Renzulli & Reis, 2018).

Figure 1

Three-Ring Model of Giftedness (Renzulli, 1978, 2005)



Note. Adapted from (a) “What Makes Giftedness? Reexamining a Definition” by J. S. Renzulli, 1978, *Phi Delta Kappan, 60*(3), p. 184 (https://doi.org/10.1177/003172171109200821). Copyright 1978 by J. S. Renzulli; (b) “The Three-Ring Conception of Giftedness: A Developmental Model for Promoting Creative Productivity” by J. S. Renzulli, in R. J. Sternberg and J. E. Davidson (Eds.), *Conceptions of Giftedness* (2nd ed., p. 257), 2005, Cambridge University Press. Copyright 2005 by Cambridge University Press.

Figure 1 provides a schematic representation of Renzulli’s (1978) *Three-Ring Model of Giftedness*. In this figure, each of the three clusters of human traits (i.e., above-average abilities, task commitment, and creativity) is visually represented by a ring. The central notion of the model – that successful interaction among the three clusters of human traits is essential for gifted behavior to occur (Renzulli, 1978; Renzulli & Reis, 2018) – is symbolized in the center of the figure by the gray overlap of the three rings. A direct, practical implication that follows from Renzulli's (1978) *Three-Ring Model of Giftedness* is that all three clusters of human traits must be considered when identifying gifted individuals and that above-average abilities must not be overemphasized at the expense of task commitment or creativity (Renzulli, 1978; Renzulli, 2005). In the following, the three basic clusters of human traits are successively described in more detail. Afterward, their mutual interactions and their relationships to personal and environmental factors are briefly summarized.

Above-Average Abilities. In Renzulli's (1978) *Three-Ring Model of Giftedness*, the cluster *above-average abilities* includes both general and specific cognitive abilities. *General cognitive abilities* primarily consist of skills with a broad scope of application, including the capacity to process information, to engage in abstract thinking, and to integrate experiences that result in appropriate and adaptive responses to new situations. Examples are general intelligence, verbal and numerical reasoning, spatial relations, memory, and word fluency (Renzulli, 2005; Renzulli & Reis, 2018). General cognitive abilities are usually measured through tests of general aptitude or intelligence (Renzulli, 2005). *Specific cognitive abilities*, on the contrary, describe the capacity to acquire knowledge, skills, or specialized routines in a particular domain of performance (Renzulli, 2005; Renzulli & Reis, 2018). Relevant examples are Mathematics, Physical Sciences, and Language Arts, each of which can be further subdivided into even narrower disciplines (e.g., Statistics, Astronomy, and Poetry). Specific cognitive abilities are typically measured using achievement tests or tests of specific aptitude. However, this is not always possible in areas such as the Fine Arts, Athletics, and Leadership. In these domains, specific cognitive abilities must be evaluated through trained observation or other performance-based assessment techniques (Renzulli, 2005).

Task Commitment. The cluster *task commitment* in Renzulli's (1978) *Three-Ring Model of Giftedness* denotes a refined or focused form of motivation (Renzulli, 1978, 2005; Renzulli & Reis, 2018). While in general, motivation is defined more in terms of energizing processes that trigger non-specific responses in organisms, the cluster *task commitment* represents energy that is brought to bear upon a specific problem or performance domain (Renzulli, 1978, 2005; Renzulli & Reis, 2018). Terms that are most commonly used to describe the cluster *task commitment* are perseverance, endurance, hard work, dedicated practice, self-confidence, interest-based action, and belief in one's abilities to successfully complete important work (Renzulli, 2005).

Creativity. The cluster *creativity* in Renzulli's (1978) *Three-Ring Model of Giftedness* is only very vaguely defined. Following Renzulli and Reis (2021), it primarily includes traits such as novelty, curiosity, originality, ingenuity, flow (Beghetto & Kaufman, 2007; Csikszentmihalyi, 1996), as well as a willingness to challenge convention and tradition. Moreover, Renzulli (2005) notes that individuals who exhibit high levels of creativity are often colloquially referred to as "gifted", "ingenious", or "eminent".

According to Renzulli's (1978) *Three-Ring Model of Giftedness*, the cluster *creativity* is a particularly important factor in the emergence of exceptional performance. As Renzulli (2005) and also Renzulli and Reis (2018) clearly point out, the focus of the model is explicitly on creative-productive giftedness as compared to schoolhouse giftedness. *Creative-productive giftedness* allows individuals to generate ideas and products that might have an impact on society and bring about change in the world. It implies devoting one's abilities to work on problems that are of personal relevance as well as acting on one's own knowledge and beliefs rather than simply acquiring and storing information for its own sake (Renzulli, 2005). *Schoolhouse giftedness*, in contrast, enables individuals to excel in school, to earn good grades, and to attain high levels of academic success in educational settings. It focuses on deductive learning, structured training, and systematic knowledge acquisition. Schoolhouse giftedness is therefore also called *high-level academic giftedness, test-taking giftedness,* or *lesson-learning giftedness* (Renzulli, 2005; Renzulli & Reis, 2018).

Model Extensions. Research findings in recent years have led to a modification of Renzulli's (1978) *Three-Ring Model of Giftedness*. Although it is still assumed that the interaction among the three basic clusters of human traits is the most important feature leading to the manifestation of gifted behaviors, it is now also recognized that besides above-average abilities, task commitment, and creativity, there are other influential factors that enable some individuals to display exceptional performance at certain times and under certain circumstances. Renzulli and Reis (2018) have grouped these factors into the two global dimensions of personality and environment, which they hypothesize underlie the manifestation of gifted behaviors. In Figure 1, a diamond pattern was chosen to illustrate the reciprocal influences of personality and environment factors on the one hand and the three basic clusters of human traits on the other hand (cf. Renzulli, 2005; Renzulli & Reis, 2018).

2.2.2 Three-Phase Model of Talent Development (Bloom, 1982)

Bloom's (1982) *Three-Phase Model of Talent Development* has stood out from the history of giftedness and gifted education because it was one of the first conceptions of giftedness to explicitly recognize that great potential can be found in very diverse fields and that exceptional performance can thus be achieved in domains other than academics. In the early 1980s, Bloom (1982) conducted a series of interviews with approximately 120 eminent individuals, their parents, and some of their final teachers. The eminent individuals were between 17 and 35 years old at the time of the interviews and were selected based on specific criteria designed to indicate world-class performance. These criteria included, for example, awards in (inter-)national competitions, judgments by expert panels, special prizes and scholarships, and various indices of recognition by other specialists in the field. Overall, three achievement domains were considered in more detail: the artistic domain, the cognitive domain, and the psychomotor domain (Bloom, 1982). The purpose of the interviews was to identify specific patterns of talent development within each achievement domain and to determine if there were parallels in these patterns across domains (Bloom, 1982). The central finding of Bloom's (1982) interview studies was that across all achievement domains, the talent development process could be divided into three major phases and that each of these phases corresponded to a period of collaboration with one of three teachers by whom eminent individuals are typically mentored on their path toward excellence. The three different stages of Bloom's (1982) *Three-Phase Model of Talent Development* are described in more detail below in chronological order.

First Phase: Teaching for Interest. According to Bloom (1982), the first phase of talent development is defined by playful engagement with an achievement domain as well as emerging interest in the relevant content and activities of that domain. The teachers who play a leading role in the lives of gifted children during this phase of talent development are usually chosen by families based on external circumstances, such as geographical proximity to the gifted child's home. They are normally friendly people who do not themselves exhibit exceptional giftedness in a particular field but who are very skilled and experienced in working with young children (Bloom, 1982). The eminent individuals who participated in Bloom's (1982) interview studies remembered their first-phase teachers primarily for their personal qualities and for the inspiration they gave them to explore their chosen domain in a playful manner (Bloom, 1982).

Second Phase: Teaching for Technique. In the second phase according to Bloom (1982), the focus of talent development gradually shifts from playful engagement with an achievement domain to more and more systematic instruction in the technique, content, and rules necessary for excellence in that domain. The teachers responsible for instructing gifted children in this phase of talent development are usually regarded as the most capable in a large geographical area. Unlike the teachers of the first phase, who normally charge very little compensation for their instruction, the second-phase teachers have higher instructional fees. In addition, they only take children as their students who they feel meet certain requirements and whom they consider “promising” in their area of instruction. In teaching their students, they require them to consistently work harder in order to improve their performance (Bloom, 1982).

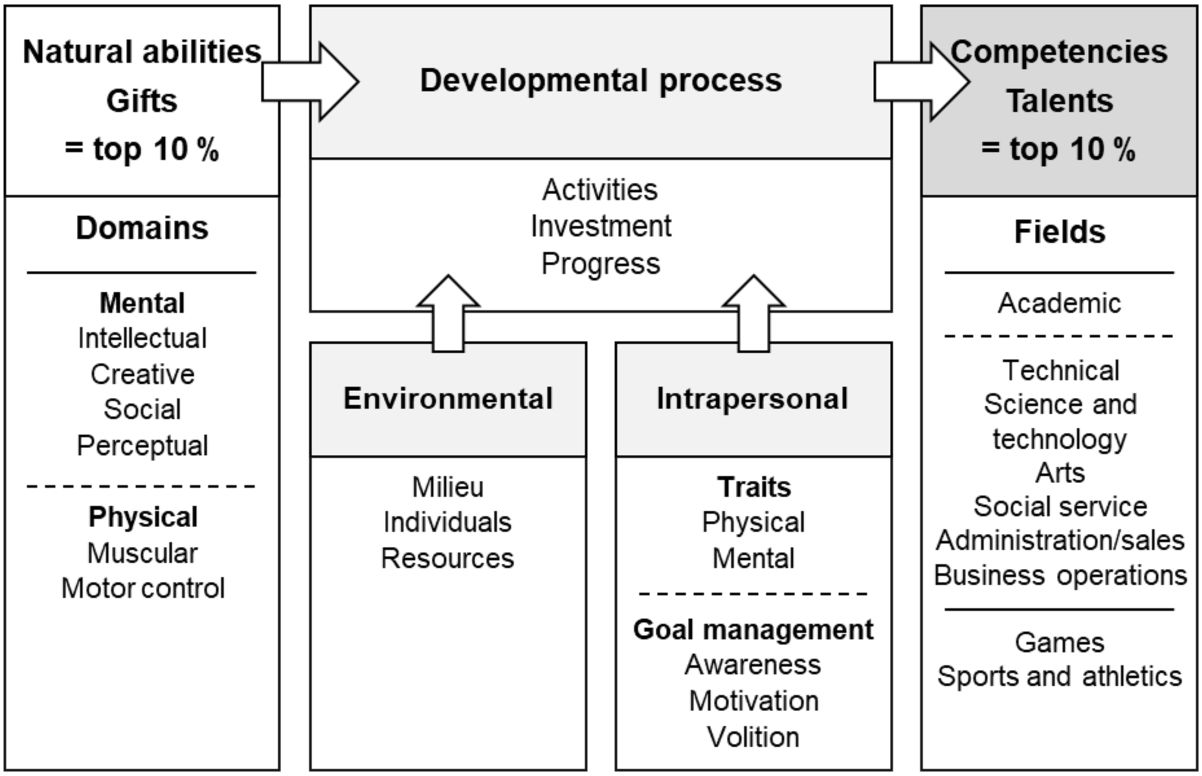
Third Phase: Mentoring for Personalized Niche. The focus of the third phase of Bloom’s (1982) *Three-Phase Model of Talent Development* is finally on students developing their own style and finding their own personalized niche in a field. The teachers who are particularly influential in this phase of talent development typically accept as their students only those gifted children or adolescents who have already been successful on a smaller scale. As Bloom (1982) notes, the reason for this is probably that the teachers’ own reputation depends in part on the constant production of outstanding performers. As a consequence, the teachers in the third phase of talent development place permanently high demands on their students’ performance. For example, they expect them to work 5 to 7 hours per day to improve their talent and to advance their training and development. Thus, regardless of the skill level that the students have already acquired in the previous two phases, training in the third phase of the talent development process requires virtually total commitment to the chosen domain if instruction is to be successful (Bloom, 1982).

2.2.3 Differentiated Model of Giftedness and Talent (Gagné, 1985)

In the history of giftedness and gifted education, Gagné (1985) was the first to make a theoretical reformulation and conceptual delineation of the relationship between giftedness on the one hand and talent on the other hand (Feldhusen, 2005). His account was based on the central assumption that talent development represents the progressive transformation of exceptional natural abilities (i.e., gifts) into systematically developed competencies (i.e., talents). This assumption was extremely important for giftedness research in the second half of the 20th century because it recognized for the first time the dynamic nature of the talent development process, thereby introducing a developmental perspective into the field of giftedness and gifted education (Sternberg et al., 2011).

Figure 2

Differentiated Model of Giftedness and Talent (Gagné, 1985, 2005, 2018)



Note. Adapted from (a) "From Gifts to Talents: The DMGT as a Developmental Model" by F. Gagné, in R. J. Sternberg and J. E. Davidson (Eds.), *Conceptions of Giftedness* (2nd ed., p. 100), 2005, Cambridge University Press. Copyright 2005 by Cambridge University Press; (b) "Academic Talent Development: Theory and Best Practices" by F. Gagné, in S. I. Pfeiffer, E. Shaunessy-Dedrick, and M. Foley-Nicpon (Eds.), *APA Handbooks in Psychology. APA Handbook of Giftedness and Talent* (p. 166), 2018, American Psychological Association. Copyright 2018 by the American Psychological Association. All rights reserved.

The conceptual delineation between gifts and talents also constitutes the central notion of Gagné's (1985) DMGT, which is systematically illustrated in Figure 2. In this figure, gifts – as the bases of talent development – are on the far left side, while talents – as the outcome variables – are on the far right side. Despite the spatial separation of gifts and talents in Gagné's (1985) DMGT, however, neither of the two model components stands alone; rather, they interact with each other and with the other model components in very dynamic ways, causing individuals to vary considerably in these interactions (Gagné, 2005, 2018). At the same time, all components of the model also exhibit complex interactions among the specific facets that comprise them (Gagné, 2005, 2018). The following sections successively describe the different components of Gagné's (1985) DMGT.

Gifts. Gagné (2018) identifies a total of six domains of natural abilities (i.e., gifts), four of which belong to the mental domain (i.e., intellectual gifts, creative gifts, social gifts, and perceptual gifts) and two of which belong to the physical domain (i.e., muscular gifts and motor control gifts; Gagné, 2018). According to Gagné (2005, 2018), natural abilities serve as raw materials or constituent elements of talents and have an impact throughout the talent development process. They are not innate but develop during childhood through maturation processes and informal practice. Their ultimate level of expression and development, however, are substantially controlled by individuals' genetic endowment (Gagné, 2018). According to Gagné (2005, 2018), individuals can be considered gifted primarily if their natural abilities in a particular domain are among the top 10 % of their age group.

Talents. Talents emerge through the gradual transformation of high natural abilities into well-trained, systematically developed competencies relevant to a particular domain of human endeavor (Gagné, 2005, 2018). In explaining exceptional achievement, talents are on the performance side and represent the outcomes of the talent development process. According to Gagné's (1985) DMGT, talent domains can be highly diverse. For example, Gagné (2018) assumes that there are nine talent subcomponents (see Figure 2), six of which originate from Holland's (1997) *Theory of Vocational Choice* (cf. Measures of Research Issue 1). As with natural abilities, individuals who are in the top 10 % of a talent domain can be considered gifted (Gagné, 2005, 2018).

Together with the talent development process, which illustrates the progressive transformation of natural abilities into systematic competencies, gifts and talents in Gagné's (1985) DMGT form the so-called *talent development trio* (Gagné, 2005). Talents arise from individuals investing their gifts in a particular area and building knowledge and skills through systematic learning, practice, and training. Overall, there are three subcomponents in the talent development process: activities, investment, and progress. Each of these subcomponents is, in turn, organized into multiple facets. For example, the activities subcomponent includes systematic programs of talent development with firmly defined contents that are typically offered within specific learning environments. The investment subcomponent quantifies the intensity of the talent development process in terms of time, psychological effort, and financial expenditure. Finally, the progress subcomponent qualitatively describes the talent development process in terms of a sequence of stages ranging from initial access to a talent area to achieving exceptional performance (e.g., novice, advanced, proficient, expert). The main quantitative indicator of the talent development process is pace (Gagné, 2018).

According to Gagné (2005), there are four different types of talent development processes: maturation, informal learning, formal non-institutional learning, and formal institutional learning. *Maturation* is a process that depends almost entirely on the genetic endowment of the individual. It ensures the growth and transformation of all biological structures, which in turn primarily affect the individual's appearance. *Informal learning* pertains to the acquisition of knowledge and skills in everyday life. Much of what is called "practical intelligence" (see Sternberg & Wagner, 1986) is the result of such informal or unstructured learning activities. *Formal non-institutional learning* refers to autodidactic or self-taught learning, whereas *formal institutional learning* describes educational activities that lead to some form of official recognition. Both processes are formal in the sense that individuals have a conscious intention to achieve specific educational goals and to go through a systematic sequence of learning steps to reach them (Gagné, 2005). From a theoretical perspective, both gifts and talents can grow through all four types of talent development processes. Nevertheless, the four processes are assumed to contribute to the development of gifts in inverse proportion to their degree of formality (Gagné, 2005).

In addition to the talent development trio, Gagné's (1985) DMGT also proposes the existence of a so-called *supporting cast* in explaining outstanding achievement. This includes both an intrapersonal and an environmental component (see Figure 2): The intrapersonal component describes factors that are internal to the person. It consists of five subcomponents, which are grouped into two main dimensions: traits (i.e., physical subcomponent and mental subcomponent) and goal management dispositions (i.e., self-awareness subcomponent, motivation subcomponent, and volition subcomponent; Gagné, 2018). The environmental component describes factors located in the person's environment. It includes three distinctive subcomponents: the atmosphere of the ambient milieu, the psychological influence of significant individuals, and the effects of talent development resources (Gagné, 2018). Both the intrapersonal and the environmental component have moderating effects on the talent development process and can facilitate or impede the transformation of gifts into talents. Nonetheless, environmental influences sometimes do not have a direct impact on the talent development process but first affect the intrapersonal component, that is, how someone experiences and evaluates environmental characteristics (Gagné, 2005).

Model Extensions. Gagné's (1985) DMGT has been revised and expanded several times over the years. For example, Gagné (2018) has pointed out that the DMGT is essentially limited to a strictly behavioral representation of the countless influences that can promote or impair the growth of competencies in general. To address this limitation and to demonstrate that the natural abilities from which the numerous competencies acquired through formal education develop are in turn anchored in individuals' biological and genetic foundations, Gagné (2018) advanced the DMGT into the *Integrative Model of Talent Development* (IMTD) by adding the so-called *Developmental Model for Natural Abilities* (DMNA), which focuses on the development of biological foundations into natural abilities. Structurally, the DMNA is similar to the DMGT, with the giftedness component transferred from the left to the right side. For more information on the IMTD, see Gagné (2018), for example.

2.2.4 Munich Process Model of Giftedness (Perleth & Ziegler, 1997)

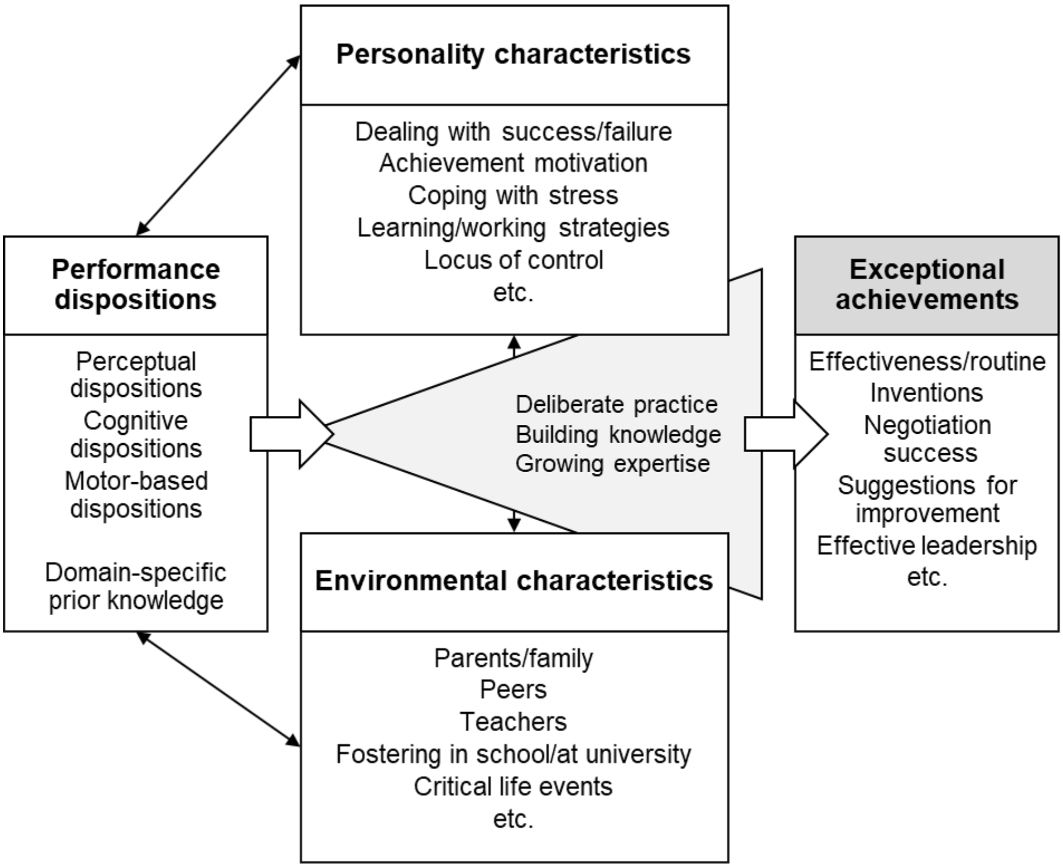
Perleth and Ziegler's (1997) MPMG (see also Ziegler & Perleth, 1997) bears a strong resemblance to Gagné's (1985) DMGT. It is distinct from the historical trends that have characterized the field of giftedness and gifted education in the second half of the 20th century primarily because it exemplifies the integration of the traditional, categorical accounts of giftedness with the emerging developmental perspective. In detail, Perleth and Ziegler's (1997) MPMG combines the multidimensional view of giftedness found in Heller's (1992, 2001) MMG with evidence from expertise and cognitive functioning approaches as well as with research on the relationship between cognitive abilities and professional performance (Heller et al., 2005).

Figure 3 schematically depicts the various components of Perleth and Ziegler's (1997) MPMG. As can be seen from the arrangement of the components in the figure, giftedness according to the MPMG is understood as a complex ability construct that emerges from the interplay of performance dispositions (i.e., predictors) with personality and environmental characteristics (i.e., moderators) and is reflected in exceptional achievement (i.e., criterion variables; Ziegler & Heller, 2000). Following Ackerman (1988), Perleth and Ziegler (1997) assume that performance dispositions constitute predictors or antecedent conditions for exceptional performance and can be roughly divided into perceptual, cognitive, and motor-based tendencies. To be specific enough for individual domains, these tendencies need to be further subdivided into separate abilities. For example, Ziegler and Heller (2000) elaborate that cognitive tendencies are composed of creative, analytical, and logical abilities. Due to its rough conceptualization of performance dispositions, Perleth and Ziegler's (1997) MPMG is in marked contrast to Heller's (1992, 2001) MMG, which postulates relatively clear-cut, independent talent factors such as intellectual abilities, creative abilities, social competence, practical intelligence, and artistic abilities as predictors of giftedness. In addition to performance dispositions, Perleth and Ziegler's (1997) MPMG also recognizes the importance of favorable background conditions for giftedness to unfold; without active learning efforts coinciding with beneficial personality characteristics and environmental features (see upper and lower rectangles in Figure 3), talents are squandered. In line with Heller (1992, 2001), Perleth and Ziegler (1997) suggest that personality characteristics comprise, for example, motivational variables, such as achievement motivation, and interests or self-regulatory skills, such as coping with stress, learning, and work strategies. Environmental features include family characteristics, such as educational level and parenting style, school characteristics, such as teachers and teaching quality, and also critical life events (see also Figure 3; Heller et al., 2005; Ziegler & Heller, 2000).

Probably the most important difference between Perleth and Ziegler's (1997) MPMG and Heller's (1992, 2001) MMG is that, in contrast to the latter, the former explicitly emphasizes the fact that the manifestation of giftedness requires the formation of expert knowledge and highly specialized routines over the course of a long, rigorous learning process (cf. deliberate practice by Ericsson et al., 1993). In Figure 3, this long, rigorous learning process is symbolized by the triangle in the center oriented to the right. The orientation of the triangle is meant to indicate that active learning processes become more and more important as individuals gain expertise, both for expanding knowledge and for acquiring domain-specific skills (Heller et al., 2005). In Perleth and Ziegler's (1997) MPMG, active learning processes are assumed to span gifted individuals' entire developmental trajectory, from taking up early activities to achieving expert status in a domain (Ziegler & Heller, 2000).

Figure 3

Munich Process Model of Giftedness (Perleth & Ziegler, 1997)



Note. Adapted from "The Munich Model of Giftedness to Identify and Promote Gifted Students" by K. A. Heller, C. Perleth, and T. K. Lim, in R. J. Sternberg and J. E. Davidson (Eds.), *Conceptions of Giftedness* (2nd ed., pp. 149-153), 2005, Cambridge University Press. Copyright 2005 by Cambridge University Press.

Finally, Perleth and Ziegler's (1997) MPMG assumes that there are multiple interaction and compensation processes among all model components. For example, the development of expertise depends strongly on whether individuals take advantage of the opportunities for experience and learning offered in their environments. These opportunities must not be regarded as static factors. Instead, gifted individuals must deliberately look for them according to their growing abilities and match them to their increased levels of performance. Moreover, the different model components complement each other. For example, a performance-oriented climate can compensate for unfavorable individual achievement motivation; likewise, less than optimal intellectual performance dispositions can be compensated for by appropriate learning opportunities. As a consequence of these compensatory effects, individuals not only develop very specific skills in their chosen domains but also go through highly individualized development processes (Ziegler & Heller, 2000).

Model Extensions. Building on the central ideas of Perleth and Ziegler's (1997) MPMG, Perleth (2001) eventually proposed an extension of the model, which he called the *Munich Dynamic Ability-Achievement Model* (MDAAM). In contrast to Perleth and Ziegler's (1997) MPMG, which postulates the existence of a single, lifelong stage of talent development, the MDAAM takes a more differentiated approach and distinguishes a total of four talent development stages, three of which correspond to the main phases of formal individual education: preschool, school, and vocational training or higher academic education. The fourth phase is only slightly indicated in the model and refers to professional activities which are supposed to culminate in the generation of creative products (Heller et al., 2005). According to Perleth's (2001) MDAAM, each talent development stage is defined by characteristic learning processes that promote the growth of specific competencies. For example, general intellectual or creative abilities, social skills, and basic musical or motor skills are formed in the preschool years (Heller et al., 2005). Then, as children progress through the school years, they accumulate increasing amounts of knowledge and develop more sophisticated competencies in various domains such as Nature, Reading, Writing, or Calculation. It is assumed that the systematic acquisition of knowledge becomes more and more relevant for the development of giftedness over time. Central educational domains include Languages, Natural and Social Sciences, Arts, and Music. Compared to the first talent development stage, sustained effort and active, goal-oriented learning are thus important in the school years to successfully advance the current state of talent development (cf. deliberate practice; Heller et al., 2005). Eventually, in vocational training or higher academic education, individuals increasingly specialize and become experts in their chosen domains. However, depending on the specific content and physical requirements of a domain, specialization processes can sometimes start earlier (Heller et al., 2005). For more information on the MDAAM, see Perleth (2001).

2.2.5 Talent Development Megamodel (Subotnik et al., 2011, 2018b)

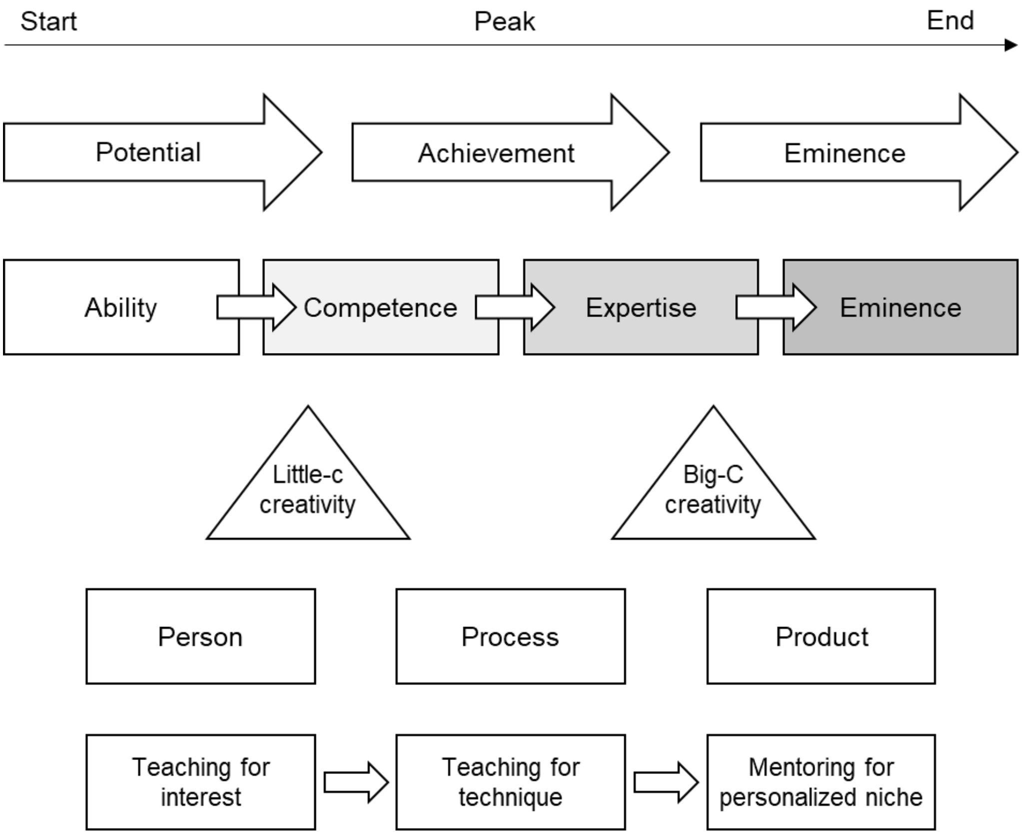
Finally, grounded in a descriptive review of the available literature, Subotnik et al. (2011, 2018b) go beyond the construct of giftedness and adopt a more holistic perspective to fully comprehend how children and adolescents develop into eminent adults (Dai, 2018). With their TDMM, they put forward an integrated model of talent development that combines the most compelling components of already established giftedness accounts and aims to apply to different domains of human endeavor (Subotnik et al., 2011, 2012). Figure 4 provides a schematic representation of Subotnik et al.'s (2011, 2018b) TDMM. As can be seen from this figure, the model can roughly be organized into several rows, each of which captures a basic principle about the nature and development of giftedness that Subotnik et al. (2011, 2018) found to be significant in their literature review. In the following, the basic principles of Subotnik et al.'s (2011, 2018b) TDMM are successively described.

First, Subotnik et al. (2011, 2012, 2018b) assume that both general and domain-specific cognitive abilities are essential for the emergence of exceptional performance. Moreover, they hypothesize that the required amount and balance of general and domain-specific abilities as well as the exact nature of domain-specific abilities vary by talent domain and by progress in the talent development process. For example, in childhood, general cognitive abilities and broad-based potentials are considered hallmarks of academic giftedness, while domain-specific abilities, such as visuo-spatial abilities or mathematical reasoning abilities, seem to be more reliable predictors of success in adulthood (Subotnik et al., 2011, 2012, 2018b). Furthermore, according to Subotnik et al. (2011, 2018b, 2019), general and domain-specific cognitive abilities are malleable. This principle clearly contradicts the core assumption of the *gifted child paradigm*, which holds that giftedness is a permanent trait and that children, once identified as gifted, remain gifted throughout their lives. Instead, Subotnik et al. (2011, 2018b) state that giftedness is a relative trait that is typically evaluated in comparison to other gifted individuals in a domain. Specifically, at the earliest stages of the talent development process, giftedness is largely defined by individuals' perceived potential, whereas at more advanced stages, it is increasingly determined by demonstrated achievement. Finally, at full maturity, eminent levels of achievement define giftedness (Subotnik et al., 2011, 2012).

A second principle identified by Subotnik et al. (2011, 2018b) in their literature review indicates that achievement domains have different trajectories. In other words, achievement domains differ in their start, peak, and end times for exceptional performance (see upper row in Figure 4; Subotnik et al., 2011, 2012, 2019, 2021). In some domains (e.g., Mathematics), potential talent can be identified and nurtured earlier than in others that require maturity and life experience, for example (e.g., Psychology or Political Sciences; Subotnik et al., 2018b). As a result, there is no single age at which giftedness can be identified across all domains (Subotnik et al., 2011, 2018b, 2019). Instead, the onset of talent development in a particular domain is contingent on the moment when talent can be reasonably recognized, either through systematic identification procedures or through knowledgeable adults. This, in turn, depends on the point in time at which skills and abilities in the respective achievement domain first emerge (Subotnik et al., 2012, 2021).

Figure 4

Talent Development Megamodel (Subotnik et al., 2011, 2018b)



Note. Adapted from "Rethinking Giftedness and Gifted Education: A Proposed Direction Forward Based on Psychological Science" by R. F. Subotnik, P. Olszewski-Kubilius, and F. C. Worrell, 2011, *Psychological Science in the Public Interest, 12*(1), p. 34 (https://doi.org/10.1177%2F1529100611418056). Copyright 2011 by the Authors.

Third, according to Subotnik et al. (2011, 2012, 2021), the talent development process can be conceptualized as a sequence of four stages, over the course of which abilities are developed into competencies, competencies are developed into expertise, and expertise is developed into eminence (see third row in Figure 4). These four stages can be distinguished, first, by the type of creativity an individual manifests (Subotnik et al., 2011, 2012). For instance, Subotnik et al. (2011, 2018b) assume that creativity changes fundamentally as individuals advance on their path to outstanding levels of achievement: Whereas creativity at the earliest stages of talent development (i.e., metaphorical thinking, divergent thinking, and creative problem-solving) is judged primarily in relation to other gifted individuals in the same domain (cf. “little c” creativity in Figure 4), creativity at the final stage is typically judged by the extent to which it moves the field forward (cf. “big C” creativity in Figure 4; Subotnik et al., 2012). A second feature that contributes to the distinction between the four stages is that the relative emphasis on person, process, and product shifts over the course of the talent development process. In childhood, for example, giftedness is largely defined by individuals’ perceived potential (see fifth row in Figure 4). Here, the focus is on the person, meaning that it is important for children to develop their creativity. Then, at more advanced talent development stages, demonstrated achievement becomes more and more imperative. In order to make important contributions, individuals need to acquire skills; accordingly, the emphasis shifts to the process. Finally, toward the end of the talent development process, the product is of central importance. Individuals are expected to couple their thinking and processing skills with deep multidisciplinary content knowledge and to use them to create intellectual, aesthetic, or practical achievements or performances (Subotnik et al., 2011, 2012).

The fourth principle states that it is important for gifted individuals to have access to special opportunities throughout the talent development process (Subotnik et al., 2019, 2021). While most of these opportunities are traditionally provided in school contexts, Subotnik et al.’s (2011, 2018b) TDMM places particular emphasis on extracurricular activities, such as competitions and special programs. Interventions that have proven effective in gifted education require a wide range of opportunities matched to individuals’ achievement domains and levels of talent development (e.g., exposure for attracting interest, specialized instruction for developing competencies, and opportunities such as mentorships for achieving expertise and creative productivity; Subotnik et al., 2021). To ensure this, expert teachers, mentors, and coaches who drive the talent development process must adapt their strategies and goals of instruction to their students' needs. In particular, at the onset of talent development, teachers should make sure to capitalize on individuals' motivation and to spark their interests in a domain. Then, in subsequent talent development stages, it is of critical importance that teachers help young people develop the needed skills, knowledge, and values associated with acquiring expertise in that domain. Finally, teachers in the last stages of talent development should assist their students in creating a personalized niche, a specific style, or a unique area of application (see last row in Figure 4; Subotnik et al., 2011, 2012, 2018b).

Fifth, in addition to general and domain-specific competencies as well as special opportunities for talent development, psychosocial skills are also important in the talent development process (Subotnik et al., 2011, 2018b, 2019). Especially in later stages, psychosocial skills serve as handlers for fostering talent development and for providing protection from inhibiting factors (Subotnik et al., 2018b). The reasons for this are manifold: First, as talented individuals progress in their field, they face more and more competition with their peers and must increasingly prove themselves in competitive situations; second, in later stages of the talent development process, skillful planning and strategic risk-taking play a much more central role in individuals' work, and third, challenging the existing dogmas, aesthetics, or values of a field, which is often necessary to produce exceptional performance, can lead to attacks or other challenges that require great psychosocial strength (Sternberg, 1997; Sternberg & Lubart, 1995). On the one hand, psychosocial skills include mental skills such as self-regulation, perseverance, and anxiety reduction that help individuals deal with successes, failures, and criticism on their talent development journey. On the other hand, psychosocial skills also encompass social competencies, such as the ability to engage with potential mentors or to promote oneself tactfully (Subotnik et al., 2011, 2019).

2.3 Talent Development in Achievement Domains Framework (Preckel et al., 2020)

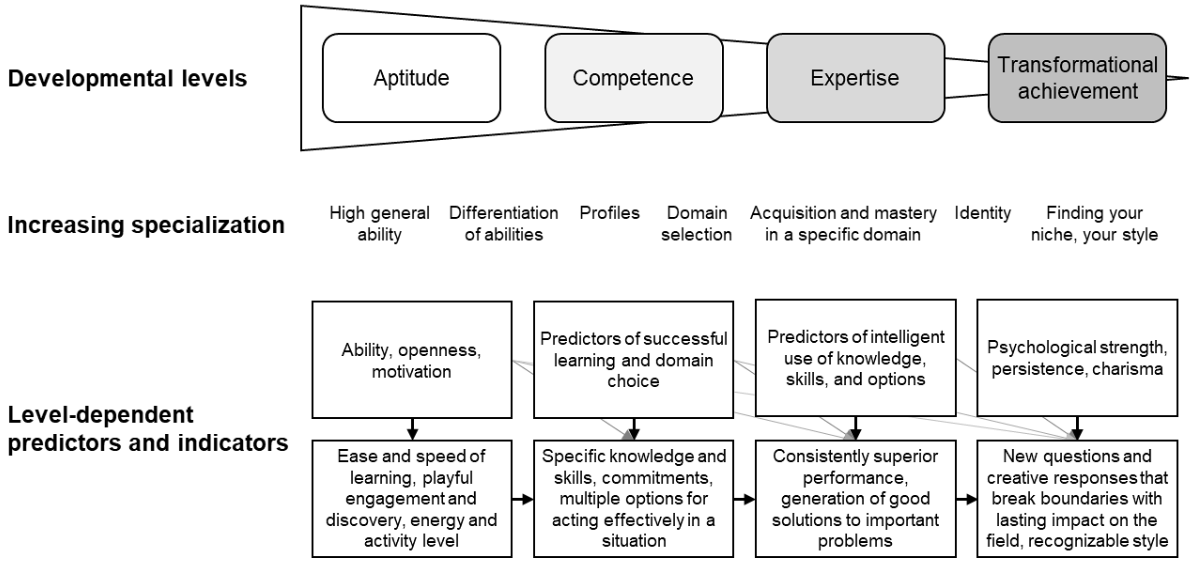
Preckel et al.'s (2020) TAD framework was developed with the intention of providing an integrated model of giftedness and talent development, that is, a model that would be applicable to a broad range of achievement domains. It is not a new model of giftedness but rather a framework for creating talent development models for specific achievement domains. At first glance, the TAD framework seems to draw heavily on Subotnik et al.'s (2011, 2018b) TDMM: For example, like Subotnik et al.'s (2011, 2018b) TDMM, it describes the talent development process as a sequence of four successive stages and follows the notion of a trajectory of talent development moving from general abilities to more specific skills and competencies. Moreover, both models regard talent development as depending on a variety of factors whose relative importance varies with the talent development stages (Preckel et al., 2020).

On closer examination, however, it is clear that Preckel et al.'s (2020) TAD framework goes a step further than Subotnik et al.'s (2011, 2018b) TDMM in making the talent development process more suitable for empirical investigations and more usable for cross-domain applications. There are four main reasons for this: First, unlike Subotnik et al.'s (2011, 2018b) TDMM, Preckel et al.'s (2020) TAD framework takes a primarily psychological perspective and concentrates on measurable, person-related variables. This perspective reduces model complexity and promotes testability (Preckel et al., 2020). Second, Preckel et al.'s (2020) TAD framework places a strong focus on processes that are internal to the person and that condition interest and success in a domain (e.g., ability differentiation, profile formation, and identity formation). In this context, the main emphasis is on the formation and precise role of so-called ability-personality profiles, as previous research has shown that these profiles are highly predictive of individuals' performance and domain choices (e.g., Lubinski, 2016; Wang et al., 2013; Wang et al., 2017). Third, Preckel et al.'s (2020) TAD framework provides more detailed information regarding the importance of predictors and indicators on different levels of the talent development process than can be derived from Subotnik et al.'s (2011, 2018b) TDMM. Since these predictors and indicators can be determined empirically, it is possible to use them to identify individuals' achievement potential and to monitor their progress over the course of talent development. In addition, Preckel et al. (2020) acknowledge that the relative importance of predictors varies throughout the talent development process. Therefore, it is suggested that predictive contributions to successive levels of talent development should be given priority over long-term contributions toward exceptional performance. Last, Preckel et al. (2020) point out that the TAD framework, like Subotnik et al.'s (2011, 2018b) TDMM, is transferable to different achievement domains. However, unlike Subotnik et al.'s (2011, 2018b) TDMM, the TAD framework provides some guidelines and examples for this endeavor. For instance, Preckel et al.'s (2020) TAD framework supports model construction by clearly differentiating distinct levels of talent development along with their respective predictors and indicators. Thus, creating a domain-specific talent development model requires outlining evidence for each part of the TAD framework, deducing evidence-based applications, pointing out gaps in the literature, and proposing a future research agenda (Preckel et al., 2020).

Figure 5 schematically summarizes the central assumptions of Preckel et al.'s (2020) TAD framework. The figure can be roughly divided into three rows, which correspond to the aspects "Developmental levels", "Increasing specialization", and "Level-dependent predictors and indicators". In the following, the three rows are successively explained in more detail.

Figure 5

Talent Development in Achievement Domains Framework (Preckel et al., 2020)



Note. Adapted from "Talent Development in Achievement Domains: A Psychological Framework for Within- and Cross-Domain Research" by F. Preckel, J. Golle, R. Grabner, L. Jarvin, A. Kozbelt, D. Müllensiefen, P. Olszewski-Kubilius, R. Subotnik, W. Schneider, M. Vock, and F. C. Worrell, 2020, *Perspectives on Psychological Science, 15*(3), p. 697, (https://doi.org/10.1177%2F17456916198950 30). Copyright 2020 by the Authors.

Developmental Levels. As can be seen in the upper row of Figure 5, Preckel et al.'s (2020) TAD framework is based on a lifespan perspective. Four successive rectangles chronologically depict the sequence of the assumed talent development stages from childhood to adulthood: aptitude, competence, expertise, and transformational achievement (Preckel et al., 2020). Across the lifespan, the number of gifted individuals is expected to decrease (cf. Simonton, 1999), as indicated by the triangle behind the four rectangles that is oriented to the right. The four stages of talent development are described below in their consecutive order.

The first talent development stage, *aptitude*, refers to individual differences in the basic constellation of psychological variables that are expected to predict positive talent development or future outstanding performance. It reflects variations in mental functioning (e.g., musicality, mathematical cast of mind, or spatial ability) that might predispose a person to take an interest in the content of a particular achievement domain or to take up relevant activities in that domain. In some achievement domains, these variations appear early in life; in other domains, these variations appear late. Regardless of their initial manifestation, however, they seem to be something of a natural fit between the person and the content or challenges of their environment. In Subotnik et al.'s (2011, 2018b) TDMM, the first talent development stage is titled *ability*. However, in Preckel et al.'s (2020) view, the term *ability* refers to individual differences in the capacity for performance on a defined class of tasks that are evident at the present moment (Carroll, 1993, p. 16). To stress the fact that it is primarily individuals' perceived potential that plays an important role in the development of achievement or future performance on this level, the TAD framework uses the title *aptitude* (Preckel et al., 2020).

The second talent development stage, *competence*, describes interrelated clusters of knowledge, skills, and abilities that result from systematic learning and enable individuals to act efficiently in different situations (Gagné & McPherson, 2016). Once children or adolescents show some interest in the activities of a certain domain and engage in those activities systematically over an extended period of time, their skills start to improve and typically stand out from those of their age group. This systematic engagement often involves deliberate practice and formal instruction. In this way, children and adolescents acquire a variety of increasingly domain-specific skills over time that open up a wide range of possible actions for them (Preckel et al., 2020).

The third talent development stage in Preckel et al.'s (2020) TAD framework is called *expertise*. It is primarily defined by high levels of consistently superior performance – similar to experts who are capable of generating appropriate solutions to important problems because of their strong grasp of a field (Subotnik et al., 2019). To reach this stage of talent development, individuals must continuously expand their knowledge base and optimize their domain-specific skills, which often requires several more years of particularized instruction. Furthermore, the expertise stage usually involves overt commitment to a domain. However, meeting these two criteria does not guarantee a successful transition to full-time professional status; rather, this additionally requires recognition as an expert by others who have already established their reputation in a field. It is therefore often helpful at this stage of talent development to have well-developed psychosocial skills in order to network and exchange ideas with others and to gain insider knowledge (Preckel et al., 2020).

The final talent development stage, *transformational achievement*, refers to levels of achievement that clearly exceed expertise in a domain. Individuals at this stage of talent development are typically able to raise highly innovative questions or to generate creative responses to important problems that significantly push the boundaries of a field. Their innovations might consist of either a single significant contribution or of multiple contributions with a lasting, memorable impact on how work in a domain is typically conducted (Jarvin & Subotnik, 2010; Subotnik et al., 2018a). Given sociocultural and chance factors, it is important for productive individuals at this stage to find a way to maintain their creative mindset and to draw from it later in life. Overall, Preckel et al.'s (2020) understanding of *transformational achievement* resembles the description of eminence in Subotnik et al.'s (2011, 2018b) TDMM. Unfortunately, the term *eminence* can easily be misunderstood (for a discussion, see Worrell et al., 2018). Therefore, Preckel et al. (2020) decided to use the more descriptive term *transformational achievement* in their TAD framework.

Increasing Specialization. The center row of Figure 5 draws attention to the fact that, according to Preckel et al. (2020), progress across the talent development stages is associated with increasing specialization of knowledge, skills, and abilities. Individuals usually do not succeed in achieving high levels of performance in multiple achievement domains at the same time. This is primarily because high levels of performance in most cases require intensive investment in a domain, withdrawing time for engagement with other activities. As a consequence, reaching high levels of talent development is almost always limited to a single domain (Preckel et al., 2020).

Following Preckel et al. (2020), there are five basic principles that contribute to increasing specialization across the four talent development stages (see center row in Figure 5): First, general as well as specific cognitive abilities are relevant for predicting exceptional achievement throughout the talent development process. For example, in their meta-analyses, Zaboski et al. (2018) found positive associations between general and more specific cognitive abilities and academic achievement, with general cognitive abilities showing the largest effects across all achievement domains and age levels (mean effect size of $r^2 = .54$). Moreover, earlier domain-specific abilities have been found to have a strong and consistent positive effect on later creative productivity, job performance, or training success (e.g., Bertua et al., 2005; Lubinski, 2016). Second, Preckel et al. (2020) suggest that both forms of ability are malleable. Even general cognitive abilities, which in relative terms tend to be rather stable characteristics, have been found to show some variation over time. For instance, Lyons et al. (2009) found that over a time span of 35 years (between the ages of 20 and 55), 44.6 % of the individuals in their study showed score changes of at least half a standard deviation in a measure of general cognitive ability. Basically, environmental factors are thought to contribute to individual differences in measures of cognitive ability to a similar extent as do genetic factors (Knopik et al., 2016). An example of this is education. Findings from longitudinal studies with pupils in the German three-track school system, for example, indicate that the development of pupils' general cognitive abilities depends in part on the type of school track attended (e.g., Becker et al., 2012; Guill et al., 2017). A third mechanism that contributes to increasing specialization in an achievement domain is that cognitive abilities differentiate and become more specific over time. There are several theoretical accounts to suggest that general intelligence is foundational for the emergence of more specific abilities (e.g., Ackerman, 1996; Cattell, 1987; Garrett, 1946). For example, Cattell's (1987) *Investment Theory* posits that general, fluid abilities are invested in the acquisition of crystallized abilities (e.g., specific knowledge or skills) by taking advantage of learning opportunities. As the environment becomes more heterogeneous across the lifespan, crystallized abilities, which are strongly affected by the environment, do so as well; in contrast, fluid abilities do not. This contrast, in turn, leads to a differentiation of abilities and to the development of more specific abilities or specialized knowledge structures. As a result, while empirical evidence does not support a general shift in intelligence structure, it does support the hypothesis that factors related to more specific, acquired content and skills become more differentiated over time (Carroll, 1993). The fourth principle, which Preckel et al. (2020) suggest contributes to increasing specialization in a talent domain, posits that ability and personality development are intertwined. The same idea can be found in theories of intellectual development (e.g., Ackerman, 1996; Ziegler et al., 2012) and in theories that include the development of achievement (e.g., Marsh & Martin, 2011). In these theories, the development of cognitive abilities and the development of non-cognitive abilities, such as self-concept, interests, or investment traits, are thought to be interrelated in the process of talent development, resulting in the materialization of specific ability-personality profiles (Preckel et al., 2020). Finally, Preckel et al. (2020) assume that ability-personality profiles inform talent development and have positive reciprocal effects with achievement. *Ability-personality profiles* include individual constellations of abilities, interests and values, motivational variables, and self-concepts that are assumed to guide talent development across a wide range of achievement levels (Ackerman & Heggestad, 1997; Snow, 1991). Although mean scores of performance-related factors have proven to be useful for predicting individuals' levels of achievement, a number of studies have shown that ability-personality profiles are critical for predicting the choice of a domain as well as the domain in which individuals perform best (e.g., Lubinski et al., 2001; Makel et al., 2016; Park et al., 2007, 2008; Wang et al., 2013, 2017). Of particular note in the context of talent development is that ability-related profiles seem to be more scattered in highly gifted individuals than in individuals of average intelligence (Lohman et al., 2008).

Level-Dependent Predictors and Indicators. The lower two rows of Figure 5 represent the level-dependent predictors and indicators of the talent development process as conceptualized in Preckel et al.’s (2020) TAD framework. Comparable to Subotnik et al.’s (2011, 2018b) TDMM, the TAD framework understands talent development as a cumulative process in which the relative importance of predictors and indicators varies as a function of the four talent development stages (i.e., aptitude, competence, expertise, and transformational achievement). Both models assume that general cognitive abilities and motivational variables are particularly important in the early stages of talent development and remain relevant throughout the talent development process. At the same time, other variables such as psychosocial and self-regulatory skills gain in importance as individuals advance from novice to expert status in a domain (Preckel et al., 2020).

A major concern of Preckel et al.’s (2020) TAD framework is to describe which predictors and indicators should be empirically assessed at the different stages of the talent development process. Predictors and indicators serve to identify individuals’ potential in terms of specific constellations of “psychological factors that indicate the likelihood of a positive development of achievement to the next level” (Preckel et al., 2020, p. 701). Since these constellations differ for different talent development stages, what defines potential can also change with the level of talent development, allowing for a tracking of individual progress in the talent domain (Preckel et al., 2020).

Following Preckel et al. (2020), the choice of appropriate psychological variables that can serve as predictors and indicators of talent development is largely dependent on the achievement domain and talent development stage under consideration. Psychological variables with predictive power for describing talent development at different stages include cognitive variables (e.g., intelligence, working memory, perceptual abilities, or creativity), personality variables (e.g., openness and further investment traits, conscientiousness, or emotional stability), motivational variables (e.g., achievement motivation, interests, values, or self-concept), and psychosocial skills (e.g., resilience, empathy, receptiveness to feedback, or a growth mindset), including self-regulatory skills (e.g., coping, goal setting, or self-regulated learning; for more information, see Jarvin & Subotnik, 2010; Schneider, 2000; Schneider & Preckel, 2017).

2.4 Comparative Comments

In order to gradually conclude the theoretical background of the present thesis, the last subchapter provides comparative comments on the *gifted child* versus the *talent development paradigm*. The goal is to recapitulate some key assumptions of both paradigms while explicitly drawing attention to the differences in their practical implications for gifted education. The comments are summarized in Table 1.

As reported above, the *gifted child* and the *talent development paradigm* agree on the assumption that individual differences in cognitive abilities are important determinants of exceptional performance. However, a difference between the two paradigms lies first in the way they conceptualize the fundamental nature of these cognitive abilities. According to the *gifted child paradigm*, high intellectual abilities are stable, innate qualities that allow individuals to be successful over time and across different contexts (Dai, 2018; Dai & Chen, 2013; Olszewski-Kubilius & Thomson, 2015). Consistent with this view, gifted individuals are identified under the *gifted child paradigm* based exclusively on measures of general cognitive ability (see Table 1). Gifted individuals are those who score well above average on general intelligence tests. In contrast, the *talent development paradigm* sees cognitive abilities as malleable and susceptible to change over time (Olszewski-Kubilius & Thomson, 2015). This is true even for general cognitive abilities, which have generally been shown to be rather stable characteristics; under the *talent development paradigm*, they are assumed to demonstrate at least some variation over longer time spans. Moreover, besides general cognitive abilities, the *talent development paradigm* also attributes particular importance to domain-specific cognitive abilities as well as to their progressive transformation into ability-personality profiles (Preckel et al., 2020). General cognitive abilities can serve as predictors of aptitude only in the earliest stages of talent development. As individuals progress toward higher talent development stages, measures of giftedness according to the *talent development paradigm* need to be tailored more specifically to the particular domain and talent development stage under consideration. For example, in late childhood, standardized tests of specific abilities, such as verbal, mathematical, or spatial abilities, are helpful in determining whether children are making adequate talent development progress or whether they might profit from more challenging educational opportunities (Olszewski-Kubilius & Thomson, 2015).

In terms of gifted education, both the *gifted child* and the *talent development paradigm* promote the deliberate cultivation of exceptional abilities through special programing inside and outside of school. However, a second difference between the two paradigms is that, following the *talent development paradigm*, the nature of these programs should be directly matched to individuals' domains of talent and their stages of talent development (see also Table 1). In detail, young children should be provided with enriched environments that expose them to various achievement domains and that spark their interests and motivation to engage in the content and activities of these domains. In contrast, in designing more advanced courses, care should be taken to ensure that children and adolescents have the chance to systematically develop their skills and to accumulate knowledge in their chosen domains. Finally, for young adults, special programs should provide opportunities to participate in more authentic course work through mentorships, apprenticeships, or higher education programs, as an example (Olszewski-Kubilius & Thomson, 2015). As opposed to these targeted measures, special programing according to the *gifted child paradigm* is broader in scope and does not follow such a differentiated schedule.

Table 1

Practical Implications of the Gifted Child and the Talent Development Paradigm

Concept	Gifted child paradigm	Talent development paradigm
Identification	Identification is exclusively based on psychometric measures of general abilities	Identification measures must be based on the domain of talent and the stage of talent development
Education	Special programing is relevant in more general terms Gifted individuals can have unique psychological needs	Special programing must be matched to the domain of talent and the stage of talent development Special programing needs to go beyond high school Psychosocial skills must be actively and deliberately cultivated
Outcome	Goal is to respond to immediate needs for greater challenges and faster pacing Long-term outcome often not specified	Goal is to cultivate domain-specific talents to a high degree Highest talent development stage as long-term outcome

Note. Adapted from "Talent Development as a Framework for Gifted Education" by P. Olszewski-Kubilius and D. Thomson, 2015, *Gifted Child Today*, *38*(1), p. 52 (https://doi.org/10.4135/9781529762235). Copyright 2015 by the Authors.

Third, the *gifted child* and the *talent development paradigm* are also different in how they conceptualize the psychosocial skills of gifted individuals. In the *gifted child paradigm*, the social, emotional, and psychological characteristics of gifted individuals are viewed as inherent to giftedness. Gifted individuals differ from the rest of the population in these characteristics precisely because they are gifted. Furthermore, the psychosocial skills of gifted individuals are thought to be the cause of their unique psychological needs. Ways to address these needs are therefore not generally considered in gifted education measures. In comparison, according to the *talent development paradigm,* the emotional and mental configuration of gifted individuals is taken to result from their highly individualized educational trajectories as well as from their striving to be different and exceptional. In addition, the fact that high-performing individuals are often out of step with others in particular cultural or social contexts may contribute to their feeling special (Olszewski-Kubilius & Thomson, 2015). As a result, the *talent development paradigm* holds that the psychosocial characteristics of gifted individuals must be actively and deliberately cultivated through programing, counseling, and mentoring. Different skills are important at different stages of talent development and need to be systematically nurtured (Olszewski-Kubilius & Thomson, 2015).

A final difference between the *gifted child* and the *talent development paradigm* concerns the intended outcome of gifted education (see Table 1). In the *gifted child paradigm*, the immediate goal is to provide children and adolescents with educational programs that match their learning pace and their level of knowledge. However, the long-term goal often remains unspecified or depends on the vision of a particular school or program (Dai, 2010). In the *talent development paradigm*, on the contrary, the primary goal of gifted education is to improve individuals' intellectual abilities as well as their social and emotional characteristics and to prepare them to advance to the next stage of talent development. The long-term goal of gifted education is to enable more gifted individuals to reach the highest levels of talent development in their domains and to become creative producers in adulthood (Subotnik et al., 2011).

3 Practical Background

Moving from the theoretical to the practical background of the present thesis, the next chapter introduces the concept of junior study programs as measures of gifted education. In particular, the first subchapter offers a definition of junior study programs and highlights their benefits from the perspectives of the most relevant actors (i.e., participants, schools, and universities). The second subchapter then provides an overview of how junior study programs are commonly implemented at German universities, while the third subchapter takes a comparative look at the neighboring countries Austria and Switzerland. Finally, setting the stage for the remainder of the present thesis, the fourth subchapter presents the results of studies that have either pro- or retrospectively examined the transition of former junior students from school to university and, related to this, their educational choices directly following their Abitur.

3.1 Definition of Junior Study Programs

Junior study programs[3] are measures of gifted education that, in addition to school classes, enable pupils to attend regular courses at university, to take exams, and to earn credits that can later be transferred to their regular studies (Deutsche Telekom Stiftung, 2011). The measures are primarily aimed at intellectually gifted adolescents in upper secondary education who demonstrate outstanding academic performance as well as high levels of achievement motivation (Halbritter, 2008b) but do not feel sufficiently challenged in school (Deutsche Telekom Stiftung, 2006, 2008, 2011; Solzbacher, 2006–2007, 2011). For these adolescents, junior study programs can be particularly appealing, especially because participation in these programs requires high investments in time and effort: Junior students are expected to

[3] In Germany, junior study programs are known by various names, among them “Frühstudium”, “Juniorstudium”, “Schülerstudium”, or “Schüler(innen) an die Universität” (Kaden, 2016; Stumpf & Schneider, 2008).

compensate for missed classes in school, to write tests, and to master the same material as their classmates. At the same time, they are also supposed to prepare for their courses at university and, if possible, to successfully take exams at the end of the semester. Furthermore, it is also not uncommon for many junior students to commute long distances from their home to university (Deutsche Telekom Stiftung, 2011).

Junior study programs are particularly widespread in Germany, Austria, and the German-speaking regions of Switzerland. From a conceptual perspective, they are broadly comparable to advanced placement (AP) and dual enrollment programs in the United States (Gabert, 2014; Halbritter, 2008b; Stumpf et al., 2011; Stumpf & Schneider, 2013). Similar to junior study programs, *AP programs* allow pupils who are still in school to attend higher education courses and to demonstrate their acquired competencies toward the end of these courses by taking the relevant exams. However, unlike those academic courses which are open to adolescents in junior study programs, AP courses in the United States take place in a high school context and must comply with the standardized criteria of the national College Board's AP Course Audit. The same is true for the exams which pupils can take at the end of the AP courses. The standardized criteria of the national College Board's AP Course Audit were developed to ensure that AP courses adhere to college-level standards. Depending on the scores pupils receive on their exams and on the AP credit and placement policy of the institution at which they plan to enroll for their regular studies after high school, college credits or placement into higher-level college courses are typically awarded (Wyatt et al., 2015).

Dual enrollment programs are even more similar to junior study programs than AP programs. In detail, they allow pupils from high schools in the United States to enroll in college-level courses and to earn college credits. Unlike AP programs, pupils in dual enrollment programs do not take standardized exams but, as in junior study programs, are awarded course grades or credits which can later be used to fulfill higher education requirements. Alternatively, however, pupils in dual enrollment programs can also count their credits toward high school courses. For this reason, dual enrollment programs are also referred to as *dual credit* or *concurrent enrollment programs* (Wyatt et al., 2015). Courses in dual enrollment programs are taught either in high school, at higher education institutions, or through distance education (Thomas et al., 2013).

As measures of gifted education, junior study programs combine aspects of both *enrichment* and *acceleration*, which are commonly distinguished in gifted education programs: First, junior study programs provide academically gifted adolescents with enriched environments at university that offer them the opportunity to acquire knowledge and skills that go well beyond the school curriculum (Solzbacher, 2008a; Stumpf, 2011; Stumpf & Schneider, 2008). Second, adolescents who participate in junior study programs are given the chance to pass through educational stages at an accelerated rate by taking exams and earning credits that can later be transferred to their regular studies (Deutsche Telekom Stiftung, 2008, 2011; Solzbacher, 2006–2007, 2008a, 2011; Stumpf & Schneider, 2008). In this way, junior students might be able to significantly shorten their study time in their regular studies later on (Stumpf & Schneider, 2008).

Aside from the enriching and accelerative aspects of junior study programs, gifted adolescents also gain a number of less obvious advantages from their participation in the gifted education measure. What is more, besides gifted adolescents, there are also schools and universities involved that can derive positive outcomes from the project. The perspectives of the three relevant actors in junior study programs (i.e., junior students, schools, and universities) are (further) described in the sections below.

How Do Junior Students Benefit? In addition to the fact that junior study programs provide young people with enriched environments at university and enable them to advance through educational stages more expeditiously, junior students might also benefit from their participation in the program in school (Deutsche Telekom Stiftung, 2011). For example, the knowledge and skills junior students typically acquire at university might give them a decisive advantage over their classmates in exams, helping them achieve better grades. Second, junior study programs are also assumed to support young people in their career orientation. For instance, in the course of their junior studies, junior students gain initial insight into their intended subject field as well as into academic life in general, which might provide them with a basis for deciding whether or not they want to commence regular studies after their Abitur (Deutsche Telekom Stiftung, 2011; Stumpf & Schneider, 2008). Third, junior study programs have been shown to help adolescents more successfully make the transition from school to university after their Abitur. Typically, during their participation in the program, junior students learn how to work scientifically and how to orientate themselves in higher education institutions (Deutsche Telekom Stiftung, 2011). Clearly, this presents them with an advantage over regular first-semester students, who have not acquired comparable skills at this point in their education (see Gabert, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). At the same time, junior students often make first contacts with lecturers and regular students at university whom they can turn to for advice if they need help at the start of their regular studies (Deutsche Telekom Stiftung, 2011). Finally, junior study programs offer academically gifted adolescents the chance to satisfy their curiosity and to fully develop their intellectual skills. For example, junior students are free to choose courses at university that match their strengths and interests instead of having to follow a specified curriculum. This might lead to them becoming increasingly enthusiastic about their intended subjects or discovering a new fascination for academic learning (Deutsche Telekom Stiftung, 2011). Furthermore, meeting like-minded people at university with whom junior students share their curiosity and their interest in certain academic disciplines might contribute to their personal development (Deutsche Telekom Stiftung, 2011; Stumpf & Schneider, 2008).

How Do Schools Benefit? Schools can also profit in numerous ways from having their high-performing pupils participate in junior study programs: First, junior students might decisively enrich the classroom with their experiences from university. For example, their advanced knowledge and their sophisticated scientific working methods might bring forward the school curriculum and help their classes progress at a faster pace. Moreover, junior students' time management skills and their strong sense of responsibility can set an example for their classmates and have a positive impact on their work attitudes (Deutsche Telekom Stiftung, 2011). Second, junior study programs also contribute to improved cooperation between schools and universities (Deutsche Telekom Stiftung, 2011). For instance, especially at the start of the semester, both educational institutions are in active communication in order to target suitable candidates, to organize selection processes, and to coordinate the university timetables of accepted junior students with their classes in school. Besides that, schools and universities also have to work together throughout the semester, for example, to closely monitor junior students' progress in school and in their junior studies.

How Do Universities Benefit? For universities offering junior study programs, the benefits are basically twofold: First, junior study programs are a welcome opportunity for universities to attract gifted pupils and to retain them as future top performers early on (Deutsche Telekom Stiftung, 2011; Stumpf & Schneider, 2008). Here, the underlying assumption is probably that adolescents who have positive associations with their participation in junior study programs are more likely to start regular studies after their Abitur as well as to stay at those institutions at which they were enrolled as junior students (Deutsche Telekom Stiftung, 2011). Second, junior study programs are supposed to help reduce dropout rates from regular studies and thus to save both personnel and financial resources at universities. Junior study programs give young people the chance to gain an overview of the range of subjects and topics offered in higher education, enabling them to make more informed subject choices for their regular studies. As a consequence, it is believed that dropout rates and subject changes among former junior students are lower than among regular students (Deutsche Telekom Stiftung, 2011).

3.2 Junior Study Programs in Germany

In the following sections, the focus is on the actual implementation of junior study programs in Germany. After a brief outline of the legal basis of the measure in the first section, the second section looks at how junior study programs have spread across Germany in recent years. Subsequently, in the third section, the organization of junior study programs at German universities is examined, with a short excursus on the organization of the junior study program at JMU Würzburg. Finally, the fourth section presents the results of selected studies that have examined the characteristics and experiences of German junior students during their participation in the program.

3.2.1 Legal Basis of Junior Study Programs in Germany

In Germany, the federal government plays only a minor role in educational matters; instead, responsibility for schools and higher education lies primarily with the individual states (European Education and Culture Executive Agency, 2020). As a consequence, the legal status of German junior students generally depends on the laws of the state in which the particular higher education institution they are attending is located (Halbritter, 2008b). In order to strengthen collaboration between schools and universities and to provide more support to gifted children and adolescents, the Ständige Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland (KMK) [Standing Conference of the Ministers of Education and Cultural Affairs of the German states] passed a nationwide resolution in 2004 calling for the timely creation of legal foundations for junior study programs in all German states (Halbritter, 2008b; Solzbacher, 2011). The *KMK* is a consortium of ministers responsible for education and schooling, institutes of higher education and research, and cultural affairs, whose task is to formulate the joint interests and objectives of the German states (Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs, 2015). In their resolution, the KMK recommended that

> pupils who, in the consensual judgement of the school and the higher education institution, display special talents, be allowed to acquire study and examination credits, complete modules and earn corresponding credit points at higher education institutions without being formally enrolled as students. (Präsidien der Hoschulrektorenkonferenz und Kultusministerkonferenz, 2004, p. 2)

The resolution of the KMK was accompanied by the request that all individual German states and higher education institutions create a legal basis for the establishment of junior study programs in the foreseeable future. Indeed, many German states have since incorporated a corresponding passage in their higher education laws. For example, the state of Bavaria, where JMU Würzburg is located, has included a passage in the Bayerisches Hochschulgesetz [Bavarian Higher Education Act] in 2006 (Bayerisches Hochschulgesetz, 2006).

3.2.2 Prevalence of Junior Study Programs in Germany

Junior study programs have been on the rise in Germany since the early 2000s (Solzbacher, 2008b). In the winter semester of 2000/2001, for example, the Universität zu Köln was one of the first higher education institutions in Germany to offer pupils the opportunity to attend academic courses and to take up junior studies in a subject of their choice (Halbritter, 2008a). Since the offer was very well received overall, the Universität zu Köln set out in the subsequent years to sensitize schools and teachers to the possibilities of junior study programs (Halbritter, 2008a, 2008b) and to encourage other higher education institutions to participate in the project (Halbritter, 2008b, 2011). In this way, the Universität zu Köln has taken on a pioneering role in the organization and implementation of junior study programs in Germany and has contributed enormously to their spread (Stumpf et al., 2011). At the same time, the media has also played a part in the success of the project by regularly reporting on the achievements of successful participants and thus raising public awareness for junior study programs (Halbritter, 2011).

Details on how junior study programs have spread across Germany following their introduction at the Universität zu Köln almost 2 decades ago are well documented in the three data reports by the Deutsche Telekom Stiftung [Deutsche Telekom Foundation] published in the winter semester of 2004/2005, the winter semester of 2012/2013, and the summer semester of 2018 (Deutsche Telekom Stiftung, 2006, 2013, 2018a). The Deutsche Telekom Stiftung is one of Germany's main educational foundations that supports projects with schools and other educational institutions in order to help children and adolescents shape their own learning and independently acquire important skills for their education and for life (Deutsche Telekom Stiftung, n.d.-b). From 2004 to 2019, the Deutsche Telekom Stiftung promoted the introduction of junior study programs in Germany (in cooperation with the Universität zu Köln; Halbritter, 2011) by providing universities with relevant information and supporting them with funds to reimburse junior students' travel expenses or to compensate mentors, as an example (Deutsche Telekom Stiftung, n.d.-a, 2008, 2011; Solzbacher, 2006–2007, 2011).

The first data report by the Deutsche Telekom Stiftung dates back to the winter semester of 2004/2005 (Deutsche Telekom Stiftung, 2006). The aim of the first report was to explore the landscape of junior study programs in Germany at the time and to find out where there was the greatest need for support with regard to the program's promotion (Deutsche Telekom Stiftung, 2006). To this end, questionnaires were sent to a total of 71 higher education institutions nationwide, of which 50 institutions returned their questionnaires, corresponding to a response rate of 70.4 %. The results of the first data report showed that of those institutions which responded, two thirds (66.0 %) were already offering junior study programs in the winter semester of 2004/2005. The average number of junior students per institution was about 32, albeit with a substantial range of 7 to 70 (median not given; Deutsche Telekom Stiftung, 2006). The total number of junior students in Germany in the winter semester of 2004/2005 was more than 750 (note that not all institutions provided information on their number of participants; Deutsche Telekom Stiftung, 2006).

At the time of the first data report by the Deutsche Telekom Stiftung (2006), the subject focus of junior study programs in Germany was clearly on the field of Mathematics, Natural, & Engineering Sciences; almost all higher education institutions offered Physics (86.7 %), Mathematics (80.0 %), or Computer Science (73.3 %) as part of their junior study programs. Furthermore, at exactly two thirds of the institutions (66.7 %), junior students were able to take Chemistry (Deutsche Telekom Stiftung, 2006). It is interesting to mention at this point that the Deutsche Telekom Stiftung initially saw junior study programs primarily as instruments to promote young talent in science (Deutsche Telekom Stiftung, 2006, 2011). Nevertheless, the first data report also recorded participants in other subject fields, such as Law, Business, & Social Sciences and the Humanities (for a detailed explanation of how subjects were grouped into subject fields throughout the present thesis, see Data Aggregation of Research Issue 1).

The second data report by the Deutsche Telekom Stiftung was conducted in the winter semester of 2012/2013 (Deutsche Telekom Stiftung, 2013). Questionnaires were sent to a total of 53 German universities that had been identified beforehand to offer junior study programs. The total number of responses was 32, representing a return rate of 60.38 %. The results of the second data report indicated that there were already more than 1,300 adolescents in Germany in the winter semester of 2012/2013 who were attending academic courses at an overall number of 31 higher education institutions (note that one institution did not provide information regarding its number of participants); this corresponded to an average number of approximately

43 junior students per university. When considering the latter finding, however, it is important to note the highly variable range of 2 to 123 junior students per university at the time (median again not given; Deutsche Telekom Stiftung, 2013).

The range of subjects that was available to junior students at German universities according to the second data report by the Deutsche Telekom Stiftung (2013), was already broader than that reported in the first data report. Although the focus at most universities was still on subjects from the field of Mathematics, Natural, & Engineering Sciences (66.7 %), junior students also had access to considerably more subjects from other subject fields (87.5 %) than was the case in the winter semester of 2004/2005 (multiple choice; Deutsche Telekom Stiftung, 2013).

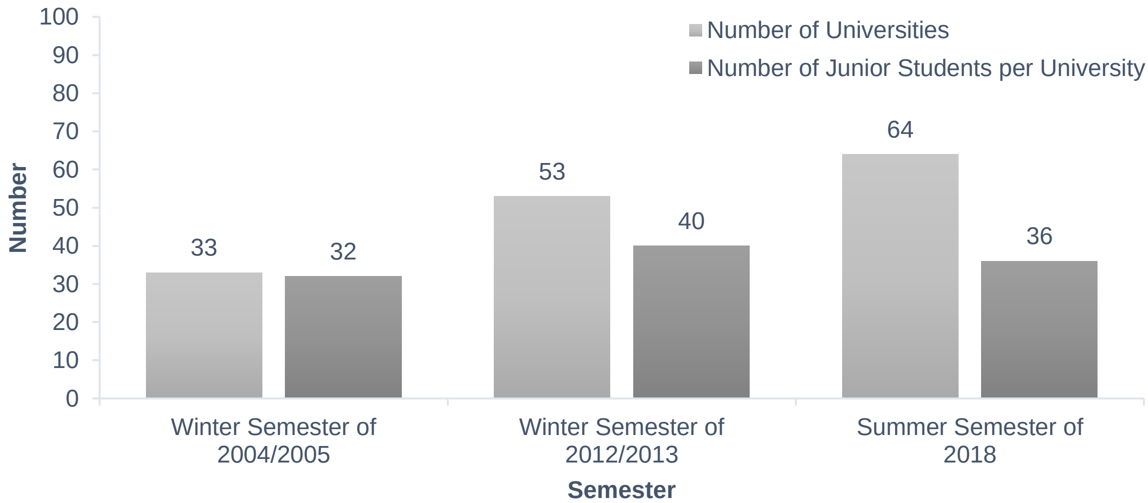
The third data report from the Deutsche Telekom Stiftung was finally commissioned in the summer semester of 2018. Overall, 64 higher education institutions that had been identified in advance as offering junior study programs were contacted and invited to complete an online survey; of these, 43 institutions submitted their responses, amounting to a response rate of 67.19 %. A central finding of the third data report was that there were 1,385 junior students registered at 39 German higher education institutions in the summer semester of 2018 (note that not all institutions provided information on their number of participants; Deutsche Telekom Stiftung, 2018a). Hence, the average number of junior students per university was just under 36, slightly lower than in the second data report but again with a considerable range of 1 to 191 (median not given; Deutsche Telekom Stiftung, 2018a).

Another central finding of the third data report commissioned by the Deutsche Telekom Stiftung (2018a) was that junior study programs were now offered in almost all subject fields. The most common was the field of Mathematics, Natural, & Engineering Sciences, which was offered at 86.0 % of the universities. At more than half of the universities, junior students could now also choose subjects from the field of Humanities (67.4 %) or from teacher training programs (58.1 %). Subjects in the field of Law, Business, & Social Sciences were available at half of the universities (48.8 %), and one fifth of the universities additionally provided other subjects (18.6 %; Deutsche Telekom Stiftung, 2018a).

Figure 6 summarizes both the number of universities offering junior study programs and the number of German junior students per university as recorded in the three data reports by the Deutsche Telekom Stiftung (Deutsche Telekom Stiftung, 2006, 2013, 2018a). From this figure, it is clear that there has been a gradual increase in the number of universities offering junior study programs in Germany across the three points of data collection. In fact, the number of universities that was recorded in the summer semester of 2018 was almost twice as high as the number recorded in the winter semester of 2004/2005. Meanwhile, the number of junior students per university has remained more or less constant (see Figure 6).

Figure 6

Number of Universities Offering Junior Studies and Number of German Junior Students per University from the Winter Semester of 2004/2005 to the Summer Semester of 2018



There are at least two likely causes for the observed trends: First, it seems possible that, while many higher education institutions have expanded their capacities for junior study programs in recent years, a growing number of smaller universities have joined the list of those providing junior study programs in Germany. For example, whereas the first data report by the Deutsche Telekom Stiftung (2006) predominantly listed universities such as the Universität zu Köln and Ludwig-Maximilians-Universität (LMU) München, with student numbers of up to 50,000, the most recent data report also included institutions such as the Technische Universität Clausthal and the Universität zu Lübeck, with only up to 5,000 active students (Deutsche Telekom Stiftung, 2018a). Smaller universities often have fewer financial and personnel resources and cover a narrower range of subjects than their larger counterparts. As a consequence, they can also only accommodate a certain number of junior students, which might have contributed to the fact that the average number of participants per university in Germany has remained almost constant.

Second, the observed trends might also be due to the virtually nationwide shortening of schooling from the 9-year (G9) to the 8-year Gymnasium (G8), which took place in almost all German states between 2001 and 2008 and was associated with a great increase in the amount of work and learning for pupils in upper secondary education (Köller, 2017). As a result of these educational reforms, pupils occasionally had to cope with more school-related stress and had substantially less free time to pursue their own interests (Köller, 2017). It can thus be assumed that motivated young people who would have applied for junior study programs at the time of the G9 decided not to participate in the G8 because of a lack of time and energy. This assumption was also supported by the coordinators of the junior study programs in Germany in the third data report from the Deutsche Telekom Stiftung (Deutsche Telekom Stiftung, 2018a, 2018b).

3.2.3 Organization of Junior Study Programs in Germany

To date, there are no uniform regulations governing the organization of junior study programs in Germany, neither at the federal nor at the state level. As a consequence, German universities offering junior study programs have to decide for themselves on how to carry out the selection of suitable candidates and how to handle the conduct of the program. The following section uses several studies that have collected information on this topic to give an impression of the procedures currently adopted for organizing junior study programs in Germany.

The first data report by the Deutsche Telekom Stiftung (2006), which was conducted in the winter semester of 2004/2005, was primarily aimed at sounding out the then-current state of junior study programs in Germany and at using the findings to improve and design the project in the future. In this context, some information was also obtained on how German higher education institutions typically organize their junior study programs. For example, it was found that public information about junior study programs varied greatly between universities. Almost all universities that offered junior study programs at the time sought to inform potential candidates through letters to schools (90.0 %) or through press and media initiatives (70.0 %). Moreover, about three quarters of the universities (76.7 %) relied on word of mouth, whereas posters seemed to play a relatively small role in publicizing the project (26.7 %). Approximately three quarters of those universities who responded to the first data report (73.3 %) also used other measures, among which information events were mentioned most frequently (multiple choice; Deutsche Telekom Stiftung, 2006).

Regarding the selection of suitable candidates, almost all universities (86.7 %) admitted that they relied largely on the schools' recommendations as the decisive criterion. In contrast, less than half of the responding universities (43.3 %) mentioned other admission criteria, such as unsolicited applications, recommendations from university subject representatives or from centers for highly gifted children and adolescents. Only one tenth of the universities (10.0 %) conducted more extensive selection processes such as psychological assessments or selection interviews. Finally, a relatively small number of universities (16.7 %) indicated that they did not use any admission criteria at all in selecting suitable candidates (Deutsche Telekom Stiftung, 2006).

At about two thirds of the universities, the organization of junior study programs was regulated in a centralized manner, for example, by coordinators from the central university administration or by academic coordinators. Just about one third of the universities organized their junior study programs in a decentralized manner (Deutsche Telekom Stiftung, 2006; see also Deutsche Telekom Stiftung, 2018a). In addition, participants were mainly supervised by professors (60.0 %) or student assistants (56.7 %) during their junior studies. More than one third of the universities (43.3 %) also indicated that schools contributed to the supervision of junior students. In comparison, counseling centers at the universities were involved in only 20.0 % of the cases (Deutsche Telekom Stiftung, 2006).

As far as cooperation with the schools is concerned, more than half of those universities (56.7 %) who responded to the first data report from the Deutsche Telekom Stiftung (2006) indicated that they had ongoing or regular contact with their external partners. However, about one third of the universities (36.7 %) only contacted schools in individual cases. Two universities (6.7 %) stated that they had no contact with schools (Deutsche Telekom Stiftung, 2006).

Besides the first data report from the Deutsche Telekom Stiftung (2006), the nationwide study that was undertaken by Solzbacher (2006–2007) at the Universität Osnabrück between October 2006 and October 2007 on behalf of the Deutsche Telekom Stiftung is another important source of information on the organization of junior study programs in Germany (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007). The results of the study were published in Solzbacher (2006–2007) and in part also in Solzbacher (2011) and in Deutsche Telekom Stiftung (2008). The declared aim of the study was to evaluate the experiences of the relevant actors in junior study programs (i.e., junior students, schools, and universities) across Germany (Deutsche Telekom Stiftung, 2008; Solzbacher, 2011). In the quantitative part of the study, a total of 331 junior students (127 female and 201 male; three junior students did not provide gender information) and 24 coordinators of German junior study programs took part in a standardized online survey (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011).

The results of Solzbacher's (2006–2007) nationwide study showed that German junior study programs differed primarily with regard to their selection processes (Deutsche Telekom Stiftung, 2011). Mostly, the selection of suitable candidates was initiated by the schools. In this context, teachers considered very good grades and outstanding school performance to be important prerequisites for successful participation in the program. In addition, pupils' work attitudes as well as their levels of independence were judged to be important (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011). In only 62.5 % of the cases, universities were also involved in the selection process. Selection interviews (64.5 %) and application documents (50.0 %) were the most common selection tools. Typically, applicants were questioned by central coordinators in the selection interviews (Deutsche Telekom Stiftung, 2011). Standardized tests were required the least frequently (7.1 %; Solzbacher, 2006–2007).

As with the selection of suitable candidates, the study by Solzbacher (2006–2007) also found major disparities between universities regarding the support they provided to active junior students throughout their participation in the program (see also Deutsche Telekom Stiftung, 2011). For example, some junior students were supervised by central coordinators (75.0 %), some by student assistants (66.7 %), and some by subject coordinators (62.5 %).

Frequently, supervision was provided in terms of one-on-one conversations with central coordinators (58.3 %) or subject coordinators (58.3 %). Regular meetings with student assistants were also common (37.5 %; Solzbacher, 2006–2007).

Excursus: Organization of the Junior Study Program at JMU Würzburg. As already mentioned in the introduction, the junior study program at JMU Würzburg was initiated in the winter semester of 2004/2005, making it the first junior study program at a higher education institution in Bavaria (Christ, 2014). The initiation of the junior study program at JMU Würzburg coincided with the establishment of the BYB, which since then has been the main institution responsible for the program's organization (Stumpf et al., 2011; Stumpf & Schneider, 2008, 2010). Concretely, the BYB regularly administers the selection of suitable candidates for the junior study program and serves as the central point of contact for pupils and junior students who have formal questions. Apart from the junior study program, other responsibilities of the BYB include conducting research projects in the field of giftedness and gifted education as well as providing advice to the regional population on giftedness-related issues, such as how to diagnose giftedness or how to best support gifted children in school (Stumpf et al., 2011; Stumpf & Schneider, 2008, 2010).

From the beginning, the junior study program at JMU Würzburg has been understood as a measure of gifted education – probably due to its organizational connection to the BYB (Stumpf et al., 2011; Stumpf & Schneider, 2008). This understanding is particularly evident in the multi-stage selection process, which comprises a total of three different components: In order to apply for the junior study program at JMU Würzburg, interested adolescents must first submit detailed application documents to the BYB. After a thorough review of the application documents, promising candidates are invited to the BYB to undergo psychological assessments. The psychological assessments are primarily designed to get a better sense of the candidates' cognitive abilities on the one hand and of their learning- and performance-related characteristics on the other hand. If the results of the psychological assessments do not indicate otherwise, the candidates are eventually invited to the BYB for a selection interview a short time later. Given a positive overall evaluation, admission to the junior study program at JMU Würzburg for at least 1 semester is granted (for a detailed description of all three components of the selection process, see Method of Research Issue 2; Stumpf, 2011).

The selection process at JMU Würzburg is carried out in close cooperation with the regional schools. There, contact teachers selectively target qualified pupils and provide them with relevant information on the conditions of application and on the course of the junior study program at JMU Würzburg (Stumpf et al., 2011). In addition to the schools, the BYB is also in constant exchange with the various departments at JMU Würzburg, especially during the multi-stage selection process for the junior study program. For example, for each subject from their organizational unit that is offered in the junior study program, the departments usually appoint a mentor who works directly with the coordinator for the junior study program at the BYB and helps with the selection of suitable candidates. Another role of the mentor is to assist admitted candidates in choosing their courses and to supervise them throughout their participation in the junior study program (Stumpf et al., 2011). At JMU Würzburg, junior students are allowed to attend courses from all subject fields, including courses from subjects with restricted admission, such as Psychology or Medicine, although no credits can be earned in these subjects (Stumpf et al., 2011).

At the start of their junior studies, all newly admitted candidates at JMU Würzburg are invited to a general introductory event, which serves to clarify organizational questions concerning studying in general, enrollment, or the technical infrastructure of the university. Furthermore, at the beginning of the semester, the subject mentors ensure that those junior students for whom they are responsible receive all the necessary information about their courses as well as about the specifics of their disciplines. In the further course of the semester, the junior students are then treated largely as regular students, which is particularly true for all areas of credit acquisition (Stumpf et al., 2011).

3.2.4 Characteristics of Junior Students in Germany

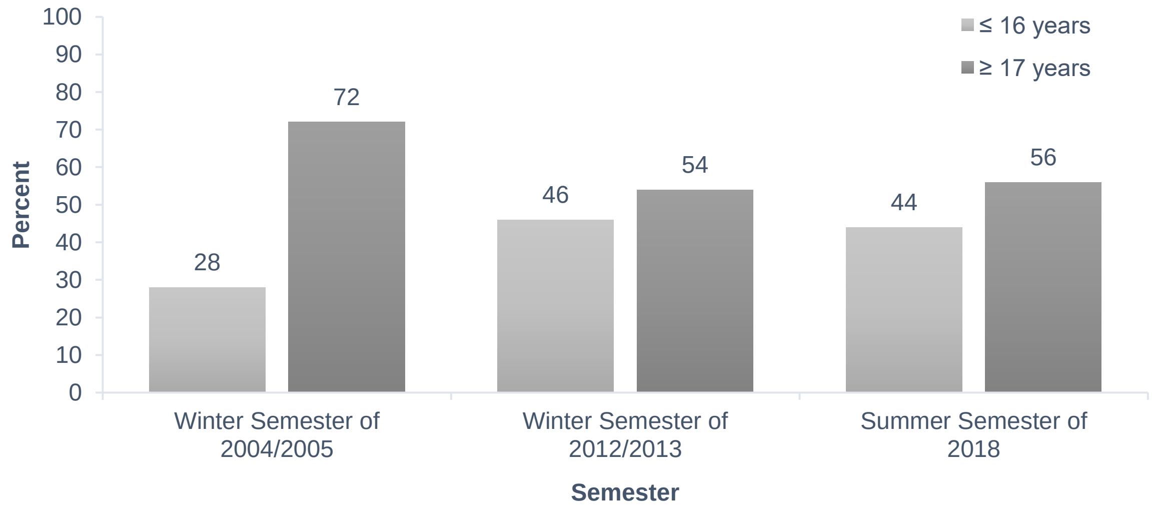
Research over the past 2 decades has provided extensive information on the typical characteristics of the group of active junior students in Germany. However, when comparing earlier studies with more recent ones, it is noticeable that some of these characteristics have been subject to marked changes over the years, while others have remained almost constant. The following section tries to describe what defines average German junior students based on key variables such as age, gender, school performance, subjects chosen for junior studies, and duration and extent of participation in junior study programs. Similar to the previous section, the findings have been compiled from several studies.

Age. Several studies have shown that German junior students are generally between 14 (Deutsche Telekom Stiftung, 2006, 2013, 2018a) and 19 years old (Solzbacher, 2006–2007, 2011), with their age distribution having shifted markedly downward since the early days of junior study programs in Germany. To illustrate this shift, Figure 7 provides the proportion of younger (≤ 16 years) and older (≥ 17 years) junior students as documented in the three data reports by the Deutsche Telekom Stiftung (Deutsche Telekom Stiftung, 2006, 2013, 2018a). It is apparent from this figure that the proportion of older junior students has decreased progressively over the years. In particular, at the time of the first data report by the Deutsche Telekom Stiftung (2006), approximately three quarters of all junior students (72 %) were at least 17 years old, whereas in total only about one quarter were 15 or 16 years old (23 %) or below the age of 14 (5 %; Deutsche Telekom Stiftung, 2006). A similar age distribution was reported in Solzbacher (2006–2007; see also Solzbacher, 2011). Here, the average age of junior students was 18 years (*SD* = 1.88; range from 9 to 26; Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011).

At the time of the second data report from the Deutsche Telekom Stiftung (2013) conducted in the winter semester of 2012/2013, the proportion of older junior students (≥ 17 years) had already dropped to nearly half (54 %; see Figure 7), while conversely the proportion of younger junior students (≤ 16 years) had grown to just under half (46 %; Deutsche Telekom Stiftung, 2013). Eventually, this trend toward a more balanced age distribution persisted, as shown in the most recent data report by the Deutsche Telekom Stiftung (2018a). Much the same as in the second data report, the proportion of older junior students (≥ 17 years) was slightly over half (55.6 %) and the proportion of younger junior students (≤ 16 years) was slightly under half (44.4 %; Deutsche Telekom Stiftung, 2018a).

Figure 7

Age Distribution of Junior Students in Germany from the Winter Semester of 2004/2005 to the Summer Semester of 2018



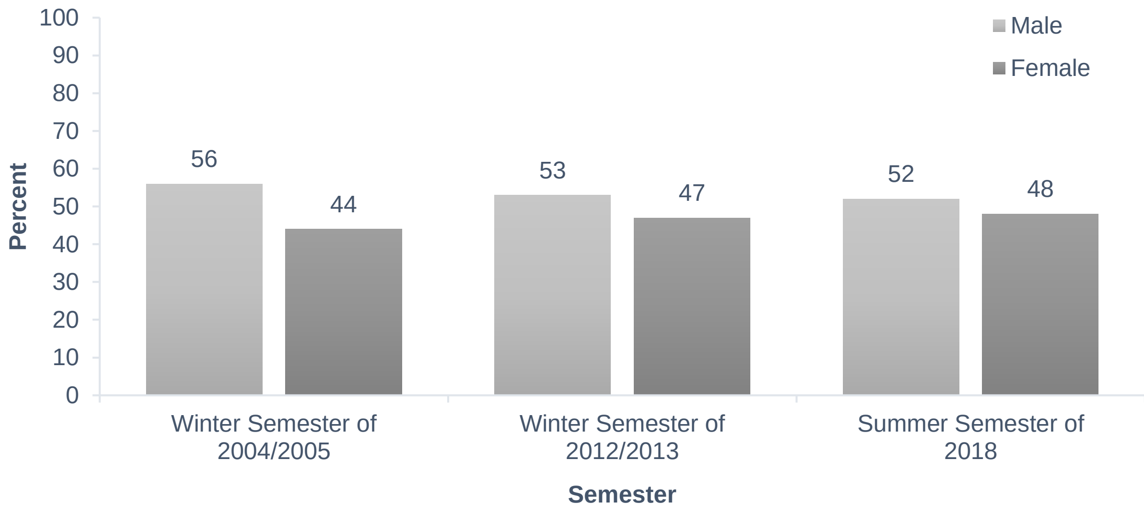
Gender. Currently, the gender ratio of junior students at German universities is roughly balanced (Deutsche Telekom Stiftung, 2013, 2018a; Kaden, 2016). Compared with the beginning of junior study programs in Germany in the early 2000s, this ratio has changed slightly. Figure 8 compares the proportion of female and male participants in German junior study programs across the three data reports from the Deutsche Telekom Stiftung (2006, 2013, 2018a). As can be seen in this figure, at the time of the first data report by the Deutsche Telekom Stiftung (2006) in the winter semester of 2004/2005, male junior students outnumbered female junior students with a ratio of 56 % to 44 % (Deutsche Telekom Stiftung, 2006). Male junior students also had a majority over female junior students in Solzbacher (2006–2007), with a ratio of about two thirds (60.73 %) to one third (38.37 %; three junior students [0.91 %] did not give gender information; Solzbacher, 2006–2007; see also Stumpf, 2011).

In contrast, the second data report by the Deutsche Telekom Stiftung (2013), dating back to the winter semester of 2012/2013, already documented an almost balanced gender ratio among German junior students with 47 % females and 53 % males (see also Figure 8; Deutsche Telekom Stiftung, 2013). This finding was confirmed quite accurately a short time later by Kaden (2016), who identified a gender ratio of 45.45 % female junior students to 52.73 % male junior students (nine respondents [1.81 %] did not give gender information) in a nationwide survey conducted between November and December 2015 at the Universität Leipzig in cooperation with the Deutsche Telekom Stiftung (Kaden, 2016; for more information on the survey, see Transition of Former Junior Students to Regular Studies).

Finally, the results of the third data report commissioned by the Deutsche Telekom Stiftung (2018a) showed that the ratio of female to male junior students had remained almost constant through the summer semester of 2018: Again, approximately half of all junior students were female (47.7 %), while the other half were male (52.3 %; Deutsche Telekom Stiftung, 2018a).

Figure 8

Ratio of Female to Male Junior Students in Germany from the Winter Semester of 2004/2005 to the Summer Semester of 2018



Grade Level. Most young people in Germany participate in junior study programs parallel to Grades 9 (Kaden, 2016) to 13 (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011; see also Stumpf, 2011). Analogous to junior students' average age, this distribution has shifted slightly downward in recent years. As more recent data indicate, most German adolescents now participate in junior study programs in Grades 9 through 12. In Kaden's (2016) nationwide survey, for example, about one tenth of those who responded (9.3 %) said that they had just entered Grade 9 when they began their junior studies, and about one third (29.4 %) said that they had just entered Grade 10. Another third (34.6 %) stated that they had been in Grade 11 when they started their junior studies, and only one fifth (21.2 %) stated that they had been in Grade 12 (note that the given percentages somehow do not add up to 100 %; Kaden, 2016).

Prior to the G8 reform, in contrast, most German junior students had taken academic courses parallel to Grades 10 through 13 (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011; see also Stumpf, 2011). This is evident, for example, from Solzbacher's (2006–

2007) cross-sectional data, according to which about one tenth of all junior students (10.3 %) had visited Grade 10 parallel to their junior studies, one quarter (23.6 %) had visited Grade 11, and clearly more than half (60.5 %) had visited Grades 12 or 13. Only a small minority (1.8 %) had been in Grade 9 parallel to their junior studies (see also Deutsche Telekom Stiftung, 2008; Solzbacher, 2011).

School Performance. Junior students in Germany typically demonstrate excellent performance in school. This is evidenced, for instance, in their good to very good school grades, especially in science subjects. Across all subject fields, the average school grade of German junior students is estimated to be somewhere around 1.77 (*SD* not provided; German grading system; Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011; see also Stumpf, 2011). Moreover, a notable proportion of junior students (16.0 %) skip at least one grade level during their school career (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011; see also Stumpf, 2011).

Besides their excellent grades, German junior students also show high levels of in- and out-of-school engagement. For example, in Solzbacher's (2006–2007) study, more than two thirds (67 %) claimed to have participated in at least one program concerned with promoting giftedness other than their junior studies (i.e., student competitions or exchange programs). In addition, more than one third (39 %) stated that they had been active as class or student representatives, while about half (45 %) stated that they had been involved in social or cultural projects (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011).

Subjects. Numerous studies have shown that subjects from the field of Mathematics, Natural, & Engineering Sciences are particularly popular among German junior students (Deutsche Telekom Stiftung, 2013, 2018a, 2018b; Kaden, 2016; Solzbacher, 2006–2007; see also Stumpf, 2011). In principle, this has not changed since the beginning of junior study programs in Germany, even though the relative proportion of junior students choosing subjects from this subject field has declined over the years as universities have opened up to other subjects as well.

A closer look at the statistics reveals that at the time of Solzbacher's (2006–2007) study, a clear majority of about three quarters of all junior students (72.3 %) were still enrolled in subjects in the field of Mathematics, Natural, & Engineering Sciences. The remaining one quarter had either chosen subjects from the field of Law, Business, & Social Sciences (19.0 %), from the field of Humanities (6.4 %), or from the field Others (2.2 %; Solzbacher, 2006–2007). Thus, the results of Solzbacher (2006–2007) are largely in line with those of the second data report from the Deutsche Telekom Stiftung (2013), which also showed that a clear majority of German junior students (65.9 %) studied subjects from the field of Mathematics, Natural, & Engineering Sciences, while only about one third (34.1 %) had chosen other subjects (not further specified; Deutsche Telekom Stiftung, 2013).

Compared to the second data report, the third data report by the Deutsche Telekom Stiftung (2018a, 2018b) indicated that the relative proportion of junior students choosing a subject from the field of Mathematics, Natural, & Engineering Sciences had fallen to less than half (46.6 %). At the same time, the results showed a considerable increase in the proportion of junior students studying subjects from the field Others (28.6 %). Furthermore, the proportion of those junior students choosing subjects from the field of Law, Business, & Social Sciences had remained constant at around one fifth (20.1 %), and the proportion of those junior students choosing subjects from the field of Humanities was again about one twentieth (4.7 %).

The decline observed over the years in German junior students' preference for subjects from the field of Mathematics, Natural, & Engineering Sciences might be explained not only by the expansion of the range of subjects offered by universities but also by the fact that the ratio of female to male junior students at German universities has changed (see above) and that subject preferences typically depend on gender. For example, as the statistics of the third data report by the Deutsche Telekom Stiftung (2018a) further indicated, male junior students were still frequently represented in the field of Mathematics, Natural, & Engineering Sciences (61.5 %) in the summer semester of 2018, while this was not even true for half of all female junior students (38.5 %). In contrast, there were far more female junior students (64.6 %) than male junior students (35.4 %) in the field of Humanities and in other subjects (55.8 % female versus 44.2 % male). Almost the same was true for the field of Law, Business, & Social Sciences, where 53.2 % of all junior students were female and 46.7 % of all junior students were male (Deutsche Telekom Stiftung, 2018a, 2018b).

Semesters. Gifted and motivated adolescents who attend academic courses at German universities while they are still in school usually enroll as junior students for a period of about 2 to 3 semesters (Deutsche Telekom Stiftung, 2008; Kaden, 2016; Solzbacher, 2006–2007; for additional information on junior students' period of participation in the junior study program at JMU Würzburg, see Stumpf, 2011). In Solzbacher's (2006–2007) nationwide study, for example, active junior students who participated in the survey reported having spent an average of between 1 and 3 semesters at university. Strikingly, nearly three quarters (70 %) had taken up their junior studies only in the current semester, while no more than one in seven (15 %) junior students had already been studying for 2 semesters. One tenth (10 %) had been studying for 3 semesters at the time of the study, and one twentieth (5 %) had been studying for 4 or more semesters (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007).

Kaden (2016), almost a decade later, reached similar results. At the time of her nationwide study, former junior students indicated having attended university for an average of 2 semesters. In addition, some junior students who had decided during their junior studies to study a second subject reported that they had been enrolled in a double degree for 1 to 2 semesters on average (Kaden, 2016).

Courses. Several studies suggest that German junior students take an average of one (Kaden, 2016) to three academic courses per semester (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011). Over the last few years, however, there has been a downward trend in the extent of participation among junior students: Prior to the widespread introduction of the G8 in Germany, junior students used to attend up to three courses per semester: Two fifths of German junior students (40.2 %) had attended one course per semester, one quarter (26.3 %) had attended two courses per semester, and well over one quarter (28.0 %) had attended three or more courses per semester (note that the given percentages somehow do not add up to 100 %; Solzbacher, 2006–2007).

In contrast, since the change in the school system, the average German junior student typically attends only one to two academic courses per semester. Approximately two thirds (62.9 %) attend one course per semester, one quarter (26.0 %) attend two courses per semester, and just about one tenth (11.1 %) attend three or more courses per semester (Kaden, 2016). For more than one third of all junior students (37.1 %), the corresponding time investment in their junior studies is between 5 and 8 hours per week. For another third (33.5 %), the weekly amount of time spent on study-related activities is more than 9 hours, while the rest (29.4 %) can manage with up to 4 hours per week (Kaden, 2016).

Certificates. A number of studies have come to the conclusion that, on average, German junior students earn at least one certificate in the course of their junior studies (Deutsche Telekom Stiftung, 2006, 2008, 2018a, 2018b; Kaden, 2016; Solzbacher, 2006–2007, 2011). Nevertheless, this number has declined in recent years – possibly also as a result of the change in the school system from the G9 to the G8. In detail, the first data report by the Deutsche Telekom Stiftung (2006) still reported that about two thirds of all German junior students took exams (61.0 %), of which about three quarters passed (72.2 %). Another third of German junior students participated in seminars (30.8 %); of these, about 80.9 % earned a certificate (Deutsche Telekom Stiftung, 2006). Given an average period of participation of about 2 to 3 semesters in junior study programs (see above; Deutsche Telekom Stiftung, 2008; Kaden, 2016; Solzbacher, 2006–2007), these results are compatible with the finding of Solzbacher (2006–2007) that German junior students used to obtain on average at least two certificates in the course of their junior studies (see also Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011).

About a decade later, in Kaden's (2016) nationwide study, only about half of all respondents (53.5 %) reported having obtained at least one certificate during their junior studies. Finally, the third data report by the Deutsche Telekom Stiftung (2018a) produced similar results: In this report, coordinators from only 15 universities (34.9 %) stated that more than half of their junior students acquired at least one certificate. Three universities (7.0 %) said that 40 % to 50 % of their junior students acquired at least one certificate, and four universities (9.3 %) said that 30 % to 40 % of their junior students acquired at least one certificate. Five universities (11.6 %) saw the criterion fulfilled in only 20 % to 30 % of the cases, and two universities (4.7 %) saw the criterion fulfilled in only 10 % to 20 % of the cases. No corresponding data were available for 14 universities (32.6 %; Deutsche Telekom Stiftung, 2018a, 2018b).

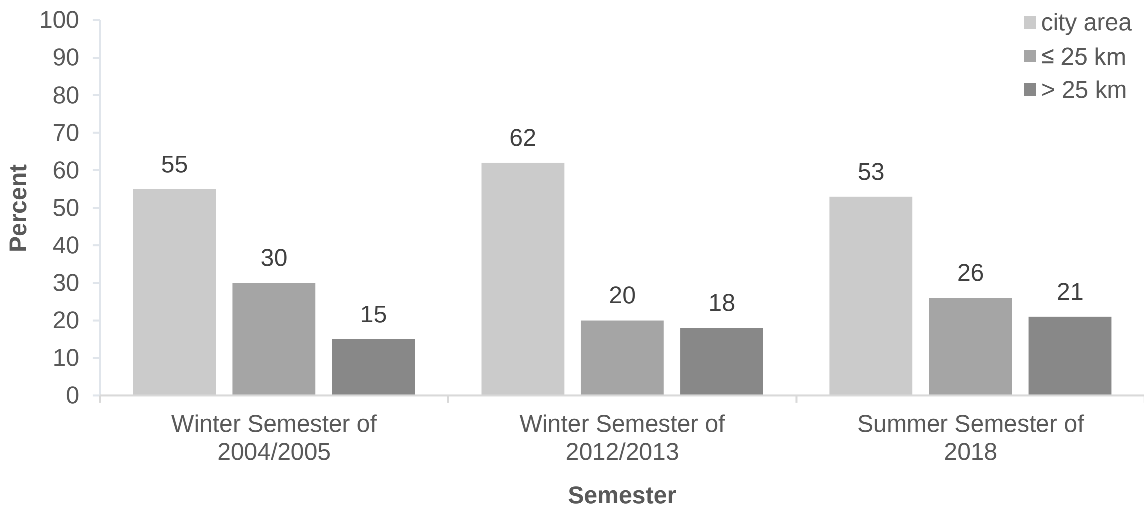
Dropouts. Dropout rates from junior study programs in Germany are relatively low. In fact, much of the available literature indicates that no more than one fifth of all active participants leave their junior studies prematurely (i.e., before the end of the semester; Deutsche Telekom Stiftung, 2013, 2018a; Kaden, 2016). For example, the second data report by the Deutsche Telekom Stiftung (2013) found that dropout rates were below 10 % at nearly two thirds of all German universities (63.2 %) and no higher than between 10 % and 20 % at about one fifth of all German universities (21.1 %). Only about one tenth of the universities reported dropout rates above 20 % (15.8 %; Deutsche Telekom Stiftung, 2013). The results of the second data report by the Deutsche Telekom Stiftung (2013) are in line with Kaden (2016), who documented that approximately nine out of 10 adolescents (85.8 %) successfully complete their junior studies, while only a small number (14.2 %) quit their junior studies before the end of the semester. Among the most frequently cited reasons for dropping out of junior studies were, for instance, high levels of stress, time constraints, upcoming Abitur examinations, and excessive demands in the chosen subjects at university (Deutsche Telekom Stiftung, 2013, 2018a; Kaden, 2016).

Educational Background. German junior students predominantly come from families with high levels of education (Deutsche Telekom Stiftung, 2008, 2011; Solzbacher, 2006–2007, 2011; for additional information on the educational background of junior students at JMU Würzburg, see Stumpf, 2011). For example, Solzbacher (2006–2007) documented that of all active German junior students, about three quarters (71.3 %) had at least one parent with a university degree and that for more than half (58.8 %) both parents had a university degree. What is more, about one quarter of all active German junior students (23.3 %) reported that at least one of their parents held a doctoral degree (see also Deutsche Telekom Stiftung, 2008; Solzbacher, 2011).

Commutes. The commutes of German junior students to those higher education institutions where they are enrolled for their junior studies vary greatly in length (Deutsche Telekom Stiftung, 2006, 2013, 2018a; Solzbacher, 2006–2007; for additional information on the commutes of junior students at JMU Würzburg, see Stumpf, 2011). Figure 9 illustrates the proportion of junior students with short (city area), medium (≤ 25 km), and long (> 25 km) commutes based on the findings of the three data reports by the Deutsche Telekom Stiftung (Deutsche Telekom Stiftung, 2006, 2013, 2018a). As can be seen from this figure, the distribution of junior students across their commuting area has changed little over the years. Especially in the first and the third data report from the Deutsche Telekom Stiftung (2006, 2018a), the statistics looked similar: Slightly more than half of all junior students came from the city area (55 % in the first and 53 % in the third data report), about one quarter traveled medium commutes (≤ 25 km; 30 % in the first and 26 % in the third data report), and about one fifth traveled long commutes (> 25 km; 15 % in the first and 21 % in the third data report; Deutsche Telekom Stiftung, 2006, 2018a; see also Solzbacher, 2006–2007). A slight deviation from this pattern was found in the second data report by the Deutsche Telekom Stiftung (2013): In the winter semester of 2012/2013, almost two thirds of all junior students (62 %) came from the city in which the university was located, which was slightly higher than in the other two data reports. At the same time, only one fifth of the junior students (20 %) traveled medium commutes (≤ 25 km) and about one fifth of the junior students (18 %) traveled long commutes (> 25 km; Deutsche Telekom Stiftung, 2013).

Figure 9

Commuting Area of Junior Students in Germany from the Winter Semester of 2004/2005 to the Summer Semester of 2018



3.3 Junior Study Programs in Neighboring Countries

Having looked in detail at junior study programs in Germany in the previous subchapter, the focus of the following subchapter is on neighboring countries, especially on Austria and the German-speaking regions of Switzerland. Analogous to the structure of the previous subchapter, the first section outlines the legal basis, prevalence, and organization of junior study programs in Austria and presents the results of an evaluation report conducted among Austrian junior students. The second section then provides corresponding information on junior study programs in Switzerland.

3.3.1 Junior Study Programs in Austria

In Austria, junior study programs are commonly known by the term “Schüler(innen) an die Hochschulen” [“Students to Universities”] (Young Science, n.d.). Similar to its German counterpart, the program “Schüler(innen) an die Hochschulen” offers pupils the possibility to attend regular courses at university and to have their course examinations credited toward their regular studies after completing their Matura[4]. Participation in the program “Schüler(innen) an die Hochschulen” is open to all age groups (Young Science, 2020b). The participants are exempt from the tuition fees that are normally charged for extraordinary students in Austria (Fritz, 2013).

Legal Bases of Junior Study Programs in Austria. The program “Schüler(innen) an die Hochschulen” was introduced in Austria as a pilot project in the winter semester of 2000/2001 on the initiative of two organizations: the Österreichisches Zentrum für Begabtenförderung und Begabungsforschung (ÖZBF) [Austrian Research and Support Center for the Gifted and Talented] and the Österreichisches Bundesministerium für Bildung, Wissenschaft und Kultur [Austrian Federal Ministry of Education, Science, and Culture],

[4] Austrian equivalent of the German Abitur.

which is now called the Österreichisches Bundesministerium für Bildung, Wissenschaft und Forschung [Austrian Federal Ministry of Education, Science, and Research] (Österreichisches Bundesministerium für Bildung, 2021; Rosner, 2003). Over the years, the program “Schüler(innen) an die Hochschulen” has become an important measure of gifted education in Austria. From a school perspective, it is legally based on an article from the Österreichisches Schulunterrichtsgesetz (n.d.) [Austrian School Act] regulating the “possibility of being absent from school for important reasons”. According to a decree issued in 1998 by the former Österreichisches Bundesministerium für Unterricht und kulturelle Angelegenheiten [Austrian Federal Ministry of Education and Cultural Affairs], this article should be interpreted generously and can be applied to measures of gifted education, such as junior study programs (Rosner, 2003; Young Science, 2020a). From the perspective of higher education institutions, the program “Schüler(innen) an die Hochschulen” is grounded in an article of the Österreichisches Hochschulgesetz (2005) [Austrian Higher Education Act], which defines that the admission to extraordinary studies demands no more than “compliance with possible requirements specified in the curriculum of a university course” (Young Science, 2020a). The requirement of a minimum age of 15 years for admission to extraordinary studies, which was to be found in a previous version of the same article (see Rosner, 2003), seems to have been dropped with the successful establishment of junior study programs in Austria.

Prevalence of Junior Study Programs in Austria. Currently, there are a total of 27 universities in Austria accepting adolescents as junior students at their institutions, among them the Universität Wien, Karl-Franzens-Universität Graz, and Leopold-Franzens-Universität Innsbruck (for a complete list of the participating institutions, see the Young Science Center website at https://youngscience.at/de/angebote/schuelerinnen-an-die-hochschulen; Young Science, n.d.). Furthermore, in addition to these national universities, Austrian pupils also have the possibility to apply for the junior study program at the German FernUniversität in Hagen, which is offered as a distance learning program (Young Science, n.d.).

Organization of Junior Study Programs in Austria. Different from Germany, the organization of the Austrian program “Schüler(innen) an die Hochschulen” is regulated nationally. For almost 20 years – from the initiation of the program in 2000 until the end of 2019 – it was coordinated by the ÖZBF. At the beginning of 2020, the organization of the program was transferred from the ÖZBF to Young Science, an initiative that offers Austrian schools a wide range of opportunities to make contact and to cooperate with universities and research institutions (Österreichischer Austauschdienst, 2018; Young Science, 2020a). The organization of the program “Schüler(innen) an die Hochschulen” includes, for example, the central collection of application documents as well as the nomination of suitable candidates at their desired institutions (Young Science, 2020b).

Characteristics of Junior Students in Austria. Comprehensive information on the typical characteristics of the group of Austrian junior students can be found in an evaluation report from Fritz (2013). The aim of the evaluation report was – comparable to the nationwide German study by Solzbacher (2006–2007) – to collect the experiences and impressions of Austrian junior students during their active participation in the program “Schüler(innen) an die Hochschulen”. In total, Fritz (2013) invited 71 junior students who were enrolled in the program “Schüler(innen) an die Hochschulen” in the summer semester of 2012 via e-mail to partake in an online survey; of these, 67 junior students could still be reached at their provided e-mail addresses. Exactly 50 junior students (20 female and 29 male; one respondent did not provide gender information) answered the survey, constituting a response rate of 70.4 %. At the time of the survey, the respondents were 17.2 years old on average (*SD* = 1.4; range from 13 to 20). About two thirds reported attending Austrian general high schools at the time of the report, roughly corresponding to the German Gymnasium (Weiss, 2014), and about one third reported attending Austrian vocational high schools. Unfortunately, the evaluation report by Fritz (2013) did not specify the grade levels which the junior students were attending at the time of the survey (see Fritz, 2013).

Overall, the results of Fritz's (2013) evaluation report seem to be largely consistent with those obtained from studies that have explored the characteristics and experiences of German junior students (e.g., Deutsche Telekom Stiftung, 2006, 2008, 2011, 2018a, 2018b; Solzbacher, 2006–2007, 2011). For example, Austrian participants in the program "Schüler(innen) an die Hochschulen" showed high levels of in- and out-of-school engagement, much like their German counterparts. In detail, exactly two fifths (40 %) reported having participated in student competitions besides their participation in the program "Schüler(innen) an die Hochschulen", and exactly one fifth (20 %) reported having taken part in other talent development courses. Conversely, only about one third of the respondents had not participated in other measures to promote giftedness. Exactly one tenth of those who responded (10 %) had skipped at least one grade level (Fritz, 2013).

Also similar to Germany, Fritz's (2013) evaluation report revealed the finding that subjects from the field of Mathematics, Natural, & Engineering Sciences were particularly popular among Austrian junior students, albeit with a smaller lead over the other subject fields. In detail, more than one third of those who took part in the online survey indicated to be studying a subject in the field of Mathematics, Natural, & Engineering Sciences, while about one quarter each indicated to be studying a subject in the field of Humanities (23 %) or in the field of Law, Business, & Social Sciences (23 %). Unfortunately, Fritz (2013) did not provide information on the subject fields of the remaining about one fifth of Austrian junior students.

At the time of the evaluation report, the respondents reported having participated in the program "Schüler(innen) an die Hochschulen" for between 1 and 4 semesters, roughly corresponding to the number of semesters that German junior students typically spend at university. Specifically, nine respondents (21.4 %) reported that they were in their first semester of study, and 13 respondents (31.0 %) reported that they were in their second semester. Another 12 respondents (28.6 %) had been studying for 3 semesters, while only eight respondents (19.0 %) had been studying for 4 semesters (Fritz, 2013).

Finally, Fritz's (2013) evaluation report yielded the finding that, like German junior students, Austrian participants in the program "Schüler(innen) an die Hochschulen" predominantly come from highly educated families. Concretely, two fifths of those who responded (40 %) indicated that both of their parents had obtained a university degree as their highest educational qualification (Fritz, 2013).

3.3.2 Junior Study Programs in Switzerland

Compared to Germany and Austria, junior study programs have spread rather slowly in Switzerland. Currently, there are exactly four universities in the German-speaking regions which offer young people the possibility to attend academic courses as junior students and to earn credits that can later be transferred to their regular studies. One of these universities is still in its pilot phase (see below).

Legal Bases of Junior Study Programs in Switzerland. In Switzerland, the federal government and the cantons have parallel powers in the area of higher education. However, since most universities were established by the cantons, they are subject to cantonal law (Kamm Jehli, 2009). In 2014, for example, the junior study program at the Universität Bern was made possible by a letter from the Bildungs- und Kulturdirektion des Kantons Bern [Department of Education and Culture of the Canton of Bern] and a decision by its rectorate (Bildungs- und Kulturdirektion des Kantons Bern, n.d.; Kamm Jehli, 2009; Schulleitung des Gymnasiums Kirchenfeld, 2017).

Prevalence of Junior Study Programs in Switzerland. The first junior study program in Switzerland was initiated in 2005 at the Universität Basel in cooperation with a local Swiss Gymnasium (Hackländer, 2020; Kamm Jehli, 2009). After a successful pilot phase in which initially only pupils from the regions of Basel-City and Basel-Country had been allowed to participate, the Universität Basel decided in 2009 to expand and continue the junior study program on a permanent basis. Today, the junior study program at the Universität Basel is open to intellectually gifted adolescents from a total of four cantons in the northwestern regions of Switzerland (Hackländer, 2020).

The number of adolescents participating in the junior study program at the Universität Basel has increased steadily since its initiation in 2005 (Hackländer, 2020). While there were only 20 active junior students in 2010, directly after the expansion of the program, this number had already more than doubled to a total of 43 active junior students by 2015. Then, in 2019, the number of pupils actively participating in the gifted education measure was 68 (Hackländer, 2020). To date, the Universität Basel has recorded an overall number of 419 junior students (Hackländer, 2020).

Junior students at the Universität Basel can choose between more than 25 subjects from six departments. According to Hackländer (2020), subjects from the Department of Science, the Department of Medicine, and the Department of Humanities & Social Sciences are particularly popular. Conversely, subjects from the Department of Business & Economy, the Department of Law, the Department of Psychology, and the Department of Theology are chosen less frequently (cf. Universität Basel, n.d.). Unfortunately, Hackländer (2020) does not provide concrete information on the distribution of participants across the different departments.

Over the last 15 years, several Swiss higher education institutions have followed the successful example of the Universität Basel and have established their own junior study programs (Werner, 2018). The Universität Bern, for instance, has opened its doors to adolescents who are in the last 2 years of schooling at the Swiss Gymnasium. They are allowed to attend one or two regular courses at the university as well as to take the corresponding exams. The credits they earn can later be transferred to regular studies in the same subject field (Gymnasium Neufeld, n.d.). Another Swiss university that has followed the successful example of the Universität Basel is the Universität Luzern, which introduced its junior study program in 2009. Adolescents who participate in the program are allowed to take two courses per semester. They can choose between subjects from all departments, that is, the Department of Theology, the Department of Humanities & Social Sciences, the Department of Law, and the Department of Economics & Management (Fischer, 2018). Finally, at the Universität Zürich, a four-year pilot project is currently running that allows pupils to attend regular academic courses for 1 to 4 semesters to deepen and expand their knowledge. The project comprises selected modules from the Department of Theology, the Department of Law, the Department of Business, Economics, & Informatics, the Department of Arts & Social Sciences, and the Department of Science (Universität Zürich, n.d.). By the end of 2020, that is, about halfway through the project, a total of 80 gifted adolescents from the canton of Zürich had been involved. The number of cooperating schools at the time was 20 (Huber, 2021).

Organization of Junior Study Programs in Switzerland. Just like in Germany, the organization of junior study programs in Switzerland is regulated in a decentralized manner; that is, the universities have to organize their junior study programs at their own discretion and on their own responsibility. A probable reason for this might be that the level of implementation and public awareness of junior study programs in Switzerland is not yet high enough to prompt a call for standardization of the project.

Characteristics of Junior Students in Switzerland. In contrast to Germany and Austria, little information is available on the characteristics of junior students in Switzerland.

Initial results can be taken from an interim evaluation that was conducted in the winter semester of 2020/2021 as part of the pilot project for the junior study program at the Universität Zürich. The interim evaluation showed that the majority of adolescents who took part in the pilot project were 17 years old and attended either Grade 6 of the Swiss Long-Term Gymnasium or Grade 4 of the Swiss Short-Term Gymnasium, corresponding to Grades 12 and 13 of the German Gymnasium, respectively (Huber, 2021). The results of the evaluation further suggested that of the available modules, junior students tended to choose Neuroinformatics most frequently, followed by Law, Astrophysics, Journalism, and Political Sciences (Huber, 2021).

3.4 Transition of Former Junior Students to Regular Studies

Compared to the large body of literature that has documented the typical characteristics, achievements, and experiences of (German) junior students during their active participation in the program, little evidence is available to date on how former junior students develop after their schooling. Preliminary evidence can be found in studies that have prospectively investigated the plans of junior students to undertake regular studies directly following their Abitur (e.g., Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007). Moreover, some studies have examined how former participants in junior study programs manage the transition from school to university and how their experiences compare to those of regular first-semester students (e.g., Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). The following subchapter describes insights from both of these approaches.

Prospective Studies. As outlined above, participation in junior study programs is assumed to have positive effects on young people's career orientation (Deutsche Telekom Stiftung, 2011; Stumpf & Schneider, 2008). For example, as part of the program, junior students gain insight into their intended field of study as well as into studying in general and, as a result, are better able to assess whether and in which field of study they would like to take up regular studies after their Abitur (Deutsche Telekom Stiftung, 2011; Stumpf & Schneider, 2008). To investigate this beneficial effect of junior study programs, some of the studies which had their actual focus on the characteristics and experiences of junior students during their participation in the program have also asked prospective questions about their education-related plans after school.

For example, in her nationwide study, Solzbacher (2006–2007) asked active junior students whether they intended to continue studying right after finishing Gymnasium. Overall, their responses revealed a clear picture: The large majority of the junior students (80.1 %) planned to pursue regular studies directly following their Abitur, either in exactly the same subject that they had chosen for their junior studies (51.7 %) or in a different subject (33.2 %). Only an extremely small group (0.9 %) intended to do vocational training first and to study afterward. About one fifth of those who responded (19.0 %) felt that they were still undecided about their future plans at the time of the survey. None of the respondents (0.0 %) definitely did not want to take up regular studies after their Abitur (multiple choice; Solzbacher, 2006–2007). When asked where they planned to take up their regular studies, more than two fifths of the junior students (43.8 %) somewhat surprisingly answered that they intended to take up regular studies at a university other than the one at which they had previously pursued their junior studies. The reasons for their intentions were manifold, with the geographical location, the attractiveness, and the reputation of the university playing particular roles (Solzbacher, 2006–2007).

In the fourth report on the junior study program at the Technische Universität Dresden, Katzarow and Hübner (2011) presented similar prospective findings: Here, too, almost all active junior students (90.9 %) intended to pursue regular studies immediately after finishing

Gymnasium, while only a small number (9.1 %) were hesitant about their future education-related plans. In contrast to the results of Solzbacher (2006–2007), however, just one fifth of those who took part in the report (19.6 %) planned to change institutions after completing Gymnasium, whereas over one third (37.0 %) planned to continue their regular studies at the Technische Universität Dresden. The remaining two fifths (43.5 %) had not yet made a decision about their future place of study at the time of the report (Katzarow & Hübner, 2011). Almost half of the respondents (42.9 %) agreed with the statement that their participation in the junior study program at the Technische Universität Dresden had exerted an influence on their intended subject choice in their regular studies. They were of the opinion that their participation in the gifted education measure had either reinforced their interest in their intended subject or steered them away from their resolve (Katzarow & Hübner, 2011).

In the fifth report on the junior study program at the Technische Universität Dresden, Katzarow and Grönholdt (2014) were again able to roughly replicate the earlier findings: While exactly as in the preceding report, about one tenth of all active junior students (10.6 %) were still undecided about their future plans, the vast majority (88.5 %) planned to continue studying directly after their school years. Only a negligible proportion (0.8 %) did not intend to take up regular studies after their Abitur. Additionally, more than one third each planned to stay at the Technische Universität Dresden (36.3 %) or to change university (37.8 %) for their regular studies. The remaining one quarter (25.9 %) had not yet made a decision in this regard at the time of the report (Katzarow & Grönholdt, 2014).

Studies on Former Junior Students' Transition to Regular Studies. As mentioned in the introduction, there are no studies available to date that have investigated the long-term educational (and professional) development of former junior students after their participation in the program. An exception to this rule is the report by Halbritter (2008a), which uses a total of seven individual cases as examples to describe the long-term educational trajectories of former junior students at the Universität zu Köln. In detail, at the time of the report, one former junior student at the Universität zu Köln had just started a doctoral degree, another former junior student had just successfully entered professional life, and the remaining five former junior students were about to complete their regular studies (Halbritter, 2008a). However, due to the small number of cases and the fact that Halbritter (2008a) explicitly referred to former junior students for whom the junior study program at the Universität zu Köln had opened up new "perspectives for a meaningful life" (Halbritter, 2008a, p. 55), the report does not allow for generalizations.

Instead of examining the long-term educational (and professional) trajectories of former junior students, a number of studies have looked more closely at the young people's transition from school to regular studies after their Abitur. For example, Stumpf et al. (2011) conducted semi-standardized telephone interviews with a group of former junior students at JMU Würzburg who had obtained their Abitur about one year earlier. The aim of the interviews was to find out whether participation in the junior study program at JMU Würzburg had affected former participants' subject choice in their regular studies as well as how they evaluated their participation in the gifted education measure in retrospect. In total, Stumpf et al. (2011) interviewed 24 former junior students; of this total, 23 former junior students (95.8 %) were in their regular studies at the time of the interviews. While almost half (47.8 %) had continued to study the subject from their junior studies, about one fifth (21.7 %) had chosen a related subject, and approximately one third (30.4 %) had chosen a completely different subject.

With regard to their transition from school to university, almost all former junior students (87.0 %) stated that participation in the junior study program at JMU Würzburg had facilitated their subject choice in their regular studies (Stumpf et al., 2011). In addition, exactly three quarters of those who were interviewed (75.0 %) reported having experienced advantages over other first-semester students at the start of their regular studies. Specifically, just over half of the former junior students (52.0 %) confirmed that their learning and working strategies had improved as a result of their participation in the gifted education measure. According to Stumpf et al. (2011), those who disagreed with the statement often ascribed their answers to so-called ceiling effects (e.g., “I already had good learning and working strategies before participating in the junior study program.”). A rather remarkable outcome of Stumpf et al.’s (2011) telephone interviews was that the former junior students unanimously (100.0 %) affirmed that, from their current point of view, they would take part in the junior study program at JMU Würzburg again and would recommend participation in the program to others. With an average grade of 1.4 (*SD* not provided; German grading system), their retrospective evaluation of the junior study program at JMU Würzburg was encouragingly positive (Stumpf et al., 2011).

Another cursory examination of the transition of former junior students from school to university can be found in the fifth report on the junior study program at the Technische Universität Dresden by Katzarow and Grönholdt (2014). Much like Stumpf et al. (2011), the intention of Katzarow and Grönholdt (2014) was to learn whether former junior students had already enrolled as regular students and whether their participation in the junior study program had influenced their subject choice in their regular studies (Katzarow & Grönholdt, 2014). To this end, Katzarow and Grönholdt (2014) surveyed a total of 204 former participants in the junior study program at the Technische Universität Dresden via e-mail; of these, 31 former participants were no longer available at their provided e-mail addresses; of the remaining 173 former participants, Katzarow and Grönholdt (2014) received 51 responses, corresponding to a return rate of 29.5 %. Approaching the matriculation office of their higher education institution, Katzarow and Grönholdt (2014) were able to find out that 50 of the 204 former junior students contacted for the survey (24.5 %) had taken up regular studies at the Technische Universität Dresden. Of these, 32 (64.0 %) had started their regular studies in the same or in a related subject as their junior studies; the rest (36.0 %) had started their regular studies in a completely unrelated subject (Katzarow & Grönholdt, 2014).

In the actual e-mail survey, Katzarow and Grönholdt (2014) asked the former junior students in an open response format whether they felt that their participation in the junior study program had influenced their subject choice in their regular studies. Among the most frequent responses was that participation in the junior study program had either confirmed (42.6 %) or disconfirmed (29.6 %) former junior students' intended subject choice. In contrast, about one third of those who responded (27.8 %) reported that participation in the junior study program had not influenced their subject choice at all (Katzarow & Grönholdt, 2014). Finally, Katzarow and Grönholdt (2014) wanted to know from the former participants which experiences during their junior studies they considered most important from their current point of view. Given the diversity of responses to this question, Katzarow and Grönholdt (2014) refrained from a quantitative analysis. The most frequent answers included "getting to know everyday student life", "assuming personal responsibility", "reducing fear of studying", "gaining insight into differences between school and university", and "facilitating transition from school to university" (Katzarow & Grönholdt, 2014).

About two years later, Stumpf and Gabert (2016) were the first to conduct a more extensive follow-up of the educational choices of former junior students after their Abitur. For this purpose, they invited a total of 280 young adults who had attended the junior study program at JMU Würzburg to fill in an online questionnaire. 162 former junior students (65 female and 97 male) completed the questionnaire, resulting in a response rate of 57.9 %. At the time of the follow-up, the former junior students were on average 21.94 years old (*SD* = 2.41; range from 18 to 36). Their average Abitur grade was 1.44 (*SD* = 0.42; German grading system; Gabert, 2014; Stumpf & Gabert, 2016). The results of the follow-up revealed that the vast majority of the former junior students (80.2 %) had directly taken up regular studies after their school years. Moreover, six former junior students (3.7 %) had opted to do voluntary work and 15 former junior students (9.3 %) had done military/civilian service. Having completed his Diplom[5] as a junior student, one respondent (0.6 %) was able to directly begin his doctoral studies upon leaving Gymnasium. Two former junior students (1.2 %) had started vocational training following their Abitur, and about one twentieth of those who responded (4.9 %) had pursued other activities (e.g., jobs, internships, stays abroad). At the time of the follow-up, almost all former junior students (96.3 %) had enrolled in their regular studies, with approximately half (43 %) having completed at least part of their regular studies at JMU Würzburg. About half of the former junior students (46 %) had continued to study the subject from their junior studies in their regular studies (Stumpf & Gabert, 2016).

Besides the education-related choices of the former junior students, Stumpf and Gabert (2016) were also interested in possible effects that participation in the junior study program might have had on the young adults' transition from school to university. About four fifths of the former junior students (78.7 %) stated that participation in the junior study program had influenced their subject choice. In addition, more than two thirds (69.3 %) reported having experienced advantages over other first-semester students at the start of their regular studies, which they attributed primarily to their more profound domain knowledge (32.5 %) as well as to their familiarity with academic processes (24.8 %; Gabert, 2014; Stumpf & Gabert, 2016). The respondents considered the greatest benefits from their participation in the junior study program as having acquired knowledge (92.6 %), having gained independence (80.7 %), and having increased their self-confidence (69.8 %). Furthermore, junior studies had obviously helped the former junior students choose their subjects (76.9 %) and obtain orientation at university (74.2 %). In terms of their learning and work strategies, the respondents observed

[5] The Diplom is a higher education qualification that is mainly obtained either at German universities or at equivalent institutions of higher education (European Education and Culture Executive Agency, 2017). It has been widely replaced by bachelor's and master's degrees in recent years.

rather weak effects, with about 15 % not observing any effect at all (Stumpf & Gabert, 2016). On the whole, the retrospective evaluation of the junior study program at JMU Würzburg by the former junior students was positive, with an average grade of 2.0 (*SD* = 1.0) on a 5-point Likert scale (1 = *highly satisfied* to 5 = *highly dissatisfied*).

The most recent study on former junior students' transition from school to university was conducted by Kaden (2016). The declared goal of the study was to gain generalizable insights into the role that junior study programs play in the subsequent academic careers of former participants. In addition, the study aimed to assess external and internal factors that influence former junior students' subject choice and their choice of university after their Abitur. In total, 514 (225 female and 261 male; 28 respondents did not state their gender or did not answer the associated question) former junior students took part in the study. At the time of their response, the former junior students were between 15 and 33 years old (*M* and *SD* not given and not predictable from the data; Kaden, 2016). The results of the study indicated that more than two thirds of the former junior students (69.5 %) had taken up their regular studies directly after finishing Gymnasium. In contrast, 44 former junior students (8.6 %) had done military/civilian service or voluntary work following their Abitur, and 11 former junior students (2.1 %) had started vocational training; 102 individuals (19.8 %) had pursued other activities (e.g., jobs, internships, stays abroad). At the time of the follow-up, about one fifth of the former junior students (19.8 %) had obtained a bachelor's degree and nearly one tenth (8.0 %) had obtained a master's degree. Four former junior students (0.9 %) had obtained a Diplom, 17 former junior students (3.9 %) had completed their State Examination, and four former junior students (0.9 %) had obtained a doctoral or other degree. In contrast, two thirds of the former junior students (66.6 %) had not yet finished their studies at the time of the survey (Kaden, 2016).

Just about one third of the former junior students (35.5 %) had remained for their regular studies at the institution where they had also pursued their junior studies. For them, personal contacts with friends and proximity to their hometown were decisive factors that had influenced their decisions. Similarly, it was important to them that the certificates they had obtained in their junior studies could be accredited to their regular studies. On the contrary, for those who had changed their institution after their junior studies, the tradition and reputation of the university as well as high rankings of the university in their intended subjects were important (Kaden, 2016). Approximately half of the former junior students (46.5 %) had continued to study the subject from their junior studies in their regular studies, while the other half (53.5 %) had decided to change subjects. Interestingly, former junior students had changed their subjects significantly less often if their motivation to participate in the junior study program had been to shorten the duration of their regular studies (33.8 % versus 56.8 %), if they had received personal support from professors or lecturers during their junior studies (43.2 % versus 56.9 %), or if they had earned credits during their junior studies (44.6 % versus 63.4 %). In contrast, former junior students had changed their subjects more often if their motivation to participate in the junior study program had been to advance their career orientation (61.2 % versus 44.0 %; Kaden, 2016).

4 Research Issues

As the theoretical and the practical background of the present thesis have been set out in the previous chapters, the following chapter now turns to a more precise framing of the two central research issues: The focus is first on Research Issue 1, which was essentially conceived as a precursor to Research Issue 2 and aims to find out what the long-term educational trajectories of former junior students look like after their school years. In order to more fully describe the scope of Research Issue 1, the first subchapter picks up individual aspects from the overview of junior study programs in Germany (see Practical Background) and identifies a number of different research questions that have guided the design of the follow-up of former junior students at JMU Würzburg.

Subsequently, Research Issue 2 is specified in more detail, which seeks to empirically test the extent to which the longitudinal data collected in the follow-up of former junior students as well as in the selection process for the junior study program at JMU Würzburg can be used to validate the structure of Preckel et al.'s (2020) TAD framework in academic domains. More specifically, in the second subchapter, the structural assumptions of Preckel et al.'s (2020) TAD framework (see Theoretical Background) are combined with relevant insights into the process of talent development in individual academic disciplines, such as Mathematics and Psychology, and, on this basis, concrete hypotheses regarding possible predictors and indicators of different talent development stages are proposed.

4.1 Research Issue 1: Follow-Up of Former Junior Students at JMU Würzburg

Previous research on junior study programs at German universities has focused primarily on examining the conditions, achievements, and experiences of active junior students (e.g., Deutsche Telekom Stiftung, 2006, 2008, 2011, 2018a, 2018b; Solzbacher, 2006–2007, 2011). Contrary to that, little is known so far about the academic (and professional) development of former junior students following their school years. Preliminary evidence is provided, for instance, by studies that have prospectively examined what activities junior students typically plan to pursue directly after their Abitur (e.g., Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007). In addition, some studies have looked into how former junior students navigate the transition from Gymnasium to university, particularly in comparison to regular first-semester students (e.g., Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). Although both of these approaches have offered important insights into the immediate effects of junior study programs on the educational choices and experiences of former participants, no conclusions can yet be drawn about the long-term impacts of the gifted education measure on former junior students' academic development.

Research Issue 1 pursues the goal of documenting what the educational trajectories of former junior students look like in the years after they have finished school, especially in the course of their regular studies. To address this issue, a comprehensive follow-up was conducted among a group of young adults who had participated in the junior study program at JMU Würzburg between the winter semester of 2004/2005 and the summer semester of 2011. The follow-up questionnaire contained sections on the academic credentials of former junior students as well as on their professional careers. In other sections of the follow-up questionnaire, it was explored how the young adults evaluated their participation in the junior study program in retrospect and what their current life situation was like. Furthermore, information was collected on some selected psychological characteristics of the former junior students. The following sections describe general considerations that went into the design of the follow-up questionnaire.

Academic Credentials of Former Junior Students. Previous research on junior study programs in Germany has consistently revealed that those adolescents who participate in the gifted education measure constitute a particularly high-performing group (e.g., Deutsche Telekom Stiftung, 2006, 2008, 2018a, 2018b; Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007, 2011; Stumpf, 2011; Stumpf & Gabert, 2016). First, this can be seen from their school performance: Junior students generally achieve above-average grades in school, especially in science subjects (Solzbacher, 2006–2007). In addition, more than one in six junior students indicate having skipped at least one grade level in their school careers (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011). At the same time, junior students also typically show high levels of in- and out-of-school engagement, with almost half of them either acting as class or student representatives or engaging in social or cultural projects (Solzbacher, 2006–2007). About two thirds of all junior students usually report having participated in one or more gifted education programs other than their junior studies, such as student competitions or exchange programs (Solzbacher, 2006–2007).

Second, the excellent performance of junior students is also evident in a higher education context: For example, they typically enroll in junior study programs for a period of 1 to 3 semesters (Deutsche Telekom Stiftung, 2008; Kaden, 2016; Solzbacher, 2006–2007, 2011; Stumpf, 2011), taking an average of one to three courses every 6 months (Deutsche Telekom Stiftung, 2008; Kaden, 2016; Solzbacher, 2006–2007, 2011). At the same time, most junior students invest more than 5 hours per week in study-related activities (Kaden, 2016), missing a weekly average of 3 hours of school which they have to compensate for on their own (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011).

Furthermore, the majority of junior students earn at least one certificate in the course of their junior studies (Deutsche Telekom Stiftung, 2006, 2008; Kaden, 2016; Solzbacher, 2006–2007, 2011), although this rate appears to have somewhat declined in recent years: For instance, in the most recent data report by the Deutsche Telekom Stiftung (2018a), which was presented in the summer semester of 2018, only about one in three universities reported that the majority of their junior students acquire at least one certificate. According to the coordinators of the junior study programs in Germany, this decline was attributable to the interim implementation of the G8 in most German states, which was associated with a permanent increase in the workload of young people and a corresponding reduction in the time available to them for extracurricular activities (Deutsche Telekom Stiftung, 2018b).

Dropout rates from junior study programs are quite low overall. On average, only about one in five junior students end their participation in the program prematurely (Deutsche Telekom Stiftung, 2006, 2013; Kaden, 2016). Frequently cited reasons for dropping out of junior studies are, among others, temporal overlaps of academic courses and school classes, examinations in school, high levels of stress, and unexpectedly high demands in the courses selected at university (Deutsche Telekom Stiftung, 2006; Kaden, 2016).

Finally, the fact that junior students constitute a particularly high-performing group is also reflected in their high academic aspirations: For example, several prospective studies have shown that almost all active junior students intend to take up regular studies directly after their Abitur (Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007). This finding is now also confirmed by retrospective studies, in which it has been shown that about three quarters of all former participants in junior study programs enter their regular studies immediately following the end of their schooling (Gabert, 2014; Kaden, 2016; Stumpf & Gabert, 2016). In comparison, only about one in seven former junior students typically start vocational training after their Abitur. The rest initially decide against continuing their education and pursue other activities such as voluntary work, jobs, internships, or stays abroad (Gabert, 2014; Kaden, 2016; Stumpf & Gabert, 2016).

Given the extensive evidence of junior students' exceptional performance in school and in their junior studies, the decision was made that the focus of the follow-up questionnaire for

Research Issue 1 should be primarily on the educational development of former junior students, that is, on their educational choices and academic credentials in their regular studies. Since it was further expected – due to junior students' high academic aspirations – that a substantial proportion of former participants would go on to pursue doctoral studies subsequent to their regular studies, it was specified that the follow-up questionnaire should equally include this stage of academic education. All in all, the design of the sections of the follow-up questionnaire on the long-term academic development of former junior students was guided by the following set of research questions:

Research Questions: Do former junior students perform equally well in their regular studies as they do in school and in their junior studies? What are their academic credentials in both their regular and their doctoral studies? What special accomplishments do they achieve?

Professional Careers of Former Junior Students. The literature on junior study programs in Germany does not yet include any studies that have recorded the professional growth of former participants. Hence, it was not possible to derive specific research questions for the follow-up questionnaire on the current professional situation of former junior students. However, since it was to be expected that some of those young adults who had participated in the junior study program at JMU Würzburg between the winter semester of 2004/2005 and the summer semester of 2011 would already have entered the workforce by the time of the follow-up, some basic research questions on their current professional situation were added to the follow-up questionnaire:

Research Questions: What is the current job situation of former junior students? How successful are they in their careers? What are their future professional goals?

Retrospective Evaluation of the Junior Study Program. Part of the current research literature on junior study programs in Germany has focused on the question of how former junior students manage the transition from school to regular studies and how they retrospectively evaluate their participation in the gifted education measure (e.g., Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). Overall, the findings can be summarized as showing that participation in junior study programs has obvious impacts on participants' educational decisions after their Abitur as well as on their initial experiences in their regular studies. For example, up to three quarters of former junior students report that their participation in junior studies has influenced their subject choice for their regular studies (Gabert, 2014; Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Stumpf & Gabert, 2016), resulting in either a confirmation or a disconfirmation of their previously intended subject (Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011). At the same time, almost all former junior students concur that participation in the junior study program facilitated their subject choice for their regular studies (Stumpf et al., 2011).

About three in four adolescents who have participated in junior study programs experience advantages over other first-semester students at the start of their regular studies (Gabert, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). Contributing factors seem to be adolescents' advanced domain knowledge as well as their familiarity with academic processes on the one hand (Gabert, 2014; Stumpf & Gabert, 2016) and their independence and their increased self-confidence on the other hand (Stumpf et al., 2011). Other important benefits that adolescents gain from their participation in junior study programs include getting to know everyday student life, assuming personal responsibility, reducing fear of studying, gaining insight into differences between school and university, and easing the transition from school to university (Katzarow & Grönholdt, 2014). In contrast, participation in junior study programs seems to have little effect on adolescents' learning and working strategies (Stumpf & Gabert, 2016; Stumpf et al., 2011).

Finally, the findings on junior study programs in Germany seem to show that former junior students have largely positive memories of their participation in the gifted education measure. For instance, former junior students tend to retrospectively rate their participation in the measure as "good" to "very good" (Gabert, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). What is more, virtually all former junior students affirm that they would participate in junior study programs again from their current perspective. Moreover, they would recommend participation in junior study programs to others (Stumpf et al., 2011).

Considering the multiple impacts that participation in junior study programs seems to have on the immediate educational trajectories of former participants, it was decided to place another focus of the follow-up of former junior students at JMU Würzburg on possible benefits of junior study programs that could still be observed after an interval of several years. In addition, the aim was to ascertain how former junior students rate their participation in the junior study program from their current perspective, that is, after having completed their regular studies. In order to gain a better understanding of these issues, the following set of research questions was integrated into the follow-up questionnaire:

Research Questions: How do young adults evaluate their participation in junior study programs in retrospect? Would they attend junior study programs again from their current point of view? What impact did their participation in junior study programs have on their long-term academic development?

Psychological Variables of Former Junior Students. In contrast to the wide variety of studies that have investigated the role of performance-related variables, such as cognitive abilities or school grades, in profitably participating in junior study programs, little attention has been paid so far to the psychological characteristics of junior students and to how these characteristics might shape their educational choices and long-term academic trajectories. Finally, to compensate for this lack of knowledge, it was decided to include some standard measures of personality traits and vocational interests in the follow-up questionnaire. The associated research questions were as follows:

Research Questions: What are the personality traits of former junior students? What are their vocational interests?

4.2 Research Issue 2: Talent Development in Academic Domains

As mentioned in the introduction, little is known to date about the talent development process in academic domains. Although much research has been conducted on the association between general cognitive abilities and exceptional academic performance under the *gifted child paradigm*, there has been little scientific work addressing the potential relevance of psychosocial variables in the talent development process and their role in predicting high academic achievement (Subotnik et al., 2019). Moreover, unlike other performance domains such as Sports or Music, academic domains do not have traditional benchmarks to indicate whether children and adolescents are making expected progress in their talent development and whether they are meeting the requirements of their age-appropriate talent development stages (Subotnik et al., 2017). Thus, from a research- and application-oriented perspective, there is still much work to be done before systematic, long-term programs can be developed that provide gifted children and young adults with suitable opportunities to gain knowledge and skills in their subjects of interest (Worrell et al., 2012).

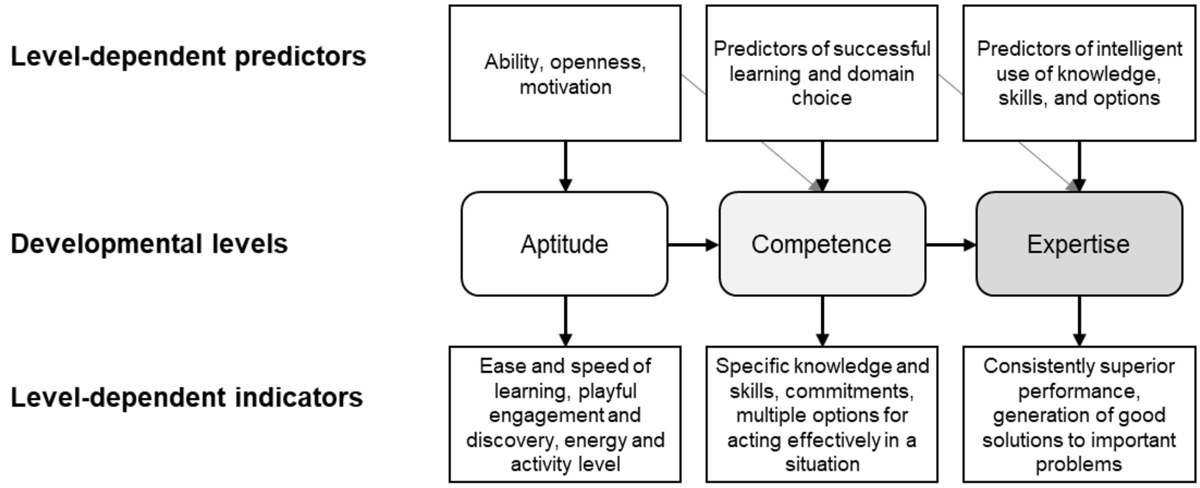
Research Issue 2 takes up this challenge and makes an attempt to improve the currently vague understanding of talent development in academic domains. Using longitudinal data from the junior study program at JMU Würzburg, it draws on Preckel et al.'s (2020) TAD framework as an empirical basis and aims to systematically examine the conditions and manifestations of outstanding academic performance. According to Preckel et al. (2020), the TAD framework constitutes a theoretical prediction model with a straightforward structure that is well suited for empirical investigations across domains. To adequately test the validity of the TAD framework, Preckel et al. (2020) recommend using linear regression models or more elaborate statistical prediction tools that can accommodate more complex features such as interactions, moderators, or mediators. The validity of Preckel et al.'s (2020) TAD framework in a given domain can then be expressed in terms of R^2 values or alternative measures of model fit. The larger the proportion of variance in an outcome variable that can be explained by a set of predictors, the better the prediction of the hypothesized model is assumed to be (Preckel et al., 2020).

In order to answer Research Issue 2, it was decided to translate the structure of Preckel et al.'s (2020) TAD framework to academic domains and to examine it using SEMs. This first required the identification of specific predictors and indicators for each talent development stage of the TAD framework. Regarding potential predictors, Preckel et al. (2020) suggest examining their validity only within a single stage of talent development or between adjacent stages rather than focusing on their long-term predictive power, as is the case for cognitive abilities in the *gifted child paradigm*. Indeed, Preckel et al.'s (2020) TAD framework is not based on the assumption that individual psychological variables necessarily have strong predictive validity across long development spans. Rather, it holds that achievement outcomes that manifest themselves at specific talent development stages (i.e., indicators of specific talent development stages) are predicted primarily by psychological variables assessed at the beginning of those stages. Moreover, it assumes that there is considerable overlap between the predictors and indicators of successive talent development stages (Preckel et al., 2020).

In the following sections, Preckel et al.'s (2020) TAD framework is used as a starting point to derive hypotheses on possible predictors and indicators of the first three talent development stages, *aptitude*, *competence*, and *expertise*, in academic domains. The final talent development stage, *transformational achievement*, is not included in the hypotheses because it was not (yet) expected that former participants in the junior study program at JMU Würzburg would be advanced enough in their academic (and professional) development at the time of the follow-up to allow for an adequate examination of this stage. The hypotheses on the remaining stages of talent development are derived in two steps: First, for each talent development stage, the cross-domain predictors and indicators as proposed in Preckel et al.'s (2020) TAD framework are briefly repeated. Second, insights into the determinants and manifestations of exceptional performance in individual academic disciplines, such as Mathematics and Psychology, are used to translate these cross-domain predictors and indicators to academic domains and to derive stage-specific hypotheses. Finally, toward the end of the following sections, a fourth hypothesis is formulated regarding the causal relationship between the talent development stages *aptitude*, *competence*, and *expertise* in academic domains. Figure 10 represents a modified version of Preckel et al.'s (2020) TAD framework that focuses exclusively on the predictors and indicators of the first three talent development stages. The figure is meant to guide hypothesis generation.

Figure 10

Level-Dependent Predictors and Indicators of the First Three Talent Development Stages of Preckel et al.'s (2020) TAD Framework



Note. Adapted from "Talent Development in Achievement Domains: A Psychological Framework for Within- and Cross-Domain Research" by F. Preckel, J. Golle, R. Grabner, L. Jarvin, A. Kozbelt, D. Müllensiefen, P. Olszewski-Kubilius, R. Subotnik, W. Schneider, M. Vock, and F. C. Worrell, 2020, *Perspectives on Psychological Science, 15*(3), p. 697, (https://doi.org/10.1177%2F1745691619895030). Copyright 2020 by the Authors.

Hypotheses on the Aptitude Level. On the aptitude level, individuals typically start to take an interest in the content of a certain domain and to engage in activities that are highly relevant to this domain. As can be seen in Figure 10, Preckel et al. (2020) theorize that, across domains, characteristics such as general cognitive abilities, openness, and achievement motivation are of particular importance in this process and can lay the foundation for successful talent development.

But how do these cross-domain predictors translate to academic domains? According to Olszewski-Kubilius et al. (2019), high levels of openness and motivation are also important prerequisites for later exceptional performance in academic domains. The same seems to be true for general cognitive abilities. Silverman (2009), for example, notes that the intellectual characteristics of mathematically talented children include intellectual curiosity, fascination with ideas and words, as well as the ability to perceive multiple aspects of a question. Olszewski-Kubilius et al. (2019) further list variables such as cognitive flexibility and problem-solving skills as relevant predictors of mathematical aptitude. In addition, it has been found that individuals who later go on to deliver exceptional performance in Psychology tend to emerge from the population of overall academically talented children and adolescents. As Olszewski-Kubilius et al. (2019) note, this observation can be generalized to other subject fields, such as the field of Humanities or the field of Law, Business, & Social Sciences. Therefore, on the aptitude level, the following hypothesis will be examined regarding relevant predictors of talent development in academic domains:

Hypothesis 1.1: *Cognitive abilities*, *openness*, and *motivation* predict individuals' level of aptitude in academic domains.

It is further evident from Figure 10 that Preckel et al. (2020) primarily consider such variables to be cross-domain indicators of aptitude that predispose individuals to systematically acquire large amounts of knowledge. On the one hand, these variables include cognitive characteristics such as intellectual precocity, ease and speed of learning, and responsiveness to learning new content and skills; on the other hand, motivational variables such as playful engagement and discovery as well as high energy or activity levels are involved (see Figure 10; Preckel et al., 2020).

In academic domains, cognitive variables such as intellectual precocity might also be important indicators of successful talent development on the aptitude level. Silverman (2009), for instance, assumes that in Mathematics, potential aptitude is exhibited by precocious reasoning abilities, including metaphorical thinking as well as the ability to visualize models and systems. Furthermore, Olszewski-Kubilius et al. (2019) summarize that across disciplines, childhood talent for academic learning often indicates a successful onset of talent development on the aptitude level. From this, it can be inferred that children with a favorable constellation of aptitude factors might equally possess considerable prior knowledge in an academic domain early on. Finally, Olszewski-Kubilius et al. (2019) note that it is not uncommon for mathematically gifted children to prematurely develop a strong enthusiasm for numerical problems. Considering these findings, the following hypothesis is assumed with regard to indicators of talent development at the aptitude level in academic domains:

Hypothesis 1.2: In academic domains, individuals' amount of prior knowledge, their perceived talent (i.e., precocity), and their motivation to engage with academic activities indicate their level of aptitude.

Hypotheses on the Competence Level. On the competence level, individuals start to systematically interact with the demands and features of their chosen domains, leading them to acquire more specific knowledge and more sophisticated skills over time. Although Preckel et al. (2020) assume that variables such as general cognitive abilities, openness, and motivation still represent relevant predictors of talent development on the competence level (see gray arrow in Figure 10), they make it clear that more domain-specific skills are thought to gain in importance. These include personality factors such as self-concept and conscientiousness on the one hand, and factors that signify successful learning and domain choice such as investment traits and interests on the other hand (see black arrow in Figure 10; Ackerman, 1996; Holland, 1997).

In academic settings, the transition from aptitude to competence likewise requires high levels of conscientiousness as well as an increasing commitment to acquiring extensive knowledge and sophisticated skills in an achievement domain (Olszewski-Kubilius et al., 2015). Often, this is accomplished through deliberate practice and through formal, domain-specific instruction with an emphasis on content knowledge and guided skill practice. For example, in academic domains, the goal is to learn basic principles and concepts in Mathematics or Science or, more generally, to acquire profound knowledge on how to perform effective computer searches or how to write structured essays (Jarvin & Subotnik, 2015). A key component in this process is long-term dedication to future goals (e.g., being a scientist), coupled with the tenacity to meet the many immediate, short-term goals that are required along the way (e.g., passing an exam; Duckworth et al., 2007; Duckworth et al., 2012). In addition, investigative interests might be an important prerequisite for academic competence. For the discipline of Psychology, for instance, Olszewski-Kubilius et al. (2019) suggest that investigative interests are the main predictor of high potential for outstanding future accomplishments in the field. Individuals who later go on to deliver exceptional performance in Psychology typically develop an enthusiasm for psychological science at some point during their regular studies (Roe, 1953; Simonton, 2019). Correspondingly, the following hypothesis is considered regarding potential predictors of talent development on the competence level:

Hypothesis 2.1: *Conscientiousness*, *study time* (i.e., deliberate practice), and *investigative interests* predict individuals' level of competence in academic domains.

Among the cross-domain indicators of competence, Preckel et al. (2020) rank first variables that demonstrate excellent learning outcomes, such as extensive declarative and procedural knowledge. *Declarative knowledge* includes domain-specific representations of facts, formulas, principles, and ideas. *Procedural knowledge* describes the exercise of cognitive representations such as a sense of what it takes to be successful in a specific domain or task (Heinecke, 2014; Jarvin & Subotnik, 2015). Since the acquisition of both types of knowledge requires increased investments of time and effort, commitment is taken to be another general indicator of successful talent development on the competence level. Finally, Preckel et al. (2020) assume that high levels of competence translate into a wide scope of action that gives competent individuals multiple options to respond effectively to different situations (see Figure 10).

The literature on talent development in individual academic disciplines suggests that reading for comprehension, writing for communication, and computing for data analysis might be important competencies for future success. Each of these competencies, when mastered effectively, allows for a deeper understanding and a more intense engagement with an academic discipline (Jarvin & Subotnik, 2015). As gifted individuals typically achieve particularly high levels of these competencies, successful talent development is likely to be most evident from their exceptional achievements in school or in higher education institutions. Gifted individuals usually receive excellent grades and are presented with awards/prizes for their outstanding academic achievements. In the discipline of Psychology, for example, accomplished adults were most often excellent students who attended selective universities and graduated with academic honors (Chambers, 1964; Rodgers & Maranto, 1989; Wispé & Ritter, 1964). Moreover, aspiring psychologists started publishing early, often even prior to completing their doctoral degrees (Chambers, 1964; Rodgers & Maranto, 1989). Finally, many gifted individuals at this level of talent development obtain scholarships or are offered coveted opportunities to work with well-known teachers (Olszewski-Kubilius et al., 2015). Therefore, on the competence level, the following hypothesis is assumed with regard to indicators of talent development in academic domains:

Hypothesis 2.2: In academic domains, the study grades, scholarships, and study awards/prizes that individuals receive during their regular studies indicate their level of competence.

Hypotheses on the Expertise Level. On the expertise level, domain-specific knowledge and sophisticated skills are no longer sufficient for individuals to meet the demands of successful talent development. As Preckel et al. (2020) explain, the predictors of the competence level rather need to be complemented by intelligent use of acquired knowledge and skills in order to effectively master important tasks and problems (see Figure 10). On the one hand, this requires advanced self-regulatory and metacognitive competencies. On the other hand, Preckel et al. (2020) also point to the fact that in order to succeed on the expertise level, individuals need social skills and a sensibility for opportunities that help effectively promote their proficiency (Sternberg & Lubart, 1991, 1992).

Evidence from the literature on individual disciplines suggests that self-regulation and metacognition are also important predictors of success on the expertise level in academic domains. For example, Olszewski-Kubilius et al. (2019) propose that in the discipline of Psychology, persistence as well as the ability to focus on one’s strengths are important determinants of positive talent development. In contrast, less is known about critical skills that impact the development of high-performing mathematicians on the expertise level, even though it is likely that constructs like persistence are also relevant (Olszewski-Kubilius et al., 2019). Besides self-regulatory and metacognitive competencies, a key component of success at the expertise stage in academic domains might also be high levels of extraversion, including self-confidence, the ability to engage successfully with colleagues and mentors, risk-taking, as well as the ability to respond gracefully to criticism. In fact, Subotnik and Jarvin (2005) argue that at the expertise level in academic domains, it is important to promote oneself, to share work and ideas, as well as to solicit and gain feedback and support in order to reach full-time professional status. Therefore, on the expertise level, the following hypothesis is proposed regarding potential predictors of talent development in academic domains:

Hypothesis 3.1: *Self-regulation*, *metacognition*, and *extraversion* predict individuals’ level of expertise in academic domains.

In terms of cross-domain indicators of expertise, Preckel et al.’s (2020) TAD framework provides rather vague information. As can be seen in Figure 10, it is generally assumed that achieving consistently superior performance and generating good solutions to important problems are indicative of successful talent development (Preckel et al., 2020).

Jarvin and Subotnik (2015) assume that both extensive declarative and procedural knowledge remain highly relevant on the expertise level, although the importance of the latter is expected to increase relative to the former (Jarvin & Subotnik, 2015).

In academic domains, the transition from competence to expertise requires going beyond learning the foundations of a discipline to specialization as well as socialization into the discipline's culture and peculiarities. The latter can be achieved, for example, through working with eminent professionals and mentors as well as through making connections with other gifted students (Olszewski-Kubilius et al., 2015; Subotnik & Jarvin, 2005; Subotnik et al., 2009). Over the course of socialization, academically gifted individuals gain useful knowledge about potential paths toward success (e.g., studying with a distinguished professor, winning a major competition, or going to a top university), important hurdles to overcome (e.g., posing an elegant dissertation question, obtaining a grant, or finding a coach or mentor), as well as influential gatekeepers in their domain (e.g., journal editors, grant reviewers, or critics; Olszewski-Kubilius et al., 2015).

In order to specialize in academic domains, gifted individuals typically receive further instruction that emphasizes the mastery of skills for creative problem-solving as opposed to knowledge acquisition on the competence level (Jarvin & Subotnik, 2015). According to Jarvin and Subotnik (2015), problem-solving skills that are important on the expertise level in academic domains include defining topics for research papers, developing original interpretations of literary or art works, or finding out why an empirical experiment did not work. Other examples are giving appealing presentations, making innovative research contributions, and succeeding in competitions (Olszewski-Kubilius et al., 2015, 2019). Specifically, Simonton (2019) suggests that indicators of expertise in academic domains include, for example, initiating fully independent research programs, such as working on a doctoral thesis, publishing frequently in high-impact scientific journals, and earning progressively more important awards/prizes and honors. These insights lead to the following hypothesis about possible indicators on the expertise level in academic domains:

Hypothesis 3.2: In academic domains, the preparation of a doctoral thesis, the number of scientific publications, and the receipt of scientific awards/prizes indicate individuals' level of expertise.

Hypothesis on the First Three Talent Development Levels. Preckel et al. (2020) describe the talent development process using a sequence of four successive levels: aptitude, competence, expertise, and transformational achievement. It is assumed that over the course of these stages, gifted individuals' potential for achievement gradually transforms into actual achievement. In the context of Research Issue 2, however, the final talent development level, *transformational achievement*, had to be excluded from hypothesis generation because it was not (yet) expected that the available data would be sufficient to allow for a reasonable investigation of potential predictors and indicators on this stage. Accordingly, the final hypothesis is also limited only to the first three talent development stages of Preckel et al.'s (2020) TAD framework, *aptitude*, *competence*, and *expertise*. Consistent with the basic structure of Preckel et al.'s (2020) TAD framework, it proposes that the first three talent development stages are predictive of each other in their chronological order:

Hypothesis 4: Successive talent development levels predict each other; that is, the aptitude level predicts the competence level, and the competence level predicts the expertise level.

5 Research Issue 1

The following chapter focuses on Research Issue 1, which aims to capture the long-term educational (and professional) development of former junior students into their early adulthood. To specify the various facets of this research issue, the previous chapter has identified several individual research questions: How do former participants in junior study programs perform in their regular studies? What are their academic credentials? What is their current job situation? And how do they evaluate their participation in junior study programs in retrospect? Aiming to find an answer to these research questions, a comprehensive follow-up was conducted among a group of former junior students at JMU Würzburg.

The chapter is organized along conventional lines of scientific communication. In the first subchapter, it delves into the methods that were used to conduct the follow-up of former junior students at JMU Würzburg. The second subchapter then reports and illustrates the results of the follow-up, while in the last subchapter, the main findings of Research Issue 1 are thoroughly discussed and evaluated against previous research.

5.1 Method

The following sections discuss the methodological aspects that had a determining influence on the follow-up of former junior students at JMU Würzburg. After the first section has described central demographic characteristics of the selected sample, the second section gives an account of data collection. The third section then provides the structure and content of the follow-up questionnaire. The fourth section focuses on data aggregation, such as categorization and combination of variables, while the fifth section deals with data diagnostics, such as controlling for data accuracy, treating missing values, and defining outliers. The last section finally addresses basic questions of data analysis.

5.1.1 Sample Characteristics

The criterion that was specified for selecting the sample for Research Issue 1 required that former junior students at JMU Würzburg had attended the (Bavarian) G9 and had thus received their Abitur in the school year 2010/2011 at the latest[6] (Bayerisches Staatsministerium für Unterricht und Kultus, 2011). For one thing, this was meant to ensure that all former junior students had received a comparable school education. For another thing, this criterion guaranteed that there was a period of at least 8 years between former junior students' Abitur and the time of the follow-up. Given a standard period of study of 6 semesters (i.e., 3 years) for a bachelor's degree and another 4 semesters (i.e., 2 years) for a master's degree, it could be assumed that former junior students would have completed most of their regular studies at the time of the follow-up, making it possible to obtain a comprehensive picture of their educational trajectories.

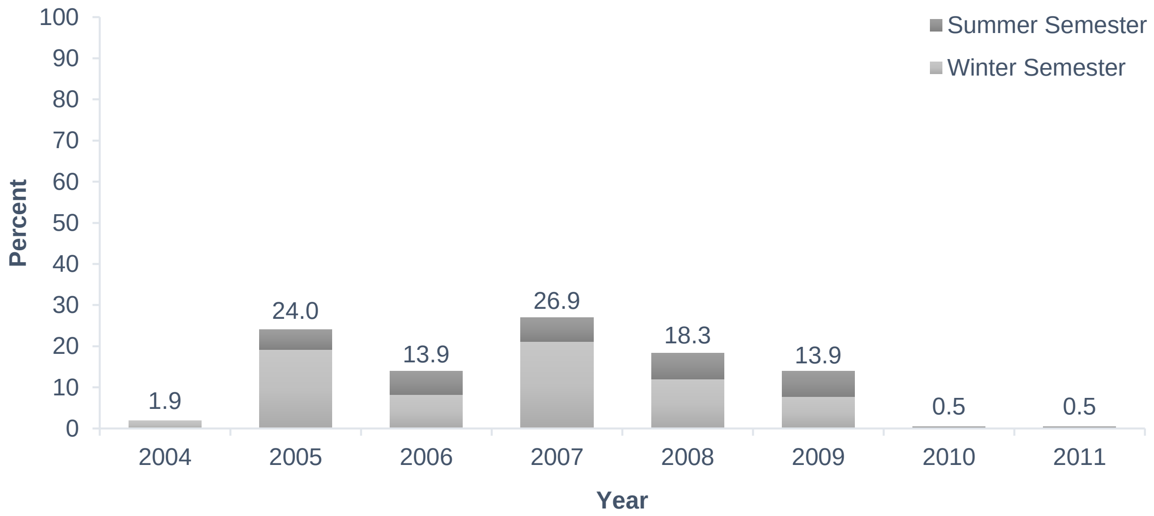
In total, 208 former junior students (83 female and 125 male) met the specified selection criterion. All former junior students had successfully applied for the junior study program at JMU Würzburg between the winter semester of 2004/2005 and the summer semester of 2011. Figure 11 shows the distribution of the selected sample across their semesters of application. As can be clearly seen, most former junior students had applied for the junior study program at JMU Würzburg in the winter semester of 2007/2008 (21.2 %), while from the summer semester of 2010 onward, the number of applications had declined sharply (0.5 %). There are two obvious reasons for this decline: First, from the perspective of the former junior students, all of whom had attended the (Bavarian) G9 according to the selection criterion, taking up junior studies in the summer semester of 2010 might have made little sense because they would be eligible to apply for regular studies only about one year later anyway. Second, adolescents

[6] The sample also included pupils from the neighboring states Hesse and Baden-Wuerttemberg, where the last G9 cohorts completed their Abitur in the school years 2011/2012 and 2012/2013, respectively (Köller, 2017).

who had attended the (Bavarian) G9 had to invest more time in school-related activities from the summer semester of 2010 onward due to the start of the last G9 Abitur preparation phase, leaving them most likely with fewer resources to participate in extracurricular activities such as gifted education programs.

Figure 11

Semesters of Application for the Junior Study Program in the Sample for Research Issue 1 (N = 208)

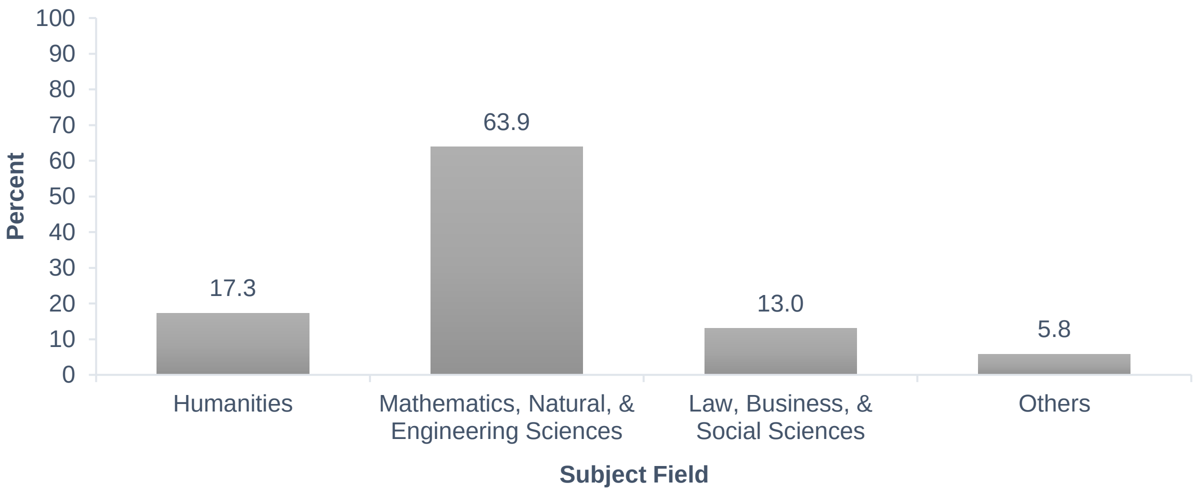


At the start of their junior studies, the former junior students in the selected sample had been 16.87 years old on average (*SD* = 1.84; range from 14 to 31). Based on their latest report cards from school, which could be obtained from their application documents for the junior study program at JMU Würzburg, their average school grade had been 1.82 (*SD* = 0.47; range from 1.00 to 3.58; German grading system), with females ($M = 1.66$, $SD = 0.44$) having had significantly better school grades than males ($M = 1.92$, $SD = 0.45$), $t(206) = 4.20$, $p < .001$, $d = -.58$. The difference in the means was 0.27 with 95 % CI [0.14, 0.39]. Most former junior students had attended either the 11th (43.5 %) or the 12th grade (39.1 %) at the start of their junior studies. Only a few had visited the 10th (9.7 %) or the 13th grade (7.7 %).

For their junior studies, the former junior students had chosen subjects from different subject fields, most frequently from the field of Mathematics, Natural, & Engineering Sciences (63.9 %). In comparison, subjects from the field of Humanities (17.3 %), the field of Law, Business, & Social Sciences (13.0 %), as well as the field Others (5.8 %) had been chosen less often. Figure 12 illustrates the distribution of the selected sample across their subject fields (for a detailed overview of which subjects were assigned to which subject field, see Table A1 in Appendix A: Subject Classification).

Figure 12

Intended Subjects for the Junior Study Program in the Sample for Research Issue 1 as a Function of Subject Fields (N = 208)



On average, the former junior students in the selected sample had participated in the junior study program at JMU Würzburg for 2.55 semesters (*SD* = 1.83; range from 1 to 12). Throughout their participation, they had attended an average of 5.71 courses (*SD* = 6.08; range from 1 to 41). Their mean number of credits earned was 1.22 (*SD* = 1.85; range from 0 to 16).

5.1.2 Data Collection

Data collection for the follow-up at JMU Würzburg was conducted over a 16-week period from October 2019 to February 2020. The follow-up questionnaire was implemented using the online survey software Unipark (Unipark, n.d.-a). Different question types and dynamic elements, such as triggers and filters, were utilized in order to map the educational trajectories of the former junior students as realistically as possible. In addition, for distributing the follow-up questionnaire, Unipark's comprehensive respondent management feature was used, making it possible to send personalized invitations and targeted reminders to the former junior students in the selected sample (Unipark, n.d.-b). The process of data collection and the structure of the follow-up questionnaire are described in more detail below.

Process of Data Collection. To obtain the highest possible response rate, data collection for the follow-up was organized in several steps (see Figure 13): In the first week of data collection, an attempt was made to invite all former junior students via e-mail to participate in the follow-up. The invitation was personalized and contained information about the goal of the follow-up as well as a link which would take participants directly to the follow-up questionnaire. For a German copy of the initial invitation, see Appendix B: Follow-Up Material.

In sending out the invitations, some e-mail addresses in Unipark were classified as "invalid" (16.4 %), presumably because they were already more than 8 years old and no longer in use at the time of the follow-up. Moreover, in some cases, e-mail addresses were not available due to missing entries in the paper files from the archives of the BYB (2.4 %). It was therefore not possible to invite about one fifth of the former junior students to the follow-up via e-mail. To circumvent this problem, attempts were made during the second week of data collection to contact the families of all former junior students in question via telephone and to ask them for current e-mail or postal addresses.

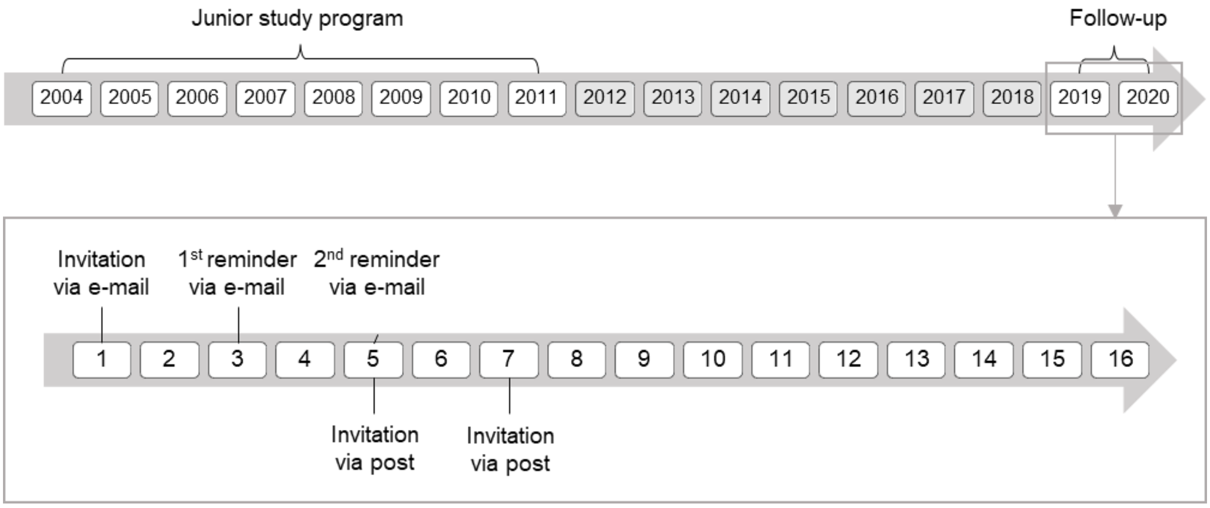
In the third week of data collection, those former junior students who had been reached via their e-mail-addresses during the first week but who had not yet responded to the follow-up were again reminded via e-mail to participate. The reminder was similar in content and structure to the initial invitation. For a German copy of the reminder, see Appendix B: Follow-Up Material.

In the fifth week of data collection, another reminder was distributed via e-mail to those former junior students who had still not responded to the follow-up. In addition, those former junior students who could even by that time not be reached via e-mail (e.g., due to invalid or missing e-mail addresses) and whose families did not respond to the attempted telephone contact were eventually invited to participate in the follow-up via post. This was done using their parents' postal addresses. Similar to the e-mail invitation, the postal invitation contained information on the goal of the follow-up as well as a personalized link that would direct participants to the follow-up questionnaire. To facilitate access to the follow-up questionnaire from the postal invitation, the link could also be accessed via QR code (see Appendix B: Follow-Up Material for a German copy of the postal invitation).

Finally, in the seventh week of data collection, all former junior students who had not responded to either the initial e-mail invitation or to any of the reminders by that time were also invited to the follow-up via post. No further attempts were made to contact the former junior students in the remaining weeks.

Figure 13

Chronological Sequence of Data Collection for Research Issue 1



Note. Numbers on the bottom timeline indicate weeks.

On average, respondents needed about 20 minutes to fully complete the follow-up questionnaire. Among all respondents, 10 vouchers for a German ticketing and live entertainment provider with a total value of 100 euros (i.e., 10 euros each) were distributed; the vouchers were sent out via post in July 2020, together with a congratulatory letter. For administrative reasons, the congratulatory letter included a postage-paid postcard, which the winners were asked to sign and return to the BYB, confirming receipt of the vouchers. Appendix B: Follow-Up Material shows a German copy of the congratulatory letter as well as German copies of the vouchers and postcards.

Structure of the Follow-Up Questionnaire. The follow-up questionnaire opened with a brief welcome and introduction, informing respondents about the objectives and the course of the project. In addition, information relevant to data protection was communicated. Figure 14 provides a schematic representation of the follow-up questionnaire. It can be seen from this representation that the first thematic section dealt with former junior students' Abitur. It was a fixed component of the follow-up questionnaire, which had to be completed by all respondents. After the Abitur section and before respondents were directed to the other thematic sections, they were presented with a timeline on which they were asked to indicate which activities they had predominantly engaged in each year from their Abitur to the present. Available categories were “Voluntary work”, “Military/civilian service”, “Vocational training”, “Regular studies”, “Preparatory service”, “Doctoral studies”, “Habilitation”[7], “Professional activities”, and “Other”. Depending on their chosen categories, respondents were then presented with different thematic sections. For instance, if they had indicated one of the categories “Vocational training”, “Regular studies”, “Doctoral studies”, “Habilitation”, or “Professional activities” on their timelines, they were asked to work through the corresponding sections in chronological order. Moreover, if they had chosen the category “Other”, they were asked to describe their activities in more detail. Regarding the categories “Voluntary work” and “Military/civilian service”, respondents did not receive any further questions.

After respondents had worked through all of their selected categories, the next thematic section of the follow-up questionnaire invited them to look back on their junior studies at JMU Würzburg, taking into account all activities they had pursued since their Abitur. Like the Abitur section, the section on the junior study program was a fixed component of the follow-up questionnaire and had to be completed by all respondents. The goal of the section was to explore the retrospective evaluation of the junior study program at JMU Würzburg by the former junior students and to identify possible effects of their participation on their subsequent educational trajectories.

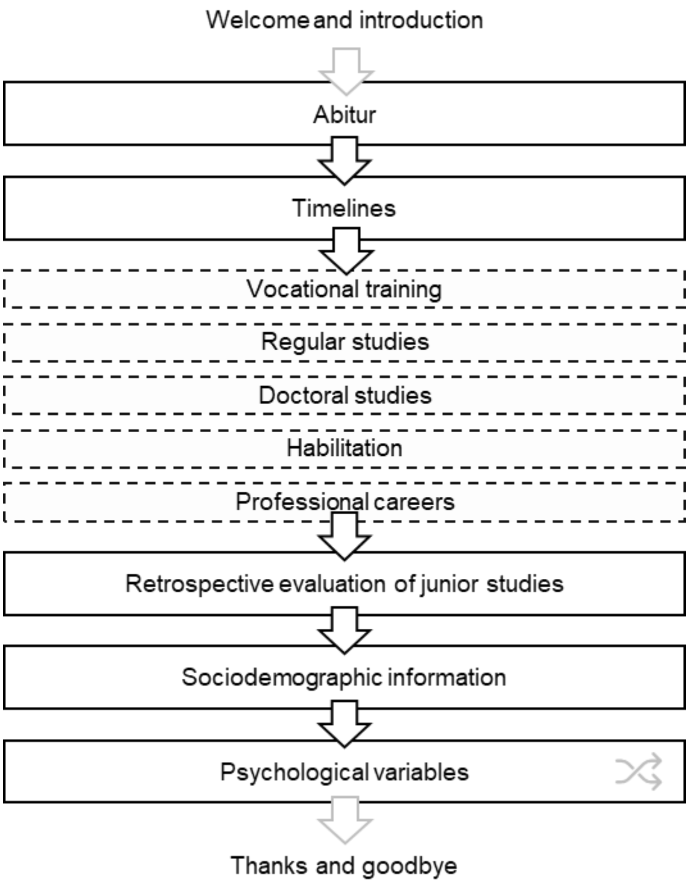
The section that followed the retrospective exploration of the junior study program was again fixed. It aimed to collect general (socio-)demographic information about the former junior students, such as their current family status or their current number of children.

[7] German postdoctoral qualification proving the ability to teach and to engage in research in an academic subject (European Education and Culture Executive Agency, 2017).

The last section of the follow-up questionnaire was designed to capture the interests and personalities of the former junior students. Like the previous two sections, it was fixed and thus had to be completed by all respondents. To avoid order effects, the (standard) personality and interest measures were randomized across respondents. Finally, the questionnaire ended with a thanks for participating and a short goodbye. For a complete example of what a German run-through of the follow-up questionnaire might have looked like, see Appendix B: Follow-Up Material.

Figure 14

Structure of the Follow-Up Questionnaire



Note. Solid lines represent fixed thematic sections of the follow-up questionnaire which all respondents were required to answer; dashed lines represent variable thematic sections. Crossed arrows symbolize randomization.

5.1.3 Measures

In the following, selected items from the Abitur section and the other thematic sections of the follow-up questionnaire (i.e., former junior students' timelines, the section on the junior study program, and the section on former junior students' (socio-)demographic information) are presented as measures of Research Issue 1. Depending on their position on former junior students' timelines, the items of the categories "Vocational training," "Regular studies," "Doctoral studies," "Habilitation," or "Professional activities" were either formulated in the past or present tense in the follow-up questionnaire. For a simplified presentation – and in accordance with the timelines of most former junior students at JMU Würzburg – the following procedure is such that all items from the categories "Vocational training", "Regular studies", "Doctoral studies", and "Habilitation" are presented in the past tense, while the items from the category "Professional activities" are presented in the present tense. The follow-up questionnaire was originally created in German and was partly translated into English for the present thesis.

Abitur. In the Abitur section of the follow-up questionnaire, respondents were asked to provide information about their Abitur year and their average Abitur grade. In addition, they were expected to indicate the extent to which they were satisfied with their Abitur results. Table 2 contains the exact wording of all items from the Abitur section, along with the response format and the response categories that could be selected.

Table 2

Items from the Abitur Section of the Follow-Up Questionnaire

Item	Response format	Categories
"In which year did you graduate from Gymnasium?"	Single choice	"2004 or earlier" (…) "2012 or later"
"What was your average Abitur grade?"	Single choice	"1.0" (…) "3.9"
"How satisfied were you with your results?"	Scale	5-point Likert scale (1 = *not satisfied at all* to 5 = *totally satisfied*)

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Academic Credentials. Subsequent to the Abitur section, the follow-up questionnaire asked respondents to complete a series of education-related sections depending on the categories they had selected on their timelines. In the following, all items of the education-related sections are provided in ascending order of educational qualification. Since the categories "Vocational training" and "Habilitation" were (so far) rarely selected by the former junior students, the corresponding items are not listed for reasons of space; instead, they can be looked up in Appendix B: Follow-Up Material.

Regular Studies. In the regular studies section, respondents to the follow-up were first required to provide basic information on their academic background. As can be seen in Table 3, this included details on their subject(s) of study, their obtained degree(s), and their final grade(s). Moreover, former junior students were asked to provide information on their satisfaction with their results in their regular studies, on their study time, and on their place(s) of study.

Table 3

Items from the Regular Studies Section of the Follow-Up Questionnaire

Item	Response format	Categories
"Which subject(s) did you study?"	Multiple choice/ Open	"Archeology" (…) "Other"
"Did you complete your studies?" What was your highest degree?	Single choice	"Yes, I earned a bachelor's degree." "Yes, I earned a master's degree." "Yes, I earned a State Examination[8]." "Yes, I earned a Diplom." "Yes, I earned a Magister[9]." "No, I didn't earn a degree."
"What was your final grade?"	Single choice	"1.0" (…) "4.0"
"How satisfied were you with your results?"	Scale	5-point Likert scale (1 = *not satisfied at all* to 5 = *totally satisfied*)
"How many semesters did you study?"	Single choice	"1 semester" (…) "15 semesters or more"
"Where did you study?"	Open	–

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

In order to get a more complete idea of the academic accomplishments that former junior students earn in their regular studies, additional information on potential scholarships,

[8] The State Examination concludes a course of study in certain subjects (e.g., medical subjects, teaching, law). It is administered by examination committees staffed not only by professors but also by representatives of the state examination offices of the German states (European Education and Culture Executive Agency, 2017).

[9] The Magister is a higher education qualification that can be obtained at German universities or equivalent institutions of higher education (European Education and Culture Executive Agency, 2017). Like the Diplom degree, it has been widely replaced by bachelor's and master's degrees in recent years.

awards/prizes, scientific papers, and scientific patents was requested (see Table 4). If an item was answered in the affirmative, further details were collected, such as former junior students' type of scholarship or their number of publications. At the end of the regular studies section, respondents were asked to estimate the amount of time (in hours) that they had invested in their regular studies each week.

Table 4

Items from the Follow-Up Questionnaire on Former Junior Students' Special Academic Accomplishments in their Regular Studies

Item	Response format	Categories
"Did you receive a scholarship?"	Single choice	"Yes" "No"
"Did you receive any study awards/prizes?"	Single choice	"Yes" "No"
"Did you publish any scientific papers?"	Single choice	"Yes" "No"
"Did you secure any scientific patents?"	Single choice	"Yes" "No"
"How much time did you invest in your studies each week?"	Open	–

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Doctoral Studies. The follow-up questionnaire section on the doctoral studies of former junior students was similar in structure to that on their regular studies. Here, too, the first set of questions was designed to obtain basic information about their academic activities (see Table 5).

Table 5

Items from the Doctoral Studies Section of the Follow-Up Questionnaire

Item	Response format	Categories
"What subject(s) did you study?"	Multiple choice/ Open	"Archeology" (…) "Romance Studies" "Other"
"Did you complete your doctoral studies?"	Single choice	"Yes, I completed my doctoral studies." "No, I didn't complete my doctoral studies."
"What was your final grade?"	Single choice	"summa cum laude" (…) "non probatum"
"How satisfied were you with your results?"	Scale	5-point Likert scale (1 = *not satisfied at all* to 5 = *totally satisfied*)
"How many semesters did you study?"	Single choice	"1 semester" (…) "15 semesters or more"
"Where did you study?"	Open	–

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Expanding on this general information, the doctoral studies section then also asked for more specific information on former junior students' scholarships, awards/prizes, scientific papers, and scientific patents. Once more, the questions were mainly consistent with those from the regular studies section (see Table 6).

Table 6

Items from the Follow-Up Questionnaire on Former Junior Students' Special Academic Accomplishments in their Doctoral Studies

Item	Response format	Categories
"Did you receive a scholarship?"	Single choice	"Yes" "No"
"Did you receive any scientific awards/research prizes?"	Single choice	"Yes" "No"
"Did you publish any scientific papers?"	Single choice	"Yes" "No"
"Did you secure any scientific patents?"	Single choice	"Yes" "No"
"How much time did you invest in your doctorate each week?"	Open	–

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Professional Careers. The items from the follow-up questionnaire section on the professional careers of former junior students are summarized in Table 7. The first item was meant to document respondents' current job titles. To measure their professional success, former junior students were then questioned about their current professional status as well as their current gross income. Both questions were based on Abele-Brehm and Hagmaier (2011). Former junior students' current weekly working hours were recorded separately for contractual and actual working hours (see also Abele-Brehm & Hagmaier, 2011). Afterward, respondents were asked to assess how satisfied they were with their jobs at the time of the follow-up. Finally, in the last question, former junior students were invited to share their future professional goals.

Table 7

Items from the Professional Careers Section of the Follow-Up Questionnaire

Item	Response format	Categories
"What's your current job?"	Open	-
"Which statement(s) applies/apply to your current job?"	Multiple choice	"As part of my job, I'm authorized to delegate tasks." "As part of my job, I have a permanent management function." "As part of my job, I officially supervise other people."
"What's your current monthly gross income?"	Single choice	"Up to 500 euros" "Up to 1,000 euros" (…) "More than 10,000 euros"
"How much time do you currently invest in your job each week?"	Open	–
"How satisfied are you with your job at the moment?"	Scale	5-point Likert scale (1 = *not satisfied at all* to 5 = *totally satisfied*)
What are your future professional goals?	Open	–

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Retrospective Evaluation of Junior Studies. Table 8 gives an overview of the most relevant items from the follow-up questionnaire section on the retrospective evaluation of the junior study program at JMU Würzburg by the former junior students. The first item was designed to ascertain whether former junior students would attend the junior study program at JMU Würzburg again from their current perspective. Subsequently, respondents were asked to select from a list of seven experiences those which they considered most important for their further academic development. The list of experiences was compiled from former junior students' responses in the studies by Gabert (2014), Katzarow and Grönholdt (2014), as well as Stumpf and Gabert (2016). At the end of the section, respondents were finally requested to rate two statements regarding potential impacts of their participation in the junior study program at JMU Würzburg on their subsequent academic and professional careers.

Table 8

Items from the Junior Studies Section of the Follow-Up Questionnaire

Item	Response format	Categories
"From your current point of view, would you attend the junior study program again?"	Scale	5-point Likert scale (1 = *no, definitely not* to 5 = *yes, definitely*)
"Which experiences as a junior student were most important for your further academic development?"	Multiple choice	"Getting to know everyday student life" "Gaining insight into university structures" "Assuming personal responsibility" "Acquiring knowledge" "Acquiring general learning techniques" "Gaining insight into one's intended subject" "Getting to know one's personal resilience limit" "Other"
"Due to my experience as a junior student, I was able to avoid changing subjects in my regular studies."	Scale	5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*)
"Due to my experience as a junior student, I'm now ahead of my former classmates in my professional career."	Scale	5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*)

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

(Socio-)Demographic Information. As shown in Table 9, in the (socio-)demographic information section, respondents were asked to provide details on their current family status and on their current number of children. Available categories were taken from Abele-Brehm and Hagmaier (2011).

Table 9

Items from the (Socio-)Demographic Information Section of the Follow-Up Questionnaire

Item	Response format	Categories
“What’s your current family status?”	Single choice	“Single” “Married” “Registered partnership” “Divorced” “Separated” “Widowed”
“How many children do you currently have?”	Single choice	“No children” “One child” “Two children” “Three children” “More than three children”

Note. Items are arranged in the order in which they appeared in the follow-up questionnaire.

Personality Measures. To assess former junior students’ personality traits, the Big Five Inventory 10 (BFI-10; Rammstedt & John, 2007), a shortened version of the Big Five Inventory 44 (BFI-44; John et al., 1991; German adaptation by Rammstedt, 1997), was used. The BFI-10 captures individuals’ dispositions on the five prototypical dimensions of personality: neuroticism, extraversion, openness (to experience), agreeableness, and conscientiousness (Rammstedt et al., 2013). It contains a total of 10 items (i.e., two items per scale), with half of them worded positively and the other half worded negatively (Rammstedt et al., 2013). All items of the BFI-10 are normally rated on a 5-point Likert scale, ranging from 1 = *strongly disagree* to 5 = *strongly agree* (Rammstedt & John, 2007). However, in the follow-up questionnaire, a 5-point Likert scale with labels ranging from 1 = *not true at all* to 5 = *totally true* was used. The following sections describe the five scales of the BFI-10 in more detail.

Neuroticism. The Neuroticism scale describes the extent to which people are emotionally stable. It separates people who tend to be insecure, nervous, anxious, tense, and depressed (e.g., “I see myself as someone who gets nervous easily.”) from those who are even-tempered and less prone to emotional disturbances (e.g., “I see myself as someone who is relaxed, handles stress well.”; John & Srivastava, 1999; Rammstedt et al., 2013). Cronbach’s α for the two items of the Neuroticism scale was .76 in the present thesis, indicating quite satisfactory internal consistency (cf. Hossiep, 2014).

Extraversion. According to John and Srivastava (1999), the Extraversion dimension indicates an energetic attitude to the social and material world. It includes traits such as sociability, activity, talkativeness, and assertiveness (i.e., “I see myself as someone who is outgoing, sociable.”) on the one hand and traits such as reserve and reclusiveness on the other hand (e.g., “I see myself as someone who is reserved.”; Rammstedt et al., 2013). In the sample for Research Issue 1, Cronbach’s α for the two items of the Extraversion scale was .87, which is quite good (cf. Hossiep, 2014).

Openness. The Openness dimension describes the breadth, depth, originality, and complexity of individuals’ mental and experimental lives (John & Srivastava, 1999). Individuals with high scores on this dimension typically are inquisitive, imaginative, intellectual, and artistically active (e.g., “I see myself as someone who has an active imagination.”), while individuals with low scores tend to have fixed, conservative views and little interest in new things (e.g., “I see myself as someone who has few artistic interests.”; Rammstedt et al., 2013). With a value of .47, Cronbach’s α for the Openness scale was rather unacceptable in the present thesis (cf. Hossiep, 2014).

Agreeableness. The Agreeableness scale refers to interpersonal behavior. Accordingly, individuals with high levels of agreeableness are altruistic, trusting, cooperative, and compliant (e.g., “I see myself as someone who is generally trusting.”), whereas individuals with low levels of agreeableness can be described as cool, critical, and distrustful (e.g., “I see myself as someone who tends to find fault with others.”; Rammstedt et al., 2013). Cronbach’s α for the Agreeableness scale in the present thesis was at a just acceptable value of .50 (cf. Hossiep, 2014).

Conscientiousness. Based on John and Srivastava (1999), the Conscientiousness dimension addresses social impulse control, which facilitates task- and goal-oriented behavior. It differentiates individuals who are determined, persistent, disciplined, and reliable (e.g., “I see myself as someone who does a thorough job.”) from those who are careless, indifferent, and unreliable (e.g., “I see myself as someone who tends to be lazy.”; Rammstedt et al., 2013). In the sample for Research Issue 1, Cronbach’s α for the Conscientiousness scale was only .39, which is generally considered unacceptable (cf. Hossiep, 2014).

Interest Measures. Respondents’ vocational interests were assessed in the follow-up questionnaire using the 12 interest items from the Fragebogen zum Erkenntnisstreben 16^{plus}, Revision (FES 16^{plus} R) [Quest for Knowledge Questionnaire 16+, Revision] (Kabisch & Karpowski, 2016). In the FES 16^{plus} R, the 12 interest items serve to capture specific content areas in which individuals’ propensity to absorb new information through targeted information search potentially shows up. The items were designed by Kabisch and Karpowski (2016) based on Holland’s (1997) *Theory of Vocational Choice*, which basically distinguishes six interest types: realistic interests, investigative interests, artistic interests, social interests, enterprising interests, and conventional interests (Holland, 1997). The 12 interest items of the FES 16^{plus} R describe educational or vocational activities in general terms. There are two items per interest type, which are typically rated on a 4-point Likert scale (1 = *agree* to 4 = *disagree*). To be consistent with the BFI-10 (Rammstedt & John, 2007), a 5-point Likert scale was used in the follow-up questionnaire, ranging from 1 = *not true at all* to 5 = *totally true*. In the following sections, the six interest scales of the FES 16^{plus} R are thoroughly described and illustrated using sample items.

Realistic Interests. Individuals with high levels of realistic interests prefer activities that entail the explicit, ordered, or systematic manipulation of objects, tools, and machines (e.g., “When a device breaks down, I like to look for the cause to fix it.”; Holland, 1997; Kabisch & Karpowski, 2016). These activities require strength, coordination, and manual dexterity and often lead to concrete, visible results. Accordingly, individuals with high levels of realistic interests exhibit skills and abilities primarily in the mechanical, technical, electrotechnical, or agricultural fields. Their character rests on common sense, straightforwardness, and honesty (Eder & Bergmann, 2015). In the present thesis, Cronbach’s α for the Realistic Interests scale was .66, indicating acceptable internal consistency (cf. Hossiep, 2014).

Investigative Interests. People with an investigative orientation favor activities that entail the observational, symbolic, systematic, and creative examination of physical, biological, and cultural phenomena (e.g., “I enjoy experimenting independently.”; Holland, 1997; Kabisch & Karpowski, 2016). They want to explore, understand, and control these phenomena and solve related problems. Their skills and abilities are primarily in science and Mathematics. Individuals with high levels of investigative interests are mentally independent, perceptive, analytical, and intellectual (Eder & Bergmann, 2015). With a value of .58, Cronbach’s α for the Investigative Interests scale was in an acceptable range in the sample for Research Issue 1 (cf. Hossiep, 2014).

Artistic Interests. Individuals with high levels of artistic interests have a preference for ambiguous, open-ended, and unstructured activities that allow them to use language or materials to create art forms or products (e.g., “I enjoy optimizing my artistic skills.”; Eder & Bergmann, 2015; Holland, 1997; Kabisch & Karpowski, 2016). Among their abilities are creativity, inventiveness, and expressiveness, which are often expressed in Language, Visual Arts, Music, Drama, or Writing. Individuals with artistic interests are typically unconventional and liberal (Eder & Bergmann, 2015). Cronbach's α for the Artistic Interests scale was .74 in the present thesis, speaking to satisfactory internal consistency (cf. Hossiep, 2014).

Social Interests. Individuals with a basic social orientation prefer activities that encompass the interaction with others to inform, teach, train, develop, cure, or care (e.g., "I like providing sustainable support for people with problems."; Eder & Bergmann, 2015; Holland, 1997; Kabisch & Karpowski, 2016). Their special skills and abilities are social empathy, patience, and teaching skills. They are idealistic, warm, sociable, and tolerant (Eder & Bergmann, 2015). Cronbach's α for the Social Interests scale in the present thesis was .35, indicating rather unacceptable internal consistency (cf. Hossiep, 2014).

Enterprising Interests. People with high levels of enterprising interests like to undertake activities in which they can influence, persuade, lead, or manipulate others to attain organizational goals or economic benefits (e.g., "I like taking responsibility for a work group."; Eder & Bergmann, 2015; Holland, 1997; Kabisch & Karpowski, 2016). They strive for success, profitability, prestige, and career advancement. Their skills and abilities include leadership skills, persuasiveness, organizational skills, and determination. They are characteristically active, dynamic, willing to perform, and responsible (Eder & Bergmann, 2015). With a Cronbach's α of .50, the internal consistency for the Enterprising Interests scale was just about acceptable in the present thesis (cf. Hossiep, 2014).

Conventional Interests. People with a basic conventional orientation prefer activities that entail the explicit, ordered, or systematic manipulation of data or things (e.g., "I enjoy arranging information in logical and systematic sequences."; Eder & Bergmann, 2015; Holland, 1997; Kabisch & Karpowski, 2016). Their specific skills and competencies are systematic thinking, organizational and managerial abilities, accuracy, and perseverance. They are characterized as accurate, dutiful, conscientious, and careful (Eder & Bergmann, 2015). In the sample for Research Issue 1, Cronbach's α for the Conventional Interests scale was .34, which is generally rather unacceptable (cf. Hossiep, 2014).

5.1.4 Data Aggregation

On completion of data collection, several items from the follow-up questionnaire were transformed or grouped into (higher-level) categories. This was done to facilitate data analysis and to allow for a clearer presentation of the results. The next section explains all measures of data aggregation.

Subject Fields. In their regular as well as their doctoral studies, those former junior students who responded to the follow-up had chosen subjects from a great variety of different subject fields. To facilitate the analysis of these subjects, they were classified into subject fields based on the subject classification system from the Statistisches Bundesamt [German Federal Statistical Office] (2020b). The subject classification system from the Statistisches Bundesamt (2020b) basically covers eight subject fields: "Agriculture, Forest, & Nutrition Sciences, Veterinary Medicine", "Art & Art Science", "Engineering Sciences", "Human Medicine/Health Sciences", "Humanities", "Law, Business, & Social Sciences", "Mathematics & Natural Sciences", and "Sports" (Statistisches Bundesamt, 2020b).

Since former junior students' subjects were distributed very unevenly across the subject fields, the following further adjustments were made: The subject fields "Humanities" and "Law, Business, & Social Sciences" were retained as given. The subject field "Engineering Sciences" was added to the subject field "Mathematics & Natural Sciences", creating the subject field "Mathematics, Natural, & Engineering Sciences". Moreover, the subject fields "Human Medicine/Health Sciences", "Art & Art Science", and "Sports" were combined to form the subject field "Others". Last, the subject field "Agriculture, Forest, & Nutrition

Sciences, Veterinary Medicine" was dropped because former junior students had not chosen any subjects from this field. A complete list of the subjects and their classification into subject fields from Research Issue 1 is available in Appendix A: Subject Classification.

Study Degrees. Similar to the subjects that the former junior students who participated in the follow-up had taken in their regular and their doctoral studies, the study degrees which they had obtained in their regular studies were grouped into superordinate categories. For this purpose, the Framework for Qualifications of the European Higher Education Area (EHEA) was used. On the level of regular studies, the Framework for Qualifications of the EHEA makes a simple distinction between two classes of degrees: bachelor's and master's degrees (European Consortium for Accreditation, 2014).

In detail, the approach to grouping respondents' study degrees in their regular studies was as follows: In a first step, Diplom degrees, Magisters, and State Examinations were classified as master's degrees. Subsequently, for each master's degree, it was controlled whether respondents had also indicated either a directly associated bachelor's degree or at least a bachelor's degree from the same subject field. If this was the case, the indicated bachelor's degree was included in the calculations; otherwise, a bachelor's degree from the same subject field as the master's degree was added.

In a second step, the maximum number of study degrees per former junior student was limited to a single bachelor's and master's degree. For those former junior students who reported having obtained more than one bachelor's or master's degree (about 5 %), the bachelor's and master's degree from the subject field that most closely matched the subject field from their junior studies were selected. This procedure was largely in accordance with that of the Statistisches Bundesamt, which equally limits its analyses by subject field to only a single study degree per case (Bayerisches Landesamt für Statistik, 2019).

Professional Fields. To increase clarity, respndents' jobs were classified into professional fields. For this purpose, the same higher-level categories were used as for the subject fields, that is, "Humanities", "Mathematics, Natural, & Engineering Sciences", "Law, Business, & Social Sciences", and "Others" (see above).

Professional Status. Former junior students' professional status was determined by the highest category they had selected for the corresponding item in the follow-up questionnaire. The categories were "Delegation powers" (i.e., the authority to transfer work to trainees, interns, or student assistants), "Management function" (i.e., the administration of a work group or unit), or "Supervisor function" (i.e., responsibilities for people who have completed their professional education; see Abele-Brehm & Hagmaier, 2011). For those respondents who had not selected any option, the category "No powers" was created.

Professional Goals. Respondents' answers to the question about their future professional goals were analyzed qualitatively and grouped into higher-level categories based on content. The resulting categories included: "(Scientific) progress", "Personal advancement/professional expertise", "Professional advancement", "Self-employment", "High(er) income", and "Work-life balance".

5.1.5 Data Diagnostics

In preparation for data analysis of Research Issue 1, data diagnostics were performed after data aggregation. This involved screening all variables from the follow-up of former junior students for data accuracy, missing values, and outliers. Moreover, issues of normality were addressed. For ungrouped data, all cases were considered at once; for grouped data, data diagnostics were performed separately for each group. If the results of data diagnostics suggested that transformations were necessary, preference was given to solutions that avoided data loss so as not to reduce the overall size of the respondent sample. All data diagnostics and necessary transformations were performed using IBM SPSS Statistics 26 (IBM Corporation, 2019).

Data Accuracy. Since respondents to the follow-up were able to enter their answers directly into the follow-up questionnaire via the online survey software Unipark (Unipark, n.d.-a), the data were readily available in electronic spreadsheets after data collection. This ensured a high degree of data accuracy and necessitated only a rough check for inconsistencies and possible typing errors.

Missing Data. Missing data in the follow-up occurred at a relatively low rate (9.8 %), mainly because of questionnaire dropout. As a consequence, it was decided not to replace missing data but to exclude the corresponding cases from data analysis in the relevant calculations (cf. Tabachnick & Fidell, 2014).

Outliers. Following the recommendation of Tabachnick and Fidell (2014), cases with standardized values in excess of ± 3.29 ($p < .001$, two-tailed test) were identified as univariate outliers in Research Issue 1. In order to reduce the impact of univariate outliers but still keep them in the data set, their standardized values were recoded to the threshold value of 3.29.

Normality. The normality of variables was assessed using the Shapiro-Wilk test (Shapiro et al., 1968). If the test indicated that the variables were not normally distributed, variable transformations, such as square root transformations, log transformations, and inverse transformations, were considered (for a detailed description of variable transformations and their recommendation for use, see Tabachnick & Fidell, 2014). However, since these transformations often did not improve the distributions, data analysis was conducted with the untransformed variables. This was justified because it could basically be assumed that all variables (in the groups) were non-normal in the same way; that is, for female and male junior students, for example, all variables were either positively or negatively skewed and thus did not unduly degrade data analysis (cf. Tabachnick & Fidell, 2014).

5.1.6 Data Analysis

The data from the follow-up of former junior students were analyzed mainly at a descriptive level. To determine potential differences between groups, individual chi-square tests of independence or independent samples *t*-tests were calculated depending on the scale level of data. For chi-square tests of independence, (Cramer's) phi coefficient Φ was used as the effect size. In line with Cohen (1988), effect sizes of approximately $\Phi = 0.10$ were considered small effects, effect sizes of approximately $\Phi = 0.30$ were considered medium effects, and effect sizes of approximately $\Phi = 0.50$ were considered large effects. For independent samples *t*-tests, the standardized mean difference *d* was used as the effect size. Here, effect sizes of about $d = 0.20$ were interpreted as small effects, effect sizes of about $d = 0.50$ were interpreted as medium effects, and effect sizes of about $d = 0.80$ were interpreted as large effects (see also Cohen, 1988). Since no systematic differences were expected in advance for any of the group comparisons, an increased significance level of $\alpha = .20$ (two-tailed) was used throughout. This was done to indirectly minimize the probability of incorrectly assuming that there were no systematic differences between the compared groups when, in fact, systematic differences existed. Data analysis was performed using IBM SPSS Statistics 26 (IBM Corporation, 2019).

5.2 Results

The next subchapter documents in detail former junior students' long-term academic (and professional) trajectories. To this end, the first section characterizes the respondent sample regarding key demographic variables and compares their values to those of the non-respondent sample. The purpose of this comparison is to see how representative the respondent sample is and how well their results generalize to the invited sample. Then, the second section takes up most of the subchapter. It comprehensively presents former junior students' academic credentials in both their regular and their doctoral studies. For those former junior students who had already entered their professional careers by the time of the follow-up, the third section subsequently provides some basic information on their current job situation. In the fourth section, respondents' retrospective evaluation of the junior study program at JMU Würzburg is addressed. Finally, the last section gives a brief outline of former junior students' personality and interest profiles.

5.2.1 Respondent Characteristics

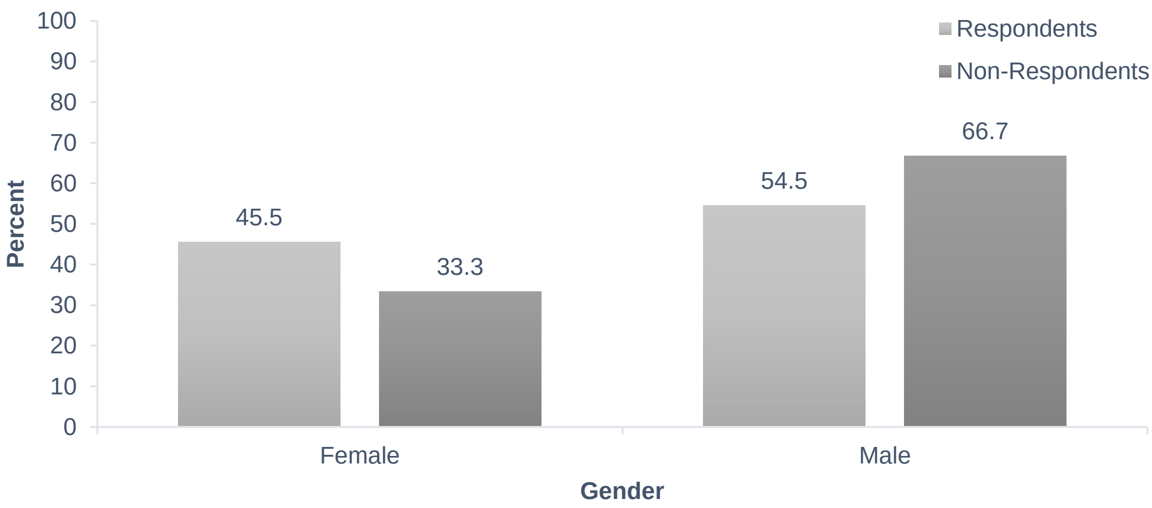
Overall, a total of $N = 112$ former junior students (51 female and 61 male) answered the follow-up questionnaire, representing a response rate of 53.8 %. Of this total, 101 respondents completed the questionnaire in full (91.2 %), whereas 11 respondents filled in only parts of the questionnaire (9.8 %).

At the time of the follow-up, the former junior students in the respondent sample were on average 29.19 years old ($SD = 1.72$; range from 25 to 38). About two thirds reported being single (68.3 %), while a total of about one third reported being married (30.7 %) or divorced (1.0 %). None reported being separated (0.0 %), in a registered partnership (0.0 %), or widowed (0.0 %). Most respondents had no children (86.1 %); there were few respondents who had either one (6.9 %), two (5.9 %), or three (1.0 %) children. None had more than three children (0.0 %).

Representativeness of the Respondent Sample. Potential differences between the former junior students in the respondent and non-respondent sample were first examined regarding gender. Figure 15 presents the proportion of females and males in both groups. While the proportion of females and males in the respondent sample was almost equal, there were about twice as many males as females in the non-respondent sample. The association between response status and gender was reliable at the specified significance level, χ^2 (1, *N* = 208) = 3.21, *p* = .073; the effect, however, was very small Φ = 0.07.

Figure 15

Ratio of Females to Males in the (Non-)Respondent Group

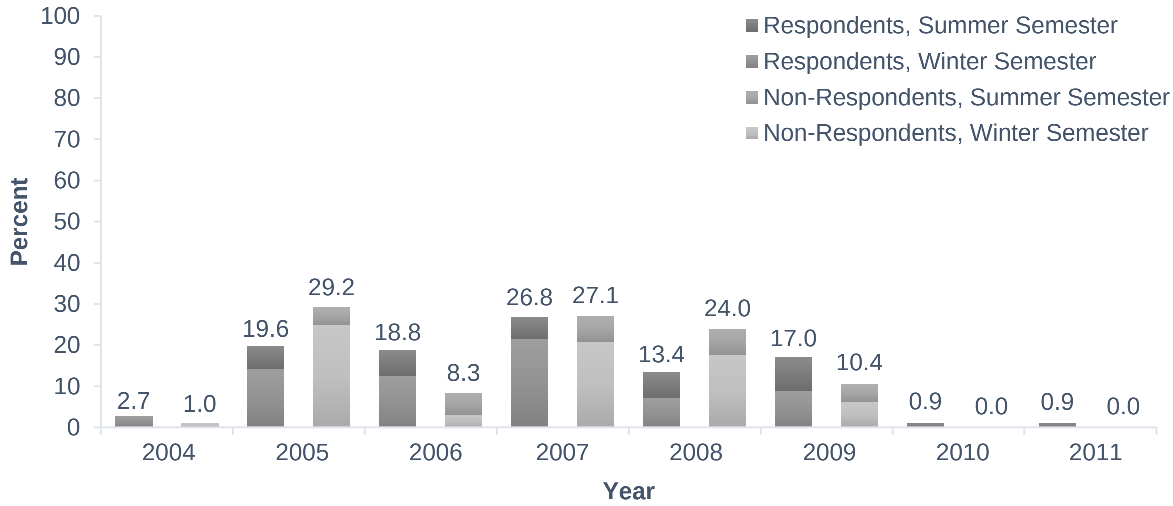


Note. *n* = 112 for respondents and *n* = 96 for non-respondents.

Next, it was analyzed whether the respondents and non-respondents differed with regard to their semesters of application for the junior study program at JMU Würzburg. Figure 16 shows the distribution of both groups across the relevant interval. As can be readily seen, those former junior students who had responded to the follow-up were distributed across the entire application period roughly in proportion to the former junior students in the invited sample. Thus, there appeared to be no bias in the respondent sample with respect to their semesters of application for the junior study program. Although a significant difference between the respondents and non-respondents was statistically found, χ^2 (12, *N* = 208) = 17.93, *p* = .118, (Cramer's) Φ = 0.29, with the maximum deviations between both groups occurring in the winter semesters of 2005/2006, 2006/2007, and 2008/2009, this result must be interpreted with caution because for some of the cells, the expected frequencies were less than 5, not guaranteeing an adequate distribution of the chi-square value in the sample (Bortz & Schuster, 2010; Sedlmeier & Renkewitz, 2018b).

Figure 16

Semesters of Application for the Junior Study Program in the (Non-)Respondent Group



Note. n = 112 for respondents and n = 96 for non-respondents.

Another interesting result of the comparison of the respondents and non-respondents was that at the time of their application, the respondents (M = 1.75, SD = 0.45) had shown significantly better average school grades than the non-respondents (M = 1.90, SD = 0.48), t (206) = 2.39, p = .018. The difference in the means was 0.15 with 95 % CI [0.03, 0.28]; the effect size was small d = 0.32. A possible explanation for this difference might be that there were relatively more women in the respondent sample than in the non-respondent sample and that women had demonstrated much better average school grades at the time of their application for the junior study program than men (see above).

There was no significant association between the response status of the former junior students in the follow-up and the grade level they had attended at the start of their junior studies,

χ^2 (3, N = 207) = 1.91, p = .591, (Cramer's) Φ = 0.10. Of both the respondents and non-respondents, around half had attended the 11th and the 12th grade of the G9. The rest were distributed evenly across the 10th and the 13th grade (see Figure 17).

Figure 17

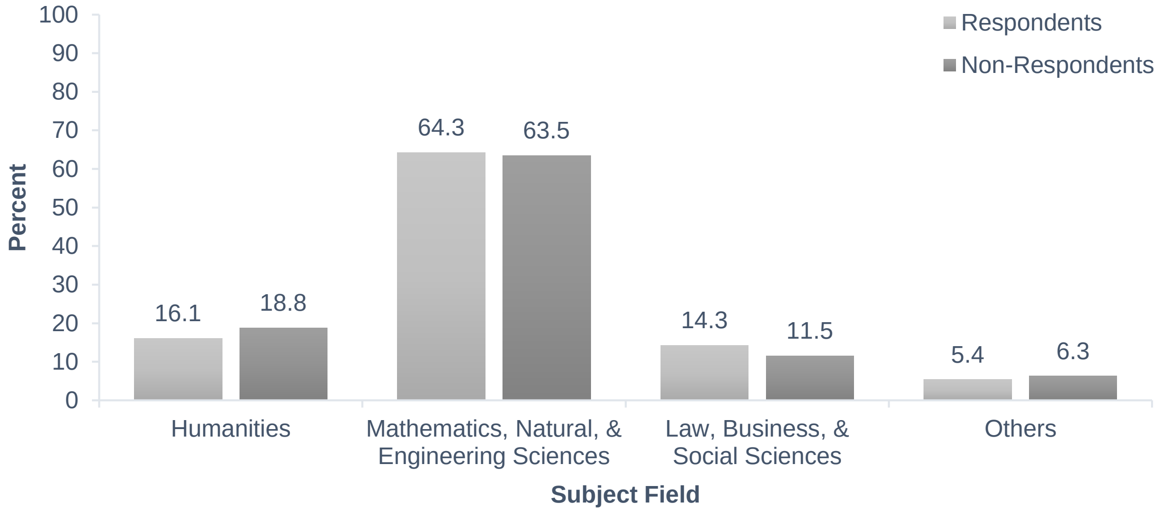
Grade Levels of the (Non-)Respondent Group at the Time of their Application for the Junior Study Program at JMU Würzburg

Note. n = 112 for respondents and n = 96 for non-respondents.

Figure 18 depicts the subject fields from which the respondent and the non-respondent sample had intended to choose their subjects at the time of their application for the junior study program. There was no significant difference in the distribution of the respondents compared to the non-respondents across their intended subject fields, χ^2 (3, n = 208) = 0.61, p = .894, (Cramer's) Φ = 0.05. In both groups, about two thirds had intended to choose a subject from the field of Mathematics, Natural, & Engineering Sciences, and about one third overall had intended to choose a subject from the field of Humanities, the field of Law, Business, & Social Sciences, or the field Others.

Figure 18

Intended Subject for the Junior Study Program in the (Non-)Respondent Group as a Function of Subject Fields



Note. n = 112 for respondents and n = 96 for non-respondents.

Table 10 finally summarizes relevant variables that have been collected during former junior students' participation in the junior study program at JMU Würzburg. There were significant differences in the number of semesters and the number of courses between the respondents and non-respondents, with the respondents scoring higher than the non-respondents on both variables. For the number of semesters, the difference in the means was -0.35 with 95 % CI [-0.82, 0.13]; the associated effect size was small d = -0.20. For the number of courses, the difference in the means was -1.10 with 95 % CI [-2.60, -0.40]; the associated effect size was also small d = -0.20. There was no reliable difference in the number of obtained credits or certificates between the former junior students in the respondent and non-respondent sample (see Table 10).

Table 10

Variables from the Course of (Non-)Respondents' Junior Studies

Variable	Respondents		Non-respondents		*t* (206)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Number of semesters	2.68	1.84	2.34	1.57	-1.44	.151	-0.20
Number of courses	6.08	5.97	4.98	4.81	-1.44	.151	-0.20
Number of credits	1.26	1.63	1.07	1.69	-0.82	.415	-0.12

Note. $n = 112$ for respondents and $n = 96$ for non-respondents. Effect sizes were calculated on Psychometrica (Lenhard & Lenhard, 2016).

Taken together, the results from the comparison of the respondents and non-respondents indicate that there were systematic differences between the two groups. What is noticeable in this context is that these differences occurred primarily in performance-related variables, such as average school grades, number of courses, and number of semesters taken part in the junior study program, with the respondent group consistently outperforming the non-respondent group. In contrast, no systematic differences were found for non-performance-related variables, such as gender, semesters of application, grade levels attended at the start of the junior study program, or intended subject fields.

Overall, it can only be speculated as to why there were differences between the two groups, especially in performance-related variables. For example, it is possible that mechanisms of self-selection are responsible for this: On the one hand, it seems conceivable that the former junior students from the respondent sample felt more committed to the measure because they had taken part in the junior study program at JMU Würzburg more extensively and for a longer period of time than the former junior students from the non-respondent sample. On the other hand, another explanation might be that the former junior students from the respondent sample, who had already been among the highest achievers in their age group during their junior studies, had also performed comparatively well in their regular studies and at the beginning of their professional careers and, for this reason, were particularly willing to provide information about their educational trajectories in the follow-up.

Regardless of their true explanation, it is important to keep in mind the differences found between the respondents and non-respondents when looking at the remainder of the results sections for Research Issue 1, as this finding can lead to a positive bias in the results. For example, in the next section, which constitutes a meticulous documentation of former junior students' academic credentials in both their regular and their doctoral studies, their average study grades or their number of bachelor's and master's degrees might be somewhat overestimated. In addition, the sampling bias might also have an impact on the retrospective assessment of the junior study program at JMU Würzburg by the former junior students, which is presented in the fourth section. To account for the fact that the percentages reported in the following sections on the respondent sample involve some degree of uncertainty when generalized to the invited sample, they are reported with confidence intervals [CI] throughout. All CIs were approximated using the normal distribution.

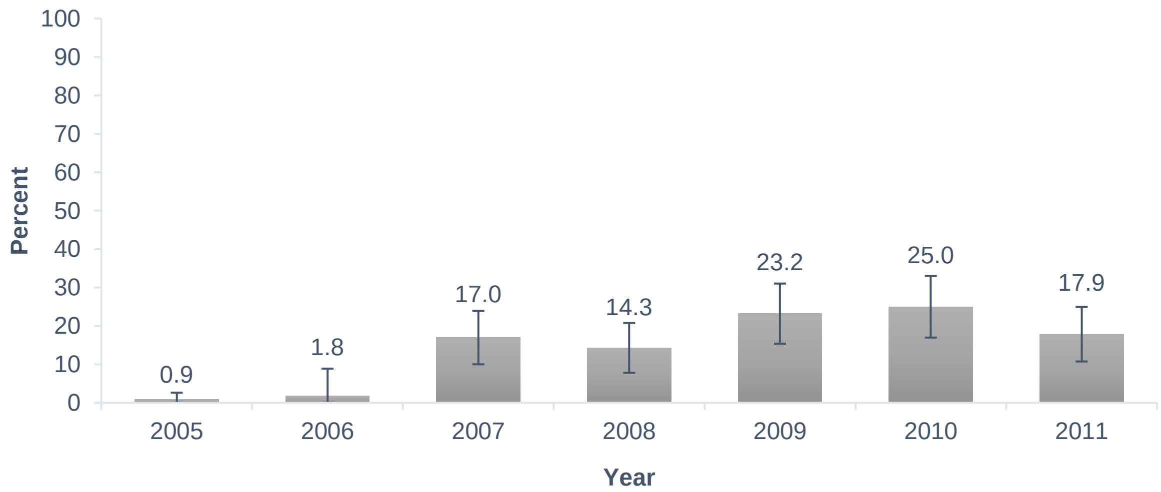
5.2.2 Academic Credentials of Former Junior Students at JMU Würzburg

The first set of research questions that guided the design of the follow-up questionnaire sought to determine whether former participants in junior study programs would continue to constitute a high-performing group into their early adulthood. In the following section, the focus is on former junior students' academic credentials in their regular and their doctoral studies. To enable an appropriate interpretation of the results, comparative values from the Statistisches Bundesamt on the academic performance of the overall population of students in Germany are reported at selected points.

Abitur. As specified by the selection criterion for the sample for Research Issue 1, all respondents to the follow-up had obtained their Abitur in 2011 at the latest; the earliest year in which the former junior students in the respondent sample had completed their Abitur was 2005. As a result, there was a period of 8 to 12 years between the end of Gymnasium and the time of the follow-up for all former junior students. Figure 19 demonstrates the distribution of the respondent sample across the relevant interval. About half (48.2 %, 95 % CI [38.9 %, 57.5 %]) had obtained their Abitur in 2009 or 2010; the other half (49.2 %, 95 % CI [39.9 %, 58.5 %]) had completed their schooling in 2007, 2008, or 2011. Almost none of those who responded (2.7 %, 95 % CI [0.0 %, 5.7 %]) had earned their Abitur in 2005 or 2006.

Figure 19

Abitur Years of the Former Junior Students



Note. $N = 112$. Error bars represent 95 % confidence intervals.

The average Abitur grade of the former junior students was 1.48 ($SD = 0.42$; range from 1.00 to 2.70; German grading system), which was much better than the national mean of 2.48[10] ($SD = 0.02$) over approximately the same years (Sekretariat der Ständigen Konferenz der

[10] Calculated as the mean of the overall average Abitur grades for the German states from 2007 to 2011.

Kultusminister der Länder in der Bundesrepublik Deutschland, n.d.). There was no statistically significant difference in average Abitur grades between females (*M* = 1.48, *SD* = 0.42) and males (*M* = 1.47, *SD* = 0.43), t (110) = -0.21, p = .832. Overall, the former junior students were quite satisfied with their Abitur results (*M* = 4.33; *SD* = 0.85; range from 2 to 5).

Immediately following their Abitur, the former junior students had made very different educational decisions. While the vast majority (80.2 %, 95 % CI [72.6 %, 87.8 %]) had decided to continue their academic education and to directly take up regular studies, some former junior students had first chosen to do voluntary work (4.7 %, 95 % CI [0.7 %, 8.7 %]) or military/civilian service (12.3 %, 95 % CI [6.0 %, 18.6 %]). Furthermore, one former participant in the junior study program at JMU Würzburg (0.9 %, 95 % CI [0.0 %, 2.7 %]) had pursued vocational training directly after completing Gymnasium; another former participant (0.9 %, 95 % CI [0.0 %, 2.7 %]) had decided to take time off to travel and to learn about other countries and cultures. Finally, one former junior student (0.9 %, 95 % CI [0.0 %, 2.7 %]) was able to start his doctoral studies immediately after school. Owing to his participation in the junior study program at JMU Würzburg, he had earned a master's degree in Computer Science at about the same time he had received his Abitur (Stumpf & Gabert, 2016).

In the following years, the timelines of the former junior students who responded to the follow-up also showed rather individualized sequences of activities. An aspect that was common to almost all sequences, however, was that at least for a certain time interval, the category "Regular studies" was listed. Even at the time of the follow-up, this was still the case for a small number of former junior students (7.5 %, 95 % CI [2.5 %, 12.5 %]). Nonetheless, the majority had meanwhile completed their regular studies and were working (61.3 %, 95 % CI [52.0 %, 70.6 %]) or pursuing a doctoral degree (19.8 %, 95 % CI [12.2 %, 27.4 %]). Two former junior students (1.9 %, 95 % CI [0.0 %, 4.5 %]) were completing their habilitation at the time of data collection. About one tenth (9.4 %, 95 % CI [3.8 %, 15.0 %]) were engaged in other activities such as postgraduate professional education or self-employment.

Regular Studies. In the course of their regular studies, almost all of the former junior students at JMU Würzburg (96.2 %, 95 % CI [92.5 %, 99.9 %]) had earned at least a bachelor's degree. Three people (2.9 %, 95 % CI [0.0 %, 6.0 %]) were still pursuing a bachelor's degree at the time of the follow-up. Accordingly, the success rate among the former junior students at JMU Würzburg was much higher than among the basic population of students who had enrolled in their regular studies at German universities during roughly the same years (78.9 %[11]; Statistisches Bundesamt, 2020a). In addition, 83.8 % (95 % CI [76.8 %, 90.8 %]) of the respondents had also secured a master's or a comparable degree during their regular studies. The results of the follow-up revealed that five former junior students (4.8 %, 95 % CI [0.7 %, 8.8 %]) were still studying for a master's degree at the time of their response.

Table 11 shows the bachelor's degrees of the respondent sample for females and males as a function of subject fields. As in their junior studies, the young adults had most frequently chosen subjects from the field of Mathematics, Natural, & Engineering Sciences in their regular studies (58.7 %). Subjects from the field of Humanities had been chosen less frequently in regular studies than in the junior study program (12.5 %, 95 % CI [6.1 %, 18.9 %]), with men choosing subjects from this field even less frequently than women. In contrast, subjects from the field Others had been chosen more frequently than in the junior study program (13.5 %, 95 % CI [6.9 %, 20.1 %]). Overall, the association between gender and subject field was significant for bachelor's degrees, χ^2 (3, n = 104) = 9.52, p = .023, (Cramer's) Φ = 0.30.

[11] Calculated as the mean of the success rates in Germany from 2006 to 2010.

Table 11

Bachelor's Degrees of the Former Junior Students as a Function of Subject Fields (n = 104)

Subject field	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Humanities	11	23.9	[11.6, 36.2]	2	3.6	[0.0, 8.5]	13	12.9	[6.4, 19.4]
	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]
Mathematics, Natural, &	23	50.0	[35.6, 64.4]	35	63.6	[50.9, 76.3]	58	57.4	[47.8, 67.0]
Engineering Sciences	1	100.0	[100.0, 100.0]	2	100.0	[100.0, 100.0]	3	100.0	[100.0, 100.0]
Law, Business, &	7	15.2	[4.8, 25.6]	9	16.4	[6.6, 26.2]	16	15.8	[8.7, 22.9]
Social Sciences	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]
Others	5	10.9	[1.9, 19.9]	9	16.4	[6.6, 26.2]	14	13.9	[7.2, 20.6]
	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]

Note. n = 101 for full number (n = 46 for females and n = 55 for males); n = 3 for full number (n = 1 for females and n = 2 for males). Gray numbers are preliminary and reflect bachelor's degrees in progress at the time of the follow-up. CI = confidence interval.

Analogous to Table 11, Table 12 shows the master's degrees of the respondent sample for females and males as a function of subject fields. Although both tables look similar at first glance, it appears that during studies for a master's degree, the popularity of subjects from the field of Mathematics, Natural, & Engineering Sciences (52.7 %, 95 % CI [42.6 %, 62.8 %]) had slightly decreased in favor of subjects from the field of Law, Business, & Social Sciences (20.4 %, 95 % CI [12.2 %, 26.8 %]). The overall association between gender and subject field for master's degrees was not significant, χ^2 (3, n = 93) = 1.65, p = .647.

Table 12

Master's Degrees of the Former Junior Students as a Function of Subject Fields (n = 93)

Subject field	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Humanities	6	14.6	[3.8, 25.4]	3	6.4	[0.0, 13.4]	9	10.2	[3.9, 16.5]
	0	0.0	[0.0, 0.0]	1	33.3	[0.0, 86.6]	1	20.0	[0.0, 55.1]
Mathematics, Natural, &	19	46.3	[31.0, 61.6]	28	59.6	[45.6, 73.6]	47	53.4	[43.0, 63.8]
Engineering Sciences	1	50.0	[0.0, 100.0]	1	33.3	[0.0, 86.6]	2	40.0	[0.0, 82.9]
Law, Business, &	10	24.4	[11.3, 37.5]	8	17.0	[6.3, 27.7]	18	20.5	[12.1, 28.9]
Social Sciences	0	0.0	[0.0, 0.0]	1	33.3	[0.0, 86.6]	1	20.0	[0.0, 55.1]
Others	6	14.6	[3.8, 25.4]	8	17.0	[6.3, 27.7]	14	15.9	[8.3, 23.5]
	1	50.0	[0.0, 100.0]	0	0.0	[0.0, 0.0]	1	20.0	[0.0, 55.1]

Note. *n* = 88 for full number (*n* = 41 for females and *n* = 47 for males); *n* = 5 for full number (*n* = 2 for females and *n* = 3 for males). Gray numbers are preliminary and reflect master's degrees in progress at the time of the follow-up. CI = confidence interval.

In their transition from school to university, a considerable number of the former junior students at JMU Würzburg (39.4 %, 95 % CI [30.0 %, 48.8 %]) had signed up for exactly the same subject as in their junior studies. In addition, about the same number (42.3 %, 95 % CI [32.8 %, 51.8 %]) had chosen a subject from at least the same subject field as in their junior studies. The rest (18.3 %, 95 % CI [10.8 %, 25.7 %]) had chosen a completely different subject.

The young adults had completed their regular studies with an average grade of 1.47 (*SD* = 0.38; range from 1.00 to 2.50; German grading system), which was again much better than the national mean of 1.93[12] (*SD* = 0.71; range from 1.00 to 4.00; German grading system) during the same period of time (Statistisches Bundesamt, 2020d). As with the Abitur, there was no significant difference in average study grades for females (*M* = 1.48, *SD* = 0.35) and males

[12] Calculated as the mean of the overall average grades in Germany from 2010, 2013, and 2018 (bachelor's and doctoral degrees excluded).

(M = 1.47, SD = 0.47), t (102) = -0.50, p = .901. The average period of study in the respondent sample was 7 semesters for a bachelor's degree (median; lower quartile 6 and upper quartile 8) and 11 semesters for a master's degree (median; lower quartile 10 and upper quartile 12). By comparison, the national median for bachelor's degrees was 7.6 semesters at the time (lower quartile 6.2 semesters and upper quartile 9.4 semesters), and the median for master's and comparable degrees was 11.4 semesters (lower quartile 9.3 semesters and upper quartile 13.5 semesters[13]; Statistisches Bundesamt, 2020c). The overall satisfaction of the former junior students with their regular study results was high (M = 4.43, SD = 0.65; range from 2 to 5).

Almost half of the former junior students (39.8 %, 95 % CI [30.4 %, 49.3 %]) stated that they had completed at least part of their regular studies at JMU Würzburg. Other frequently mentioned universities included the Technische Universität München (6.8 %, 95 % CI [1.9 %, 11.7 %]), the Duale Hochschule Baden-Württemberg (5.8 %, 95 % CI [1.3 %, 10.3 %]), LMU München (5.8 %, 95 % CI [1.3 %, 10.3 %]), and Friedrich-Alexander-Universität (FAU) Erlangen-Nürnberg (4.9 %, 95 % CI [0.7 %, 9.0 %]). In addition, some former junior students had studied at the University of Oxford, at the University of Cambridge, at Stanford University, at the Massachusetts Institute of Technology, or at Harvard University, all of which are currently ranked among the world's top universities (THE World Universities Insights Limited, 2019).

Table 13 summarizes all further academic accomplishments which the former female and male junior students had received in their regular studies. Overall, the results showed that more than half of the former junior students (55.3 %, 95 % CI [45.7 %, 64.9 %]) had been scholarship recipients during their regular studies. The young adults were most frequently supported by the German Academic Scholarship Foundation/the Max Weber Program (51.8 %,

[13] (Calculated as the mean of) medians of the total study period for bachelor's degrees and for university degrees/ State Examinations in 2018; no data for master's degrees available.

95 % CI [38.7 %, 64.9 %]) or the Germany Scholarship (19.6 %, 95 % CI [9.2 %, 30.0 %]). Overall, there was no reliable association between receipt of a scholarship and gender, χ^2 (1, n = 103) = 0.03, p = .856.

Additionally, almost one third of the former junior students (30.1 %, 95 % CI [21.2 %, 39.0 %]) stated that they had received awards or prizes during their regular studies, such as for outstanding academic performance (51.6 %, 95 % CI [36.1 %, 67.1 %]) or excellent bachelor's and master's theses (32.3 %, 95 % CI [17.8 %, 46.7 %]). The overall association between receipt of awards/prizes and gender did not reach significance, χ^2 (1, n = 103) = 0.13, p = .715.

More than one quarter of the former junior students (26.2 %, 95 % CI [17.7 %, 34.7 %]) had already been involved in publishing scientific papers in the course of their regular studies. All in all, there was a significant association with gender: Former male junior students were considerably more likely to have contributed to scientific papers than former female junior students, χ^2 (1, n = 103) = 7.45, p = .006, Φ = 0.27.

One former female and one former male junior student (1.9 %, 95 % CI [0.0 %, 4.5 %]) each had published a scientific patent during their regular studies. There was no significant association between gender and patent publication, χ^2 (1, n = 103) = 0.02, p = .878.

Table 13

Special Academic Accomplishments of the Former Junior Students During their Regular Studies (n = 103)

Accomplishment	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Scholarships	24	55.8	[41.0, 70.6]	31	59.6	[46.3, 72.9]	55	57.9	[48.0, 67.8]
	1	33.3	[0.0, 86.6]	1	20.0	[0.0, 55.1]	2	25.0	[0.0, 55.0]
Awards/prizes	13	30.2	[16.5, 43.9]	18	34.6	[21.7, 47.5]	31	32.6	[23.2, 42.0]
	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]
Publications	5	11.6	[2.0, 21.2]	20	38.5	[25.3, 51.7]	25	26.3	[17.4, 35.2]
	1	33.3	[0.0, 86.6]	1	20.0	[0.0, 55.1]	2	25.0	[0.0, 55.0]
Patents	1	2.3	[0.0, 6.8]	1	1.9	[0.0, 5.6]	2	2.1	[0.0, 5.0]
	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]

Note. *n* = 95 for full number (*n* = 43 for females and *n* = 52 for males); *n* = 8 for full number (*n* = 3 for females and *n* = 5 for males). Gray numbers are preliminary and reflect regular studies in progress at the time of the follow-up. CI = confidence interval.

On average, the respondents to the follow-up had invested about 36.21 hours per week in their regular studies (*SD* = 11.71, range from 6 to 60). There was no significant difference between males and females, t (99) = -0.28, p = .978.

Doctoral Studies. At the time of the follow-up, more than half of the former junior students (56.1 %, 95 % CI [46.3 %, 65.9 %]) had started or already completed a doctoral degree. Thus, the proportion of doctoral students in the respondent sample far exceeded the nationwide proportion of doctoral students in a cohort (9.2 %[14]; Statistisches Bundesamt, 2020c, 2020d).

[14] Calculated as the average of the relative number of doctoral degrees in 2013 and 2018 to the number of first-semester students in Germany in 2005 and 2010, respectively.

Table 14 contains the (intended) doctoral degrees of the respondents for females and males as a function of subject fields. As at previous educational stages, subjects in the field of Mathematics, Natural, & Engineering Sciences were most popular in doctoral studies; overall, more than half of the former junior students (54.7 %, 95 % CI [41.3 %, 68.1 %]) belonged to this subject field. In addition, the number of (intended) degrees in the subject field Others was comparably higher than before (20.8 %, 95 % CI [9.9 %, 31.7 %]), which is presumably due to the high prevalence of study-related doctoral degrees in medicine (Schade, 2021). On the whole, the association between gender and subject field was not significant for doctoral degrees, χ^2 (3, n = 53) = 3.11, p = .375.

Table 14

Doctoral Degrees of the Former Junior Students as a Function of Subject Field (n = 53)

Subject field	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Humanities	2	14.3	[0.0, 32.6]	0	0.0	[0.0, 0.0]	2	7.1	[0.0, 16.6]
	1	8.3	[0.0, 23.9]	1	7.7	[0.0, 22.2]	2	8.0	[0.0, 18.6]
Mathematics, Natural, &	8	57.1	[31.2, 83.0]	8	57.1	[31.2, 83.0]	16	57.1	[38.8, 75.4]
Engineering Sciences	5	41.7	[13.8, 69.6]	8	61.5	[35.0, 88.0]	13	52.0	[32.4, 71.6]
Law, Business, &	1	7.1	[0.0, 20.6]	1	7.1	[0.0, 20.6]	2	7.1	[0.0, 16.6]
Social Sciences	5	41.7	[13.8, 69.6]	2	15.4	[0.0, 35.0]	7	28.0	[10.4, 45.6]
Others	3	21.4	[0.0, 42.9]	5	35.7	[10.6, 60.8]	8	28.6	[11.9, 45.3]
	1	8.3	[0.0, 23.9]	2	15.4	[0.0, 35.0]	3	12.0	[0.0, 24.7]

Note. n = 28 for full number (n = 14 for females and n = 14 for males); n = 25 for full number (n = 12 for females and n = 13 for males). Gray numbers are preliminary and reflect doctoral studies in progress at the time of the follow-up. CI = confidence interval.

Of those respondents who had already completed their doctoral studies at the time of the follow-up, more than one third (36.4 %, 95 % CI [16.3 %, 56.5 %]) had received a “summa cum laude" and exactly half (50.0 %, 95 % CI [29.1 %, 70.9 %]) had received a "magna cum laude". One person each had obtained a "cum laude" (4.5 %, 95 % CI [0.0 %, 13.2 %]), a "satis bene" (4.5 %, 95 % CI [0.0 %, 13.2 %]), and a "rite" (4.5 %, 95 % CI [0.0 %, 13.2 %]). The average period of study for a doctoral degree amounted to 7 semesters in the respondent sample (median; lower quartile 6 and upper quartile 8). On average, the former junior students were satisfied with their doctoral study results (M = 3.98, SD = 0.90; range from 2 to 5), albeit, from a descriptive perspective, not quite as satisfied as with their Abitur results or the results of their regular studies.

About one fourth of those who had chosen to pursue doctoral studies (26.8 %, 95 % CI [13.3 %, 40.4 %]) named JMU Würzburg as their research institution. Other repeatedly mentioned universities were FAU Erlangen-Nürnberg (4.9 %, 95 % CI [0.0 %, 11.5 %]), LMU München (4.9 %, 95 % CI [0.0 %, 11.5 %]), the Technische Universität Berlin (4.9 %, 95 % CI [0.0 %, 11.5 %]), the University of Cambridge (4.9 %, 95 % CI [0.0 %, 11.5 %]), and the University of Oxford (4.9 %, 95 % CI [0.0 %, 11.5 %]).

Table 15 summarizes all special academic accomplishments that the former female and male junior students had achieved in their doctoral studies. What stands out in the table is that approximately half (41.5 %, 95 % CI [26.4 %, 56.5 %]) had again received a scholarship. The funding institutions were diverse. The association between receipt of a scholarship and gender tended to be significant, χ^2 (1, n = 41) = 1.17, p = .279, with considerably more women receiving scholarships than men.

About one quarter of the respondent sample (22.0 %, 95 % CI [9.3 %, 34.6 %]) reported having received awards/prizes in their doctoral studies. Poster prizes (33.3 %, 95 % CI [2.5 %, 64.1 %]), prizes for talks (22.2 %, 95 % CI [0.0 %, 49.4 %]), and university awards (22.2 %, 95 % CI [0.0 %, 49.4 %]) were frequently mentioned, for instance. There was no significant association between receiving awards/prizes and gender, χ^2 (1, n = 41) = 1.48, p = .224.

Almost three quarters of the former junior students (73.2 %, 95 % CI [59.6 %, 86.7 %]) had been involved in the publication of scientific papers in their doctoral studies. Unlike in regular studies, however, there was no reliable difference between males and females in the number of publications, χ^2 (1, n = 41) = 1.33, p = .249.

One former female junior student and two former male junior students (7.3 %, 95 % CI [0.0 %, 15.3 %]) each had published a scientific patent as doctoral students. The association between gender and patent publication was not significant, χ^2 (1, n = 41) = 0.31, p = .578.

Table 15

Special Academic Accomplishments of the Former Junior Students During their Doctoral Studies (n = 41)

Accomplishment	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Scholarships	7	70.0	[41.6, 98.4]	3	30.0	[1.6, 58.4]	10	50.0	[28.1, 71.9]
	3	30.0	[1.6, 58.4]	4	36.4	[7.9, 64.8]	7	33.3	[13.2, 53.5]
Awards/prizes	5	50.0	[19.0, 81.0]	1	10.0	[0.0, 28.6]	6	30.0	[9.9, 50.1]
	1	10.0	[0.0, 26.8]	2	18.2	[0.0, 41.0]	3	14.3	[0.0, 29.3]
Publications	7	70.0	[41.6, 98.4]	9	90.0	[71.4, 100.0]	17	80.0	[62.5, 97.5]
	6	60.0	[29.6, 90.4]	8	72.7	[46.4, 99.0]	14	66.7	[46.5, 86.8]
Patents	0	0.0	[0.0, 0.0]	1	10.0	[0.0, 28.6]	1	5.0	[0.0, 14.6]
	1	10.0	[0.0, 28.6]	1	9.1	[0.0, 26.1]	2	9.5	[0.0, 22.1]

Note. n = 20 for full number (n = 10 for females and n = 10 for males); n = 21 for full number (n = 10 for females and n = 11 for males). Gray numbers are preliminary and reflect doctoral studies in progress at the time of the follow-up. CI = confidence interval.

On average, the respondents had invested about 44.67 hours per week in their doctoral degrees (SD = 15.57; range from 8 to 80). Once more, there was no difference between males and females in terms of invested time, t (37) = -0.88, p = .382.

5.2.3 Professional Careers of Former Junior Students at JMU Würzburg

In the literature on junior study programs in Germany, there are no studies to date that have recorded the professional growth of former participants. Since it was to be expected that some of those former junior students who had participated in the junior study program at JMU Würzburg between the winter semester of 2004/2005 and the summer semester of 2011 would already have entered the workforce by the time of the follow-up, a set of research questions was generated which aimed to find out what their current job situation looked like and what their professional goals were. As it turned out, the proportion of former junior students who were already pursuing their professional careers at the time of data collection was about two thirds. Of these, slightly more than two thirds (about 70 %) had started working directly after their regular studies. The rest (about 30 %) reported that they had started working only after completing their doctoral degree or that they were currently pursuing their doctoral degree alongside work. The next section provides basic information on the current job situation of former junior students. Similar to the previous section, comparative values from the Statistisches Bundesamt on the basic population of employees in Germany are reported at selected points to facilitate interpretation of the results.

Professional Fields. Table 16 shows the distribution of the former junior students at JMU Würzburg across their professional fields for females and males. Among females, more than one third (37.5 %, 95 % CI [20.7 %, 54.3 %]) were working in the field of Mathematics, Natural, & Engineering Sciences, and approximately half (43.8 %, 95 % CI [26.6 %, 60.9 %]) were working in the field of Law, Business, & Social Sciences. Among males, half (48.8 %, 95 % CI [33.5 %, 64.1 %]) were working in the field of Mathematics, Natural, & Engineering Sciences, and about one third (34.2 %, 95 % CI [19.6 %, 48.7 %]) were working in the field of Law, Business, & Social Sciences. In the field Others, men (17.1 %, 95 % CI [5.6 %, 28.6 %]) were working descriptively more often than women (15.6 %, 95 % CI [3.0 %, 28.2 %]).

Among both genders, almost none of the respondents (1.4 %, 95 % CI [0.0 %, 4.0 %]) were employed in the field of Humanities. There was no significant association between professional field and gender, χ^2 (3, n = 73) = 2.26, p = .521.

Table 16

Jobs of the Former Junior Students as a Function of Professional Field

Professional field	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Humanities	1	3.1	[0.0, 9.2]	0	0.0	[0.0, 0.0]	1	1.4	[0.0, 4.0]
Mathematics, Natural, & Engineering Sciences	12	37.5	[20.7, 54.3]	20	48.8	[33.5, 64.1]	33	43.8	[32.5, 55.2]
Law, Business, & Social Sciences	14	43.8	[26.6, 60.9]	14	34.2	[19.6, 48.7]	28	38.4	[27.2, 49.5]
Others	5	15.6	[3.0, 28.2]	7	17.1	[5.6, 28.6]	11	16.4	[7.9, 24.9]

Note. n = 73 for full number (n = 32 for females and n = 41 for males). CI = confidence interval.

Professional Status and Income. As can be seen in Table 17, former female and male junior students held quite diverse professional statuses at the time of the follow-up. Women were consistently most likely to hold positions with delegation powers (60.0 %, 95 % CI [40.8 %, 79.2 %]) or management functions (20.0 %, 95 % CI [4.3 %, 35.7 %]). Among men, in contrast, professional statuses were more diverse. About one third held positions with no powers (31.3 %, 95 % CI [15.2 %, 47.4 %]), another third held positions with delegation powers (31.3 %, 95 % CI [15.2 %, 47.4 %]), and about one fifth held positions with supervisor functions (21.1 %, 95 % CI [7.6 %, 36.2 %]). Management positions were held by about one seventh of former male junior students (15.6 %, 95 % CI [3.0 %, 28.2 %]). The association between professional status and gender was significant, χ^2 (3, n = 57) = 6.79, p = .079, albeit with a small effect size of (Cramer's) Φ = 0.35.

Table 17

Professional Status of the Former Junior Students

Professional status	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
No powers	3	12.0	[0.0, 24.7]	10	31.3	[15.2, 47.4]	13	22.8	[11.9, 33.7]
Delegation powers	15	60.0	[40.8, 79.2]	10	31.3	[15.2, 47.4]	25	43.9	[31.0, 56.7]
Management function	5	20.0	[4.3, 35.7]	5	15.6	[3.0, 28.2]	10	17.5	[7.7, 24.7]
Supervisor function	2	8.0	[0.0, 18.6]	7	21.9	[7.6, 36.2]	9	15.8	[6.3, 25.3]

Note. n = 57 for full number (n = 25 for females and n = 32 for males). CI = confidence interval.

Table 18 shows the distribution of the respondent sample across all income categories for females and males. Whereas the picture was again very consistent for women, with almost all of them (91.6 %, 95 % CI [80.5 %, 100.0 %]) reporting a current monthly gross income of "Up to 3,000 euros" to "Up to 8,000 euros", this was true for fewer men (74.2 %, 95 % CI [58.8 %, 89.6 %]). In comparison to the women's distribution, the men's distribution spanned almost all income categories, with 16.1 % of the men (95 % CI [3.2 %, 29.0 %]) even occupying the two highest ranges. Nonetheless, the association between income and gender was not significant, χ^2 (9, n = 55) = 6.48, p = .691. Regardless of gender, the average monthly gross income of the respondents most likely exceeded the average gross income of the general population in Germany, which is currently 3,708 euros per month according to the Statistisches Bundesamt (2019).

Table 18

Income of the Former Junior Students

Income	Female			Male			Full number		
	n	%	95 % CI	*n*	%	95 % CI	*n*	%	95 % CI
Up to 1,000 euros	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]	0	0.0	[0.0, 0.0]
Up to 2,000 euros	1	4.2	[0.0, 12.2]	2	6.5	[0.0, 15.2]	3	5.5	[0.0, 11.5]
Up to 3,000 euros	2	8.3	[0.0, 19.3]	1	3.2	[0.0, 9.4]	3	5.5	[0.0, 11.5]
Up to 4,000 euros	6	25.0	[7.7, 42.3]	5	16.1	[3.2, 29.0]	11	20.0	[9.4, 30.6]
Up to 5,000 euros	6	25.0	[7.7, 42.3]	7	22.6	[7.9, 37.3]	13	23.6	[12.4, 34.9]
Up to 6,000 euros	2	8.3	[0.0, 19.3]	5	16.1	[3.2, 29.0]	7	12.7	[3.9, 21.5]
Up to 7,000 euros	4	16.7	[1.8, 31.6]	3	9.7	[0.0, 20.1]	7	12.7	[3.9, 21.5]
Up to 8,000 euros	2	8.3	[0.0, 19.3]	2	6.5	[0.0, 15.2]	4	7.3	[0.4, 14.1]
Up to 9,000 euros	1	4.2	[0.0, 12.2]	1	3.2	[0.0, 9.4]	2	3.6	[0.0, 8.6]
Up to 10,000 euros	0	0.0	[0.0, 0.0]	1	3.2	[0.0, 9.4]	1	1.8	[0.0, 5.3]
More than 10,000 euros	0	0.0	[0.0, 0.0]	4	12.9	[1.1, 24.7]	4	7.3	[0.4, 14.1]

Note. n = 55 for full number (n = 24 for females and n = 31 for males). CI = confidence interval.

Professional Situation. On average, the respondents to the follow-up were quite satisfied with their current job situation (M = 4.07, SD = 0.90; range from 2 to 5). Their contractual working hours averaged 37.62 each week (SD = 6.27; range from 15 to 45), with no significant difference in contractual working hours for females and males (see Table 19). The actual working hours of the respondents totaled 44.04 each week (SD = 13.42; range from 15 to 90). Unlike contractual working hours, there was a significant difference in actual working hours for females and males, with the latter working significantly more extra hours each week than the former (see also Table 19). The difference in the means was 5.29 hours with 95 % CI [-0.92, 11.50].

Table 19

Working Hours of the Former Junior Students

Working time	Female		Male		*t* (54)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Contractual working hours	37.15	6.59	38.96	3.33	1.25	.220	0.36
Actual working hours	41.83	9.53	47.13	13.64	1.62	.110	0.44

Note. *n* is 25 and 24, respectively, for females and *n* is 31 and 32, respectively, for males. Effect sizes were calculated on Psychometrica (Lenhard & Lenhard, 2016).

Professional Goals. The most prevalent categories that were inferred qualitatively from the former junior students' answers to the question about their future professional goals were "(Scientific) progress", "Personal advancement/professional expertise", "Professional advancement", "Self-employment", "High(er) income", and "Work-life balance". Table 20 provides example quotes for all of these categories.

Table 20

Former Junior Students' Answers to the Question "What are your future professional goals?"

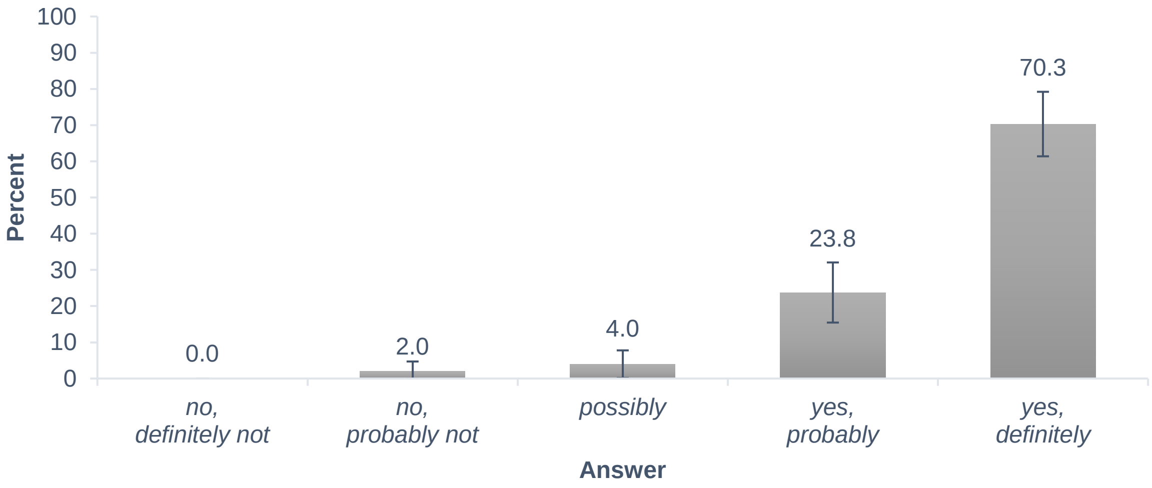
Professional goal	Example quote(s)
(Scientific) progress	"I want to generate scientifically significant research output." "I would like to make a meaningful contribution to this society/world with my skills and knowledge."
Personal advancement/ professional expertise	"Never stand still, i.e., I always want to develop professionally, socially, and personally. I want to become a proven expert in my field." "I have planned no major changes, rather lateral development, i.e., explore further work and thematic fields and competencies."
Professional advancement	"First, I would like to advance to managing the department, and then I want to work as a managing director." "I want to assume responsibility for a larger team."
Self-employment	"I want to start my own business." "I want to become self-employed, most likely as an independent laboratory physician."
High(er) income	"I aspire to a higher paid position in the private sector."
Work-life balance	"I want to integrate family planning and career."

5.2.4 Retrospective Evaluation of the Junior Study Program at JMU Würzburg

Another focus of the follow-up concerned the retrospective evaluation of the junior study program at JMU Würzburg by the former participants. Research questions in this context were whether former participants would attend the junior study program again from their current point of view and what impact their participation in the junior study program had had on their long-term academic development. As depicted in Figure 20, almost all respondents (94.1 %, 95 % CI [89.5 %, 98.7 %]) asserted that they would attend the junior study program at JMU Würzburg again from their current perspective. There was no former junior student (0.0 %, 95 % CI [0.0 %, 0.0 %]) who would *definitely not* attend the junior study program again. Only a minority were undecided in their response (4.0 %, 95 % CI [0.2 %, 7.8 %]) or would *probably not* participate in the junior study program again (2.0 %, 95 % CI [0.0 %, 4.7 %]).

Figure 20

Former Junior Students' Answers to the Question "From your current point of view, would you attend the junior study program again?"



Note. n = 101. Error bars represent 95 % confidence intervals.

Table 21 summarizes the responses of the former junior students to the question of which experiences from their junior studies they felt were most important for their further academic development. More than three quarters (78.2 %, 95 % CI [70.1 %, 86.3 %]) considered gaining insight into their intended subjects as momentous. Moreover, for almost two thirds each, getting to know everyday student life (65.3 %, 95 % CI [56.0 %, 74.6 %]) and gaining insight into university structures (57.4 %, 95 % CI [47.8 %, 67.0 %]) appeared to be important experiences. In addition, about half of the former junior students each identified acquiring knowledge (51.5 %, 95 % CI [41.8 %, 61.2 %]) and assuming personal responsibility (49.5 %, 95 % CI [39.7 %, 59.3 %]) as principal influences. In contrast, getting to know one's personal resilience limit (35.6 %, 95 % CI [26.3 %, 44.9 %]) and acquiring general learning strategies (15.8 %, 95 % CI [8.7 %, 22.9 %]) were hardly perceived to be relevant.

Table 21

Number and Percentage of the Former Junior Students Who Regarded the Respective Item as (Most) Important for Their Subsequent Academic Development

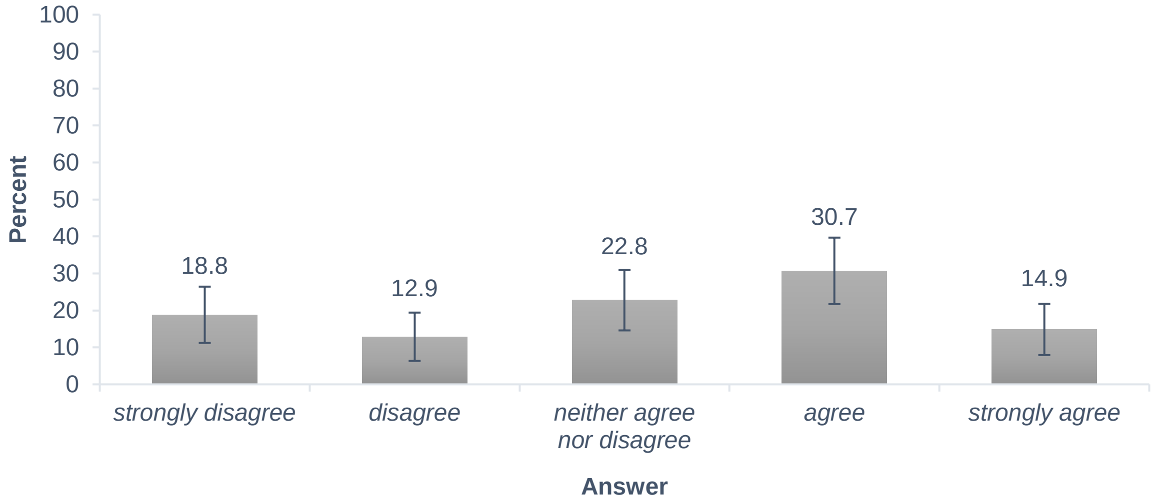
Item	Full number		
	n	%	95 % CI
"Getting to know everyday student life"	66	65.3	[56.0, 74.6]
"Gaining insight into university structures"	58	57.4	[47.8, 67.0]
"Assuming personal responsibility"	50	49.5	[39.7, 59.3]
"Acquiring knowledge"	52	51.5	[41.8, 61.2]
"Acquiring general learning strategies"	16	15.8	[8.7, 22.9]
"Gaining insight into one's intended subject"	79	78.2	[70.1, 86.3]
"Getting to know one's personal resilience limit"	36	35.6	[26.3, 44.9]

Note. *n* = 101. CI = confidence interval. Response format was multiple choice.

It is apparent from Figure 21 that the former junior students' reactions to the statement that their experiences as junior students had helped them avoid changing subjects in their regular studies were mixed. While some respondents either *strongly disagreed* (18.8 %, 95 % CI [11.2 %, 26.4 %]) or *disagreed* (12.9 %, 95 % CI [6.4 %, 19.4 %]) with the statement, almost half of the former junior students *agreed* (30.7 %, 95 % CI [21.7 %, 39.7 %]) or *strongly agreed* (14.9 %, 95 % CI [8.0 %, 21.8 %]). About one quarter of the former junior students (22.8 %, 95 % CI [14.6 %, 31.0 %]) were uncertain of whether their participation in the junior study program had helped them avoid changing subjects in their regular studies.

Figure 21

Respondents' Agreement to the Statement "Due to my experience as a junior student, I was able to avoid changing subjects in my regular studies."

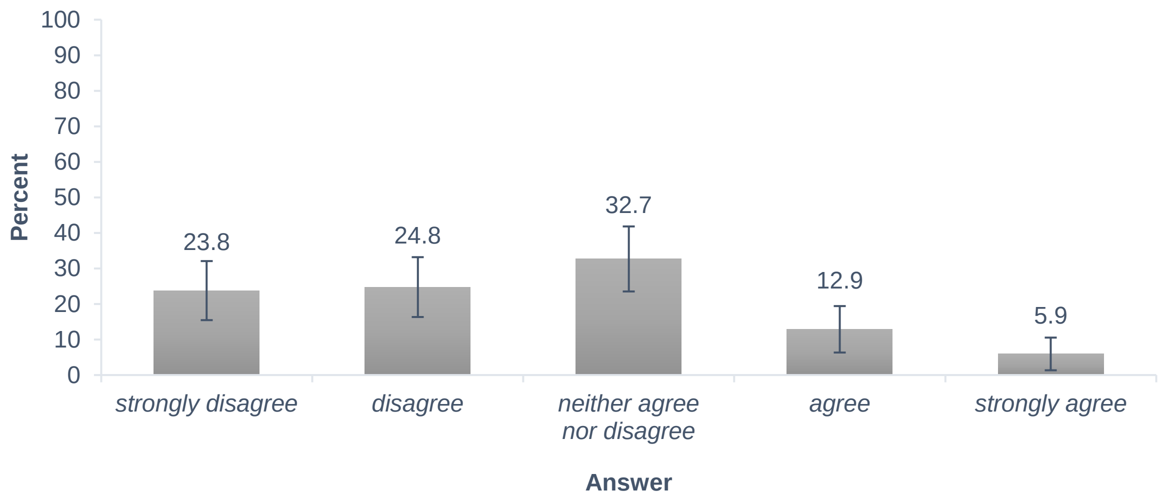


Note. *n* = 101. Error bars represent 95 % confidence intervals.

Finally, the respondents to the follow-up tended to reject the statement that they were now ahead of their former classmates in their professional careers due to their experiences as junior students (see Figure 22). Overall, no more than one fifth of those who responded *agreed* (12.9 %, 95 % CI [6.4 %, 19.4 %]) or *strongly agreed* (5.9 %, 95 % CI [1.3 %, 10.5 %]) with the statement, whereas about half *strongly disagreed* (23.8 %, 95 % CI [15.5 %, 32.1 %]) or *disagreed* (24.8 %, 95 % CI [16.4 %, 33.2 %]). About one third of the respondents (32.7 %, 95 % CI [23.6 %, 41.8 %]) were undecided in their assessment of the statement.

Figure 22

Respondents' Agreement to the Statement "Due to my experience as a junior student, I am now ahead of my former classmates in my professional career."



Note. n = 101. Error bars represent 95 % confidence intervals.

5.2.5 Psychological Variables of Former Junior Students at JMU Würzburg

A final set of research questions that informed the design of the follow-up questionnaire had resulted from the fact that relatively little attention has been paid so far to (former) junior students' psychological characteristics compared to their performance-related characteristics. Therefore, the aim was to find out what the personality traits and vocational interests of former junior students were like. The BFI-10 (Rammstedt & John, 2007) results for former female and male junior students at JMU Würzburg are summarized in Table 22. It can be seen from this table that both genders scored highest on the Conscientiousness scale and lowest on the Neuroticism scale. Another interesting finding was that women showed higher scores than men across all scales. Except for the Conscientiousness, the Extraversion, and the Neuroticism scales, however, there were no considerable gender differences. For the Neuroticism scale, the difference in the means between females and males was -0.58 with 95 % CI [-0.98, -0.18], corresponding to an effect size of d = -0.58, which can be classified as medium according to

Cohen (1988). For the Extraversion scale, the difference in the means was -0.31 with 95 % CI [-0.74, -0.22]; the associated effect size was small *d* = -0.30. Finally, the difference in the means for the Conscientiousness scale was -0.50 with 95 % CI [-0.78, -0.21], indicating a medium effect size of *d* = -0.70.

Table 22

Personality Profile of the Former Junior Students

Personality scale	Female		Male		*t* (99)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Neuroticism	3.07	1.00	2.49	1.01	-2.85	.005	-0.58
Extraversion	3.36	1.06	3.04	1.10	-1.43	.155	-0.30
Openness	3.64	0.88	3.50	1.02	-0.75	.456	-0.15
Agreeableness	3.32	0.74	3.22	0.86	-0.61	.542	-0.12
Conscientiousness	4.18	0.65	3.68	0.77	-3.48	.001	-0.70

Note. *n* = 45 for females and *n* = 56 for males. Effect sizes were calculated on Psychometrica (Lenhard & Lenhard, 2016).

Using the relevant items from the FES 16^{plus} R (Kabisch & Karpowski, 2016), the follow-up questionnaire also assessed the vocational interests of the former junior students in the respondent sample. Table 23 includes the means and standard deviations of former female and male junior students on all interest scales. What stands out in this table is that, for both genders, mean scores were well above the theoretical scale means of 2.50. Equally important, as with the BFI-10 results, females demonstrated consistently higher scores than males on all FES 16^{plus} R interest scales. An exception was the Realistic Interests scale, where men scored higher than women. Nevertheless, gender differences were significant only for social interests.

Here, the difference in the means was -0.24 with 95 % CI [-0.54, 0.05], whereby females demonstrated higher scores than males.

Table 23

Vocational Interest Profile of the Former Junior Students

Interest scale	Female		Male		*t* (99)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Realistic	3.79	0.90	3.97	0.90	1.02	.309	0.20
Investigative	3.73	0.96	3.63	0.95	-0.57	.573	-0.11
Artistic	2.94	1.15	2.68	1.12	-1.17	.244	-0.23
Social	4.24	0.70	4.00	0.77	-1.63	.107	-0.32
Enterprising	3.59	0.89	3.43	0.93	-0.88	.382	-0.18
Conventional	3.96	0.85	3.88	0.91	-0.46	.649	-0.09

Note. n = 45 for females and n = 56 for males. Effect sizes were calculated on Psychometrica (Lenhard & Lenhard, 2016).

5.3 Discussion

Research Issue 1 aimed to comprehensively document the long-term educational trajectories of former junior students well beyond their school years. Based on the previously available literature on junior study programs in Germany, several research questions were generated, which subsequently shaped the design of an extensive follow-up of former participants in the junior study program at JMU Würzburg. The follow-up ran over a 16-week period from October 2019 to February 2020. In the next subchapter, the results of the follow-up are discussed along the lines of the generated research questions.

Academic Credentials of Former Junior Students. Previous studies on junior study programs in Germany had impressively attested to the fact that those adolescents participating in the gifted education measure constitute a particularly high-performing group (Deutsche Telekom Stiftung, 2006, 2008, 2013, 2018a, 2018b; Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007, 2011; Stumpf, 2011; Stumpf & Gabert, 2016). Correspondingly, the first set of research questions used to design the follow-up questionnaire aimed to ascertain whether former junior students would also demonstrate as high levels of performance in their regular studies as they did in school and in their junior studies. The results of Research Issue 1 contribute to the current research literature on junior study programs in Germany in a variety of ways.

First of all, the findings in Research Issue 1 corroborate the observations of previous studies examining the educational trajectories of former junior students either pro- or retrospectively within a short period of time after their Abitur. For example, in agreement with Stumpf and Gabert (2016), it was found that former junior students had excellent Abitur results. In fact, the average Abitur grade of the former junior students in the sample for Research Issue 1 was much better than the national average reported by the Statistisches Bundesamt for the relevant cohorts (cf. Sekretariat der Ständigen Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland, n.d.). Furthermore, the vast majority of the former junior students took up regular studies directly after school (e.g., Kaden, 2016; Katzarow & Grönholdt, 2014; Katzarow & Hübner, 2011; Solzbacher, 2006–2007; Stumpf & Gabert, 2016). About four fifths decided to enter regular studies immediately following their Abitur, while only about one fifth pursued other activities such as voluntary work or military/civilian service. When transitioning to regular studies, two fifths of the respondents had continued studying exactly the same subject as in their junior studies, and just under half had chosen a subject from at least the same subject field as in their junior studies. Only about one fifth had decided on a completely different subject. These figures are roughly comparable to those of Stumpf and Gabert (2016), Stumpf et al. (2011), and Kaden (2016), who reported that nearly half of all former junior students retained the subject from their junior studies in their regular studies, whereas the other half chose either a related or a completely different subject in their regular studies (Kaden, 2016; Stumpf & Gabert, 2016; Stumpf et al., 2011). Finally, almost half of those who responded to the follow-up stated that they had completed at least part of their regular studies at JMU Würzburg. Hence, the proportion of former junior students who remain at the same institution after their junior studies appears to be somewhat higher at JMU Würzburg than at other German universities. Indeed, Kaden (2016) found that the nationwide proportion of former junior students who continue to study at the institution at which they had attended their junior study program was just about one third, and Katzarow and Grönholdt (2014) even identified a proportion of only about one quarter based on the data from the fifth report on the junior study program at the Technische Universität Dresden.

Second, the results of Research Issue 1 clearly extend those of previous studies by showing that the educational trajectories of former junior students continue to be successful long after their Abitur. Particularly noteworthy in this context is the finding that at the time of their response, almost all of the former participants in the junior study program at JMU Würzburg had earned a bachelor’s and a master’s degree – far more than would have been expected, given the success rate among regular students at German universities in the relevant interval (Statistisches Bundesamt, 2020a). Moreover, the average grade of the former junior students in their regular studies proved to be much better than the average grade of German regular students in roughly the same years (Statistisches Bundesamt, 2020d). The former junior students’ average period of study for a bachelor’s and a master’s degree was at least slightly below the national reference value (Statistisches Bundesamt, 2020c).

However, it was not only the basic information provided by the former junior students on their regular studies in the follow-up that implied high academic performance in the long term. Even alongside their regular studies, they had managed to attain considerable academic honors: For example, about one third had received awards/prizes in their regular studies, such as for outstanding academic performance or excellent bachelor's and master's theses. Furthermore, more than one quarter had been involved in publishing scientific papers, and more than half had been awarded scholarships. The latter finding appears particularly impressive given the fact that the organizations for the promotion of young talent in Germany, including both the German Academic Scholarship Foundation and the Germany Scholarship, collectively support no more than 1 % of German regular students (Statistisches Bundesamt, n.d.; Studienstiftung des Deutschen Volkes e.V., n.d.).

Another impressive outcome of Research Issue 1 was that more than half of those who responded to the follow-up had initiated or already completed their doctoral studies at the time of their response. Thus, the proportion of doctoral students in the respondent sample was more than 5 times higher than the nationwide proportion of doctoral students in a cohort (cf. Statistisches Bundesamt, 2020c, 2020d). In addition, more than one third of those doctoral students who had already completed their thesis at the time of the follow-up had received a "summa cum laude" and exactly half had received a "magna cum laude".

As in their regular studies, the former junior students had also made substantial achievements over the course of their doctoral studies. In detail, almost half had received a scholarship, with apparently more women than men obtaining support from scholarship providers. Moreover, well over one quarter had been honored with awards/prizes, such as poster prizes, prizes for talks, or university awards, while more than three quarters had been involved in the publication of scientific papers. Finally, two former junior students reported having published a scientific patent during their doctoral studies.

Professional Careers of Former Junior Students. Another set of research questions that guided the design of the follow-up questionnaire dealt with former junior students' current job situation. The questions had resulted from the fact that previous studies had not yet documented what kinds of jobs former junior students typically choose and how successful they are in their professional careers. However, even the findings in Research Issue 1 allow no more than a tentative answer to these research questions since, at the time of the follow-up, only about half of the former junior students at JMU Würzburg were already pursuing professional activities. The results on the professional situation of the former junior students should therefore be taken with caution until they are confirmed by future research.

Overall, the results of Research Issue 1 indicated that among those former junior students who had already entered the workforce at the time of the follow-up, almost equal numbers were holding jobs in the field of Mathematics, Natural, & Engineering Sciences and in the field of Law, Business, & Social Sciences. This was somewhat surprising, as in their regular and doctoral studies, the former junior students had consistently shown a strong preference for subjects from the field of Mathematics, Natural, & Engineering Sciences. A possible explanation for this shift in preference might be that, besides factors such as interests and talents that are important for subject choice in the context of academic education, other factors such as income and professional advancement come into play when choosing a career.

In addition to the former junior students' professional fields, the follow-up also collected indicators of their career success. These indicators included average gross income and professional status, with the first indicator in particular turning out to be high. The average gross income of the former junior students was mostly in the range of "Up to 4,000 euros" to "Up to 7,000 euros" per month, clearly exceeding the average gross income of the working population in Germany (cf. Statistisches Bundesamt, 2019). Among men, a notable proportion even reported earning an average of "Up to 10,000 euros" or more per month, putting them well at the upper end of the overall German income distribution. This was not the case for women, however; here, the majority reported earning between "Up to 3,000 euros" and "Up to 8,000 euros". Compared to the monthly gross income of the former junior students, their professional statuses were quite heterogeneous: While most women held mid-level positions involving delegation or management functions, men were equally represented across all professional statuses (i.e., “No powers”, “Delegation powers”, “Management function”, and “Supervisor function”). This heterogeneity might stem from the fact that the former junior students at JMU Würzburg were not (yet) particularly advanced in their professional careers at the time of the follow-up and that their current professional status was only a temporary stage on their way to the peak of their careers.

Finally, the follow-up data on the current job situation of the former junior students revealed that their contractual working hours averaged almost 40 each week. This was essentially in line with the weekly average of contractual working hours for the total German workforce in 2019 as reported by the Statistisches Bundesamt (cf. Statistisches Bundesamt, 2021). No difference between females and males could be identified. Contrastingly, the actual working hours of the former junior students totaled an average of about 45 hours each week and demonstrated a significant gender effect, with men investing considerably more extra time in their jobs than women. A somewhat similar result can be found in Lubinski and Benbow (2006), who reported that the percentage of extraordinarily gifted individuals who are willing to work less than 40 hours per week is substantially higher among women than among men. It is reasonable to assume that such gender effects have clear impacts on the professional success of gifted individuals. For example, Lubinski and Benbow (2006) point to the differences that are likely to accrue in research productivity over a period of 5 to 10 years between researchers who work 45 hours per week and those who work 65 hours per week.

Retrospective Evaluation of the Junior Study Program. In addition to the set of research questions relating to the academic credentials and the current professional situation of the former junior students, Research Issue 1 also explored the young adults’ retrospective view of the junior study program at JMU Würzburg. In line with previous studies, the results suggest that the gifted education measure has beneficial impacts on former junior students' subsequent educational trajectories, though it should be noted that at the time of the follow-up, these impacts were sometimes no longer as clearly observable as they were, for example, during former junior students' transition from school to regular studies.

Nevertheless, an impressive finding of Research Issue 1 was that almost all the young adults would attend the junior study program at JMU Würzburg again from their current perspective. This indicates that former junior students not only give the program a positive evaluation shortly after their participation, as reported by Stumpf et al. (2011), but also have positive memories of it several years later. A possible explanation for this finding might be that most former participants had experiences as junior students that had helped them advance in their educational trajectories. Accordingly, the results of Research Issue 1 further showed that, with regard to their further academic development, the former junior students in the respondent sample attributed particular importance to those experiences from their junior studies that were associated with a clear expansion of their school routine. In particular, the experience of gaining insight into their intended subjects was perceived as momentous by three quarters of those who responded to the follow-up. In addition, for almost two thirds each, getting to know everyday student life and gaining insight into university structures appeared to be important experiences. The results match those of previous studies, which found that participation in junior studies exerts an influence on young people's subject choice in their regular studies (see Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011). Furthermore, the respondents in Stumpf and Gabert (2016) had stated that their experiences in the junior study program had helped them orientate themselves in higher education institutions and that this had been one of the reasons why they had experienced advantages over other first-semester students at the start of their regular studies (Gabert, 2014; Stumpf & Gabert, 2016).

In the follow-up, just half of the former junior students identified acquiring knowledge as an important experience. For comparison, at the time of their transition from school to regular studies, almost all former junior students had admitted that gaining knowledge was a positive consequence of their junior studies (Stumpf & Gabert, 2016). This seemingly contradictory result might be attributed to the fact that potential advantages that former junior students have over regular first-semester students as a result of participating in the gifted education measure are most noticeable in the initial phases of their regular studies and then level off over the course of the semesters, resulting in fewer affirmative responses about the importance of the statement with a time gap of several years. Finally, as in Stumpf and Gabert (2016), acquiring general learning strategies was hardly perceived to be relevant by the former junior students in Research Issue 1.

The former junior students' reactions to the statement that their experiences as junior students had helped them avoid changing subjects in their regular studies were rather mixed. This can probably be explained by the fact that the young adults had different experiences in their junior studies: On the one hand, it is possible that for some former junior students, participation in the junior study program had led to a revision of their intended subject choice and to a successful reorientation with regard to their regular studies (cf. Katzarow & Grönholdt, 2014); as a result, they might have *(strongly) agreed* with the statement. On the other hand, it is conceivable that former junior students whose experiences in the junior study program had confirmed their intended subject choice for their regular studies (cf. Katzarow & Grönholdt, 2014) might have *(strongly) disagreed* with the statement. They would probably have chosen exactly the same subject for their regular studies even if they had not participated in the junior study program. The reverse argumentation might apply to those former junior students who, despite having participated in the junior study program, had changed subjects again in their regular studies; they probably also *(strongly) disagreed* with the statement.

Finally, the results of Research Issue 1 indicated that at the time of their response, the former junior students (with a few exceptions) tended not to see themselves as being ahead of their former classmates in their professional careers as a result of their participation in the junior study program. In line with the findings reported above, it can be assumed that most former junior students viewed their participation in the junior study program primarily in terms of expanding their school routine and obtaining career orientation; accordingly, most of them might have *(strongly) disagreed* with the statement that they were now ahead of their former classmates in their professional careers. This assumption is also consistent with previous studies reporting that the clear majority of active junior students consider junior study programs to be an enriching rather than an accelerating experience (Deutsche Telekom Stiftung, 2008; Solzbacher, 2006–2007, 2011). Only a minority of the former junior students at JMU Würzburg seem to have used their participation in the junior study program to earn credits and later have them counted toward their regular studies; these former junior students might have *(strongly) agreed* with the statement.

Psychological Variables of Former Junior Students. To help compensate for the relative lack of previous research on the psychological versus performance-related characteristics of junior students, the final section of the follow-up questionnaire asked the former junior students at JMU Würzburg to complete standard personality and interest measures. The results of Research Issue 1 thus give a general overview of the personality and interest profiles of former junior students.

As far as personality traits are concerned, it can first be stated descriptively that the former junior students in the respondent sample scored highest on the Conscientiousness scale and lowest on the Neuroticism scale. Therefore, it can be assumed that former junior students are generally determined, persistent, disciplined, reliable, and have a rather balanced temperament. In addition, there were differences between males' and females' scores on the

Neuroticism, the Extraversion, and the Conscientiousness scales, with the latter consistently scoring higher than the former. Interestingly, such gender differences have been repeatedly found in previous studies and have been linked to evolutionary or sociocultural influences, for example (e.g., Weisberg et al., 2011).

The most striking result to emerge from the interest measures was that the former junior students at JMU Würzburg had high scores across all scales except the Artistic scale. This indicates that former junior students are generally very open-minded and enthusiastic about a wide range of topics, although the emphasis seems to be less on creative activities. In addition, there was a reliable gender difference on the Social Interests scale, with females showing higher social interests than males. This finding also appears to reflect a gender-typical pattern, as similar observations have been made in previous studies with both intellectually average (e.g., meta-analysis by Su et al., 2009) and gifted samples (e.g., Achter et al., 1996; Lubinski, 2016; Lubinski & Benbow, 1992, 2006).

Limitations. Research Issue 1 has produced comprehensive evidence on the academic (and professional) trajectories of former junior students from their schooling well into their early adulthood. However, the generalizability of these results is subject to certain limitations. There are several reasons for this: First, those former junior students who participated in the follow-up were not fully representative of the invited sample. In particular, the comparison between the respondents and non-respondents revealed systematic differences between both groups, especially with respect to performance-related variables: The former junior students in the respondent sample had shown significantly better average school grades at the time of their application for the junior study program and had subsequently participated in the junior study program significantly longer and more extensively than the non-respondents. Even though the corresponding effects were rather small according to Cohen (1988), the comparatively higher achievement level of the respondent group might have introduced a positive bias into the results of Research Issue 1.

Second, the data for the follow-up were obtained exclusively from former junior students at JMU Würzburg, making it unlikely that the results can be readily generalized to the entire population of junior students in Germany. Given the multi-stage selection process alone, it must be assumed that former junior students at JMU Würzburg are a highly selective group that differs markedly from former participants in junior study programs at other German universities. As Stumpf et al. (2011) note, the proportion of adolescents who participate in the junior study program for more than 1 semester is considerably higher at JMU Würzburg than the national average. A possible explanation for this observation might be that the critical reflection on one's own participation motives during the selection process for the junior study program at JMU Würzburg leads to a high level of identification with the gifted education measure. Other factors that might have an impact on the selectivity of the group include specifics in the implementation of the junior study program at JMU Würzburg or regional circumstances, such as its rural catchment area. In order to counteract possible influences from these factors, a large-scale follow-up of former junior students at all universities offering junior study programs in Germany would be desirable.

A third factor that limits the generalizability of the results of Research Issue 1 stems from the fact that the follow-up of former junior students lacked a control group, making it difficult to distinguish the consequences of the former junior students' participation in the junior study program from those of their individual maturation (Subotnik & Arnold, 1995). For example, it is unclear to what degree the successful academic development of the former junior students after their Abitur can be attributed to either their participation in the junior study program at JMU Würzburg or to more general development processes typically occurring in early adulthood, such as increases in memory capacity and information processing speed.

Research Issue 1 attempted to address this problem by reporting reference values for the basic population of students and employees in Germany according to the Statistisches Bundesamt at selected points. However, this population differs from former junior students not only in terms of their non-participation in the gifted education measure, but it can also be assumed that there are significant differences between both groups in their cognitive and personal characteristics. For this reason, among others, the design of a control group would have been conceptually and logistically difficult.

Finally, the results of Research Issue 1 are compromised by historical effects. In the invited sample, all former junior students had roughly the same chronological age, making them subject to similar social and environmental conditions in their development. Thus, it is possible that the educational trajectories and academic credentials of the former junior students reflect the circumstances of a common milieu rather than being the result of their participation in the gifted education measure. Consistent with this, Schmiedeler et al. (2022) have pointed out that the cohort of junior students who attended the (Bavarian) G9 during their school years differs systematically from those junior students at JMU Würzburg who attended the (Bavarian) G8. As a result, other cohorts from different sociohistorical contexts might show divergent developmental patterns, which should be taken into account in subsequent empirical investigations (cf. Subotnik & Arnold, 1995).

6 Research Issue 2

The following chapter is dedicated to Research Issue 2. Its goal is to determine the extent to which the educational trajectories of former junior students can be used to empirically validate the structure of Preckel et al.'s (2020) TAD framework in academic domains. Former junior students' educational trajectories were constructed longitudinally from data of the selection process for the junior study program and from data of the follow-up of former junior students at JMU Würzburg (see Research Issue 1).

The chapter is structured along the same lines as the previous one. The first subchapter elaborates on the methods that were used to answer Research Issue 2. In the second subchapter, the results of the empirical validation of Preckel et al.'s (2020) TAD framework in academic domains are presented. Finally, in the third subchapter, the most important findings are summarized and discussed with regard to the proposed hypotheses on the structure of Preckel et al.'s (2020) TAD framework in academic domains (see Research Issues).

6.1 Method

The following sections provide the methodological background for Research Issue 2. After the first section has briefly outlined the demographic characteristics of the selected sample, the second section explains how the data in the selection process for the junior study program at JMU Würzburg are routinely collected. This is followed by a detailed description of the measures of the selection process in the third section. The fourth section concentrates on issues of data diagnostics, such as controlling for data accuracy, treating missing values, and defining outliers. Finally, the fifth section elaborates on the strategies that were used for data analysis of Research Issue 2.

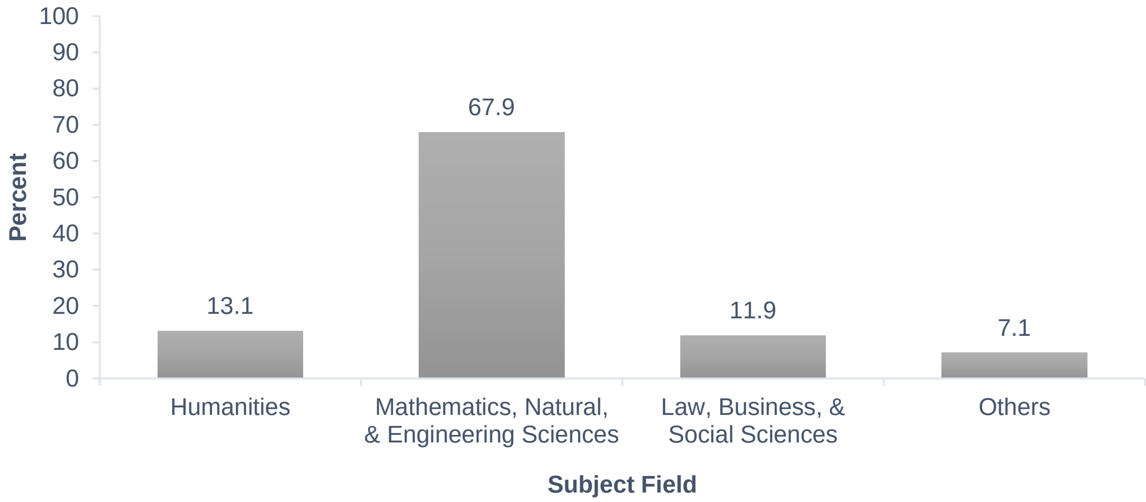
6.1.1 Sample Characteristics

As documented in Research Issue 1, a total of 112 former participants in the junior study program at JMU Würzburg had responded to the follow-up. These former junior students were now available as a potential sample for Research Issue 2. In addition to having participated in the follow-up, another selection criterion for Research Issue 2 required that former participants in the junior study program at JMU Würzburg had chosen a subject from the same subject field in their regular studies as in their junior studies. This was necessary because Preckel et al.'s (2020) TAD framework is based on the implicit assumption that talent development is a continuous process that unfolds within a single achievement domain. In other words, the TAD framework does not account for transitions between achievement domains that might occur during the talent development process due to, for example, shifts in interests or changing life circumstances.

Based on the second selection criterion for Research Issue 2, 28 former junior students had to be excluded from the potential sample of Research Issue 1. Thus, the final sample for Research Issue 2 comprised 84 former junior students at JMU Würzburg (40 female and 44 male) whose subject choice in their regular studies had broadly matched those in their junior studies. Figure 23 shows the distribution of the final sample across their subject fields. As is apparent from this figure, the clear majority (67.9 %) had chosen a subject from the field of Mathematics, Natural, & Engineering Sciences at both stages of their academic education.

Figure 23

Subject Fields in the Sample for Research Issue 2 (N = 84)



At the time of the follow-up, the average age of the final sample was 29.29 years (SD = 1.71; range from 26 to 38). About two thirds reported being single (66.7 %), and about one third overall reported being married (31.1 %) or divorced (1.2 %). None reported being separated (0.0 %), in a registered partnership (0.0 %), or widowed (0.0 %). Most former junior students in the final sample had no children (84.0 %); there were few former junior students who had either one (7.4 %), two (7.4 %), or three (1.2 %) children. None had more than three children (0.0 %).

6.1.2 Data Collection

The longitudinal data for Research Issue 2 were constructed from the data of the follow-up of former junior students and from the data of the selection process for the junior study program at JMU Würzburg. Figure 24 visualizes the chronological sequence of the entire data collection process for Research Issue 2. The follow-up of former junior students ran from October 2019 to February 2020 (see Data Collection of Research Issue 1). The data from the selection process for the junior study program at JMU Würzburg were recorded approximately between October 2004 and September 2011. Consequently, there was an interval of at least 8 years between the first and the second point of data collection.

Figure 24

Chronological Sequence of Data Collection for Research Issue 2

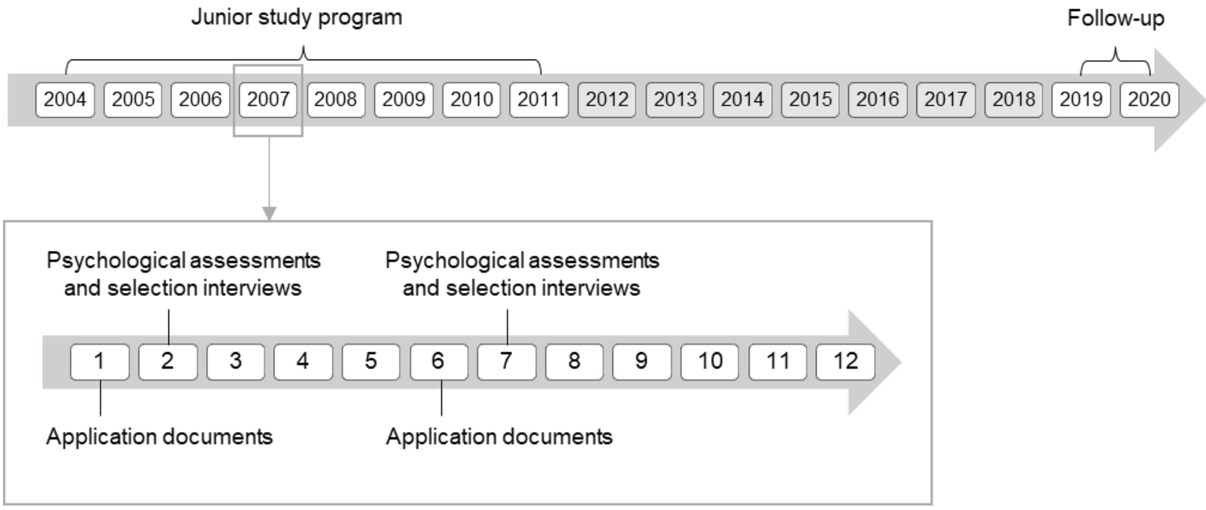
Data collection in the follow-up has already been covered in detail in Research Issue 1 and is therefore not rediscussed here. Instead, the following section reports on how data collection in the selection process for the junior study program at JMU Würzburg typically proceeds.

Selection Process. According to Stumpf et al. (2011), the selection process for the junior study program at JMU Würzburg was designed with a special focus on giftedness and gifted education. Two goals were central to the design: First, admission criteria should not only allow pupils with above-average school grades to attend the junior study program at JMU Würzburg but also those who showed high cognitive abilities but did not have excellent academic records. These pupils often struggle with motivational problems or boredom in school. Through attending the junior study program, they should be given the chance to get interested in learning and the classroom again (Stumpf et al., 2011). A second goal that was pursued in designing the selection process for the junior study program at JMU Würzburg was to admit not only pupils with uniformly high cognitive abilities but also those with narrower cognitive profiles that showed clear strengths and weaknesses (Stumpf & Schneider, 2008). This criterion was taken into account primarily because extreme discrepancies in cognitive abilities are especially common among individuals with above-average abilities as compared to those with average abilities (Lohman et al., 2008). Overall, the design resulted in a multi-stage selection process consisting of three components: application documents, psychological assessments (including the identification of cognitive profiles), and selection interviews (Stumpf, 2011; Stumpf et al., 2011; Stumpf & Schneider, 2010).

The BYB organizes the selection process for the junior study program at JMU Würzburg twice a year. Figure 25 shows how the selection process for the junior study program chronologically proceeds, using the year 2007 as an example. About 3 months before the start of the semester, that is, no later than January for a summer semester application and no later than June for a winter semester application, interested adolescents are invited to submit their application documents to the BYB. After a careful review of the application documents, promising applicants are invited to the BYB for psychological assessments the next month. Following this, they usually have a selection interview with the coordinator for the junior study program at the BYB and the mentor from their intended subject (Universität Würzburg, 2017). More information on the three components of the selection process for the junior study program at JMU Würzburg is provided in the subsequent sections.

Figure 25

Chronological Sequence of the Selection Process for the Junior Study Program at JMU Würzburg



Note. Numbers on the bottom timeline indicate months.

Application Documents. The application documents for the junior study program at JMU Würzburg include a cover letter, a standardized application form with a declaration of consent from both parents and the school management, and a socio-demographic questionnaire. In addition, applicants must submit a short resume, their most recent report card from school, and a letter of recommendation written by a teacher who supervises them in their intended subject (Stumpf, 2011; Stumpf et al., 2011; Stumpf & Schneider, 2010). The primary purpose of the application documents is to provide the coordinator for the junior study program at the BYB and the mentors from applicants' intended subjects with a basis on which they can form a first impression of the young people's school performance, their motivation, and their families' and schools' attitudes toward the junior study program (Stumpf et al., 2011).

Psychological Assessments. The psychological assessments conducted as part of the selection process for the junior study program at JMU Würzburg are meant to provide a more accurate account of applicants' cognitive abilities as well as their performance-related characteristics. In the chronological sequence of the selection process, the psychological assessments are routinely scheduled about one month after the end of the application period, that is, in February and July each year (see Figure 25). Applicants' cognitive abilities are measured using the Kognitiver Fähigkeitstest für 4. bis 12. Klassen, Revision (KFT 4–12+ R) [Cognitive Abilities Test for Grades 4 to 12, Revision] (Heller & Perleth, 2000). According to Heller and Perleth (2000), the KFT 4–12+ R provides both a differential record of those cognitive abilities that are relevant for educational achievement in school and a global measure of pupils' overall ability level (for more information, see Measures of Research Issue 2). To assess applicants' performance-related characteristics in the selection process, the Würzburger Fragebogen zur Selbstregulation (FB-SR-WÜ) [Würzburg Self-Regulation Questionnaire] (see Müller, 2007) is used. The FB-SR-WÜ is a comprehensive personality questionnaire that was developed specifically for the junior study program at JMU Würzburg; it is made up of different scales of already established instruments (cf. Stumpf & Schneider, 2010; for a more detailed description of the FB-SR-WÜ, see Measures of Research Issue 2). The psychological assessments are conducted under the supervision of the coordinator for the junior study program at the BYB or a trained student assistant. Applicants are divided into groups of about 10 for this purpose.

Selection Interviews. As the third component of the selection process for the junior study program at JMU Würzburg, the selection interviews are routinely held a few days after the psychological assessments. The main purpose of the selection interviews is to further assess applicants' academic potential and to gain a more complete impression of their personalities. Both the coordinator for the junior study program at the BYB and the mentors who oversee applicants' intended subjects are responsible for conducting the selection interviews (Stumpf, 2011; Stumpf & Schneider, 2010). Toward the end of the selection interviews, they typically make a mutual decision for or against applicants' acceptance.

6.1.3 Measures

The measures used in Research Issue 2 to model the indicators and predictors of Preckel et al.'s (2020) TAD framework in academic domains included both measures from the selection process for the junior study program at JMU Würzburg and measures from the follow-up of former junior students. The latter primarily concerned indicators of academic success, such as final grade(s) and scholarship(s). To be complete, they are again presented in Table 24.

Table 24

Measures from Research Issue 1 that were used in Research Issue 2

Item	Response format	Categories
"What was your final grade?"	Single choice	"1.0" (…) "4.0"
"How many semesters did you study?"	Single choice	"1 semester" (…) "15 semesters or more"
"Did you receive a scholarship?"	Single choice	"Yes" "No"
"Did you receive any study awards/prizes?"	Single choice	"Yes" "No"
"Did you complete your doctoral studies?"	Single choice	"Yes, I completed my doctoral studies." "No, I didn't complete my doctoral studies."
"Did you publish any scientific papers?"	Single choice	"Yes" "No"
"Did you receive any scientific awards/research prizes?"	Single choice	"Yes" "No"

Other measures from the follow-up of former junior students that were used in Research Issue 2 included the young adults’ scores on the Openness scale, the Conscientiousness scale, and the Extraversion scale of Rammstedt and John’s (2007) BFI-10 as well as their scores on the Investigative Interests scale of Kabisch and Karpowski’s (2016) FES 16^{plus} R.

The measures from the selection process for the junior study program at JMU Würzburg which were used in Research Issue 2 basically focused on former junior students’ cognitive abilities as well as on their performance-related characteristics. The next section presents these measures in detail.

Cognitive Abilities. The cognitive abilities of the former junior students had been determined in the selection process for the junior study program with the KFT 4–12+ R (Heller & Perleth, 2000), which provides a measure of general cognitive ability for children and adolescents in Grades 4 to 12. The KFT 4–12+ R consists of a verbal, a numerical, and a non-verbal part, each of which, in turn, contains three subtests with 12 to 25 items per grade level. According to Heller and Perleth (2000), the administration of all three parts takes about 2.5 hours.

The KFT 4–12+ R was standardized on a normative sample of 6,765 German pupils of different age groups and school types. For pupils from Grades 4 to 9, the KFT 4–12+ R provides grade-specific standard scores for interpreting the raw scores; for pupils from Grades 5 to 12, school-specific norms are additionally available (for the German Haupt-/Mittelschule, Realschule, and Gymnasium; Heller & Perleth, 2000). In the selection process for the junior study program at JMU Würzburg, the school-specific norms for Gymnasium are typically used to evaluate applicants’ cognitive abilities. The standard scores of the KFT 4–12+ R are given in T-scores with a mean of 50 and a standard deviation of 10 (cf. Häcker, 2014).

The KFT 4–12+ R is available in two parallel test forms (A and B) and can be administered as a single or a group test. Heller and Perleth (2000) calculated internal consistencies for both test forms using the Kuder-Richardson formula 20 (Lienert, 1969, p. 226f); the median for both test forms across all grade levels was r = .95 (Heller & Perleth, 2000). In the present thesis, Cronbach's α for both test forms across all subtests and grade levels was .82, indicating good internal consistency (cf. Hossiep, 2014).

Personality Measures. All personality measures used in Research Issue 2 above and beyond those from Research Issue 1 were collected using the FB-SR-WÜ, which has been included as a standard in the selection process for the junior study program at JMU Würzburg since the winter semester of 2006/2007 (for further information, see Müller 2007). In its entirety, the FB-SR-WÜ contains 14 scales consisting of 77 items. All items of the FB-SR-WÜ are uniformly rated on a 5-point Likert scale, ranging from 1 = *very rarely* to 5 = *very often*. The following sections describe the scales from the FB-SR-WÜ that were used for Research Issue 2.

Self-Motivation. The self-motivational skills of the former junior students in the final sample had been determined in the selection process for the junior study program using the Self-Motivation scale developed by Perels et al. (2005). The Self-Motivation scale consists of five items that capture the extent to which individuals manage to maintain work on a task even in the face of difficulty or reluctance (e.g., “I try to make myself do my homework even when I don't feel like it.”). Perels et al. (2005) do not provide a measure of internal consistency for the Self-Motivation scale. In the present thesis, Cronbach's α for the Self-Motivation scale was initially .55. However, a look at the item scale statistics revealed that one item in particular was responsible for a significant deterioration in internal consistency. After deleting this item, Cronbach's α for the Self-Motivation scale was .71, which can be considered satisfactory (cf. Hossiep, 2014).

Metacognition. The metacognitive abilities of the former junior students in Research Issue 2 had been assessed in the selection process as a combination of the scales Metacognitive Planning (Wild & Schiefele, 1994) and Metacognitive Monitoring (Perels et al., 2005). The first scale, Metacognitive Planning by Wild and Schiefele (1994), contains a total of four items that describe considerations about the selection and amount of the material to be learned as well as the proper sequence of learning steps; these considerations are typically made in advance of the learning process. Whereas all items of the Metacognitive Planning scale in Wild and Schiefele (1994) are context-independent (e.g., "I think about the order in which I work through the material beforehand."), some items were transferred to a school context for inclusion in the FB-SR-WÜ (e.g., "I think about the order in which I work through the homework beforehand."). Wild and Schiefele (1994) do not report a measure of internal consistency for the Metacognitive Planning scale.

The second scale used to determine the metacognitive abilities of the former junior students, Metacognitive Monitoring by Perels et al. (2005), is made up of six items that measure the extent to which individuals are aware of their current learning progress in relation to their learning goal (e.g., "As I work toward a goal, I check to see if my actions are bringing me closer to that goal."). Thus, compared to the Metacognitive Planning scale (Wild & Schiefele, 1994), the Metacognitive Monitoring scale aims to assess control functions that occur during the learning process and that are temporally subsequent to considerations about the selection and amount of the material to be learned. Unfortunately, Perels et al. (2005) also do not specify a measure of internal consistency for the Metacognitive Monitoring scale.

In order to obtain a single indicator for the metacognitive abilities of the former junior students in Research Issue 2, the scales Metacognitive Planning (Wild & Schiefele, 1994) and Metacognitive Monitoring (Perels et al., 2005) were combined into the higher-order scale Metacognition with a total of ten items. Cronbach's α for the higher-order scale was initially

.60. A look at the item scale statistics, however, revealed that two items particularly contributed to a significant deterioration in internal consistency. After deletion of these two items, the final Metacognition scale included eight items with a Cronbach's α of .71, indicating satisfactory internal consistency (cf. Hossiep, 2014).

Self-Regulation. The self-regulatory skills of the former junior students in the final sample had been assessed with Schwarzer's (1999) Self-Regulation scale. Overall, the Self-Regulation scale comprises nine items which describe individuals' ability to maintain a difficult action even when there are influences impairing motivation and attention (e.g., "If I get distracted by something, I immediately come back to the topic." or "I can concentrate on something for a long time if necessary."; Schwarzer, 1999). Being able to concentrate, even when distracting factors are at play, is an important regulatory competence. The same is true for maintaining motivation or restoring it after setbacks. Cronbach's α of the Self-Regulation scale is .82 according to Schwarzer (1999). In the present thesis, Cronbach's α was likewise .82, indicating good internal consistency (cf. Hossiep, 2014).

Mentor Ratings. During or after the selection interviews for the junior study program, the mentors from the various departments at JMU Würzburg usually complete a protocol sheet, indicating the extent to which they consider their applicants qualified to successfully participate in the junior study program and making recommendations for or against admission (for a German copy, see Appendix C: Selection Process Material). The protocol sheet is formalized and asks the mentors for applicants' assessment on a total of five dimensions: subject-related prior knowledge, subject-related talent, motivation to attend the junior study program, perceptions of the subject, and expectations of the subject. In the context of Research Issue 2, the first three dimensions were used (see Table 25). The dimensions are rated on a 5-point Likert scale, ranging from 1 = *very low* to 5 = *very high*. Alternatively, if the mentors feel that they could not gain a sufficient impression of their applicants within the limited time available for the selection interview, they can choose the option “no rating possible”.

Subject-Related Prior Knowledge. The mentors take different approaches to assessing applicants’ subject-related prior knowledge. For example, some mentors use short language or programming tests to help make decisions. Others prefer brief questions about relevant educational experiences or skills. Basically, the critical point is to determine whether applicants’ prior knowledge is sufficient to profitably participate in introductory courses in their intended subjects.

Subject-Related Talent. Some mentors assess applicants’ talent along with their subject-related prior knowledge, for instance, by putting them through small performance tests or asking them brief questions. Other mentors, in contrast, rely entirely on their subjective impression of the applicants gained during the selection interview. In either case, since the dimension is not further specified on the protocol sheet, it is the mentors’ responsibility to interpret it against their departments’ peculiarities and to draw on their experiences with other talented regular or junior students to make a reasonable judgement.

Motivation to Attend the Junior Study Program. The mentors usually seek to ascertain applicants’ motivation to attend the junior study program by asking them specific questions. The aim is to find out whether the application for the junior study program is more due to the young people’s own initiative or to the expectations of their parents or teachers. Another important aspect is to determine applicants’ subject-related ambition. The mentors might ask applicants, for example, how much effort they are willing to make in order to attend academic courses in their intended subjects.

Table 25

Items from Mentors' Protocol Sheets in the Selection Interviews

Item	Response format	Categories
"How high do you rate the applicant's amount of subject-specific prior knowledge?"	Scale	5-point Likert scale (1 = *very low* to 5 = *very high*) "No rating possible"
"How high do you rate the applicant's subject-related talent?"	Scale	5-point Likert scale (1 = *very low* to 5 = *very high*) "No rating possible"
"How high do you rate the applicant's motivation to attend the junior study program?"	Scale	5-point Likert scale (1 = *very low* to 5 = *very high*) "No rating possible"

Note. Items are arranged in the order in which they appeared in the protocol sheet.

6.1.4 Data Diagnostics

Prior to data analysis for Research Issue 2, the longitudinal data from the selection process for the junior study program and from the follow-up of former junior students at JMU Würzburg were screened for data accuracy, missing values, and outliers. Moreover, issues of normality, multicollinearity, and singularity were addressed. All data diagnostics were performed using IBM SPSS Statistics 26 (IBM Corporation, 2019).

Data Accuracy. The data from the selection process for the junior study program had been archived in paper files at the BYB over the years, with student assistants having only sporadically transferred entries from the files into electronic spreadsheets. To make the files usable for data analysis, all documents were first scanned, and then the missing data from the files were entered into electronic spreadsheets. After data entry, all cases were rechecked and proofread against the scanned files to clean up possible input errors.

Missing Data. Missing data in Research Issue 2 occurred by far most frequently for the scales of the FB-SR-WÜ and for the mentor ratings, as these have only been used in the selection process for the junior study program at JMU Würzburg since the winter semester of 2006/2007 and the winter semester of 2007/2008, respectively. In order to compensate for the missing data, full information maximum likelihood (FIML) estimation was used in the assessment of SEMs (see below).

The use of FIML estimation assumes that data are either completely missing at random (CMAR) or missing at random (MAR; Allison, 2003), that is, that the pattern of missing data for a particular variable is either unpredictable or predictable from another variable in the data set but not from the value of the variable itself (Enders & Bandalos, 2001; Tabachnick & Fidell, 2014). The MAR assumption could be considered true in Research Issue 2 for both the scales of the FB-SR-WÜ and the mentor ratings because there was no reason to assume that the pattern of missing data depended, for example, on the level of applicants' performance-related characteristics or on the ratings provided by the mentors. Rather, missing data could be predicted from the time when the former junior students had applied for the junior study program at JMU Würzburg (i.e., before or after the winter semester of 2006/2007 or the winter semester of 2007/2008).

Nevertheless, in order to fully guarantee the robustness of the estimated data, all analyses of Research Issue 2 were repeated again after the FIML estimation using only complete cases. According to Tabachnick and Fidell (2014), this is particularly recommended if the available data set is small, the proportion of missing values in the data set is high, or the values are missing in a non-random pattern. If the results of the re-analysis are similar to the initial results, this can be taken as an indication of their reliability. However, if they are different, it is necessary to investigate the reason for the difference and either to evaluate which results more closely approximate "reality" or to report both sets of results (Tabachnick & Fidell, 2014).

Outliers. Just as with Research Issue 1, all cases with standardized scores in excess of ± 3.29 ($p < .001$, two-tailed test) were identified as univariate outliers in Research Issue 2 and recoded to a standardized value of 3.29 (cf. Tabachnick & Fidell, 2014). In addition, cases with a Mahalanobis distance whose chi-square value χ^2 exceeded a significance level of $p < .001$ with degrees of freedom equal to the number of variables were classified as multivariate outliers and removed from the data set (cf. Tabachnick & Fidell, 2014).

Normality. The normality of variables was assessed with the Shapiro-Wilk test (Shapiro et al., 1968). If the test indicated that the variables were not normally distributed, variable transformations, such as square root transformations, log transformations, and inverse transformations, were considered (for a detailed description of variable transformations and their recommendation for use, see Tabachnick & Fidell, 2014). However, since the variable transformations often did not improve the distributions, it was decided to use SEM estimation with robust (Huber-White) standard errors and Yuan-Bentler scaled chi-square test statistics instead, which have been found to be robust to deviations from normality (see below; Yuan & Bentler, 2000).

Multicollinearity and Singularity. Bivariate correlations in excess of .90 or squared multiple correlations around .99 can indicate multicollinearity or singularity (Tabachnick & Fidell, 2014). However, no such correlations were found in Research Issue 2.

6.1.5 Data Analysis

To answer Research Issue 2, the longitudinal data from the selection process for the junior study program at JMU Würzburg and from the follow-up of former junior students were analyzed using SEMs. All SEMs were estimated with Rosseel et al.'s (2021) Latent Variable Analysis (lavaan) package in R (R Core Team, 2020). The significance level was set at $\alpha = .05$ (one-tailed unless otherwise stated). Prior to data analysis, all variables were centered at the mean. The following section provides a brief introduction to structural equation modeling as well as an explanation of how it was used in the context of Research Issue 2.

SEMs. SEMs are a collection of statistical techniques that allow hypotheses about potential relations between latent and observed variables to be specified in a theoretical model and empirically tested for their adequacy using sample data (Schumacker & Lomax, 2016; Tabachnick & Fidell, 2014). *Latent variables* represent variables that cannot be directly measured; they are also referred to as *constructs* or *factors* and are typically inferred from a set of observed variables. In comparison, *observed variables* are directly measured; they are also called *manifest variables* or *indicators* (Schumacker & Lomax, 2016; Tabachnick & Fidell, 2014). The relations between latent and observed variables constitute a so-called *measurement model*. The hypothesized relations among the constructs are typically summarized in what is called a *structural model* (Tabachnick & Fidell, 2014).

Both latent and observed variables can be defined as either independent or dependent variables. *Independent variables* are model components that exert an influence on other variables but are not themselves affected by other model components. In contrast, *dependent variables* are model components that are influenced by other variables (Schumacker & Lomax, 2016). For example, a regression model can be thought of as a SEM that consists solely of observed variables and in which a single dependent variable is predicted or explained by one or more independent variables (Schumacker & Lomax, 2016). The effect of an independent variable on a dependent variable is referred to as a *direct effect*. Moreover, an *indirect effect* represents the effect of an independent variable on a dependent variable through a mediating variable (Schreiber et al., 2006).

The goal of structural equation modeling is to test whether the hypothesized theoretical model provides an adequate fit to the sample data (Schumacker & Lomax, 2016; Tabachnick & Fidell, 2014). If the sample data are consistent with the theoretical model, the specified relations among the variables are assumed to exist. In contrast, if the sample data do not show adequate fit to the theoretical model, post-hoc modifications or alternative models need to be specified (Schumacker & Lomax, 2016).

SEM Estimation. There are different estimation methods available to assess the fit between the hypothesized theoretical model and the sample data: For example, the SEMs for Research Issue 2 were examined using FIML estimation with robust (Huber-White) standard errors and Yuan-Bentler scaled chi-square test statistics. In FIML estimation, the software first determines a conditional expectation of all the missing data in a data set given the observed values and the current estimates of the parameters, such as correlations. These expectations are then substituted for the missing data. Afterward, maximum likelihood estimation is performed as though the missing data had been filled in (Tabachnick & Fidell, 2014).

For FIML estimation to produce reasonable results, two conditions must be met: First, the missing data must satisfy the CMAR or MAR assumption, and second, the data must follow a multivariate normal distribution (Tabachnick & Fidell, 2014). A description of how these two conditions were handled in the context of Research Issue 2 has already been provided in the previous sections.

SEM Model Fit. As is typically done in structural equation modeling, model fit was evaluated in Research Issue 2 using a combination of multiple fit indices. The assumption here is that well-fitting models most often produce consistent results across different indices (Tabachnick & Fidell, 2014). A first important index that was used in Research Issue 2 is the chi-square value χ^2, which denotes the fit of the sample data to the theoretical model. The basic rule for this index is that a model is assumed to have a good fit exactly when the ratio of the chi-square value χ^2 to the degrees of freedom in the model is not substantially greater than 2 (Tabachnick & Fidell, 2014). Other fit indices used in Research Issue 2 include the non-normed fit index (NNFI), the comparative fit index (CFI; Bentler, 1990), and the root-mean-square error of approximation (RMSEA; Browne & Cudeck, 1992): The NNFI or Tucker-Lewis index (TLI; Tucker & Lewis, 1973) evaluates the theoretical model by comparing the chi-square value χ^2 of the theoretical model to the value of the independence model, that is, to the model that corresponds to completely unrelated variables, and adjusting for the degrees of freedom in the model. Values above .95 are indicative of well-fitting models (Tabachnick & Fidell, 2014). The CFI (Bentler, 1990) also compares the theoretical model to the independence model. It is normed to a range of 0 to 1, with values above .95 often indicating well-fitting models (Hu & Bentler, 1999). Of note, the CFI provides a good estimate of model fit even with small samples (Bentler, 1990; Tabachnick & Fidell, 2014). Finally, the RMSEA (Browne & Cudeck, 1992) estimates the lack of fit in the theoretical model compared to the perfect (saturated) model. When the theoretical model is perfect, the RMSEA equals 0. The greater the misspecification of the model, the larger the RMSEA. Values of .06 or less indicate a well-fitting model relative to the associated degrees of freedom (Hu & Bentler, 1999). Values larger than .10 indicate poor model fit (Browne & Cudeck, 1992).

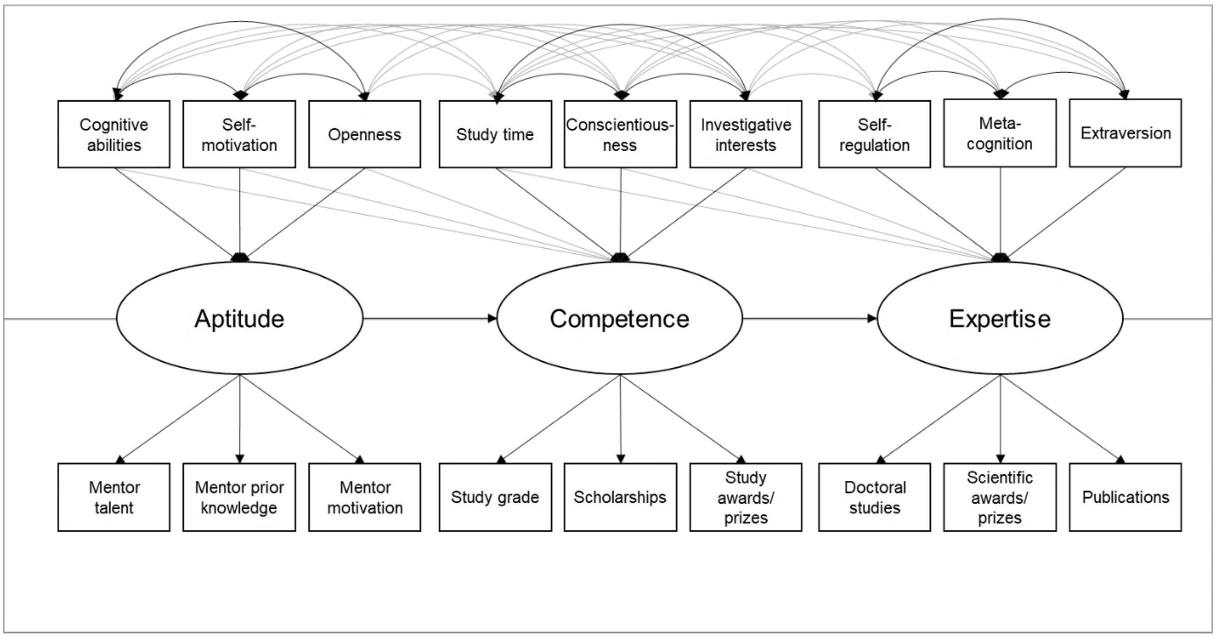
Multiple Indicators Multiple Causes (MIMIC) SEM. The relations among the predictors, indicators, and talent development stages of Preckel et al.'s (2020) TAD framework can be viewed as a particular type of SEM called a MIMIC model. Roughly speaking, MIMIC models make it possible to define latent variables from a set of pre-selected indicators and to simultaneously predict them using observed variables. To this end, in the measurement part of a MIMIC model, one or more latent variables are specified based on multiple indicators. In the structural part of a MIMIC model, these latent variables are then inferred from one or more predictors (Schumacker & Lomax, 2016).

Figure 26 shows the MIMIC model for the hypothesized relationships among the predictors, indicators, and the first three talent development stages of Preckel et al.'s (2020) TAD framework. The lower half of Figure 26 forms the measurement part of the MIMIC model; here the constructs *aptitude*, *competence*, and *expertise* are defined. The arrows pointing from the construct *aptitude* toward the observed variables *mentor talent*, *mentor prior knowledge*, and *mentor motivation* suggest that these variables are assumed to function as indicators of the construct *aptitude* (see Hypothesis 1.2). The same is true for the arrows pointing from the construct *competence* toward the observed variables *study grade*, *scholarships*, and *study awards/prizes* (see Hypothesis 2.2), as well as for the arrows pointing from the construct *expertise* toward the observed variables *doctoral studies*, *scientific awards/prizes*, and *publications* (see Hypothesis 3.2). Finally, the arrows pointing from *aptitude* toward *competence* and from *competence* toward *expertise* indicate that these constructs are assumed to be causally related (see Hypothesis 4).

The upper half of Figure 26 represents the structural part of the MIMIC model, in which the observed variables are used to predict the constructs. As implied by the arrows pointing from the observed variables *cognitive abilities*, *self-motivation*, and *openness* to the first talent development stage, these variables are assumed to predict the construct *aptitude* (see Hypothesis 1.1). Furthermore, it is hypothesized that the observed variables *study time*, *conscientiousness*, and *investigative interests* predict the construct *competence* (see Hypothesis 2.1) and that *self-regulation*, *metacognition*, and *extraversion* determine the latent variable *expertise* (see Hypothesis 3.1).

Figure 26

Hypothesized SEM of Talent Development Levels, Predictors, and Indicators Based on Preckel et al.'s (2020) TAD framework



Note. Rectangles represent observed variables and ovals represent latent variables. Black lines indicate (bivariate) relationships between variables of the same talent development level. Gray lines indicate (bivariate) relationships between variables of adjacent talent development levels.

To obtain robust SEM results, some minimum sample sizes are usually recommended. Backhaus et al. (2015), for example, propose that the sample size K be at least 5 times greater than the number of parameters t to be estimated, that is, $\frac{K}{t} > 5$, or that the sample size K exceed the number of parameters t to be estimated by at least 50, that is, $K - t > 50$ (Backhaus et al., 2015). Since the size of the final sample for Research Issue 2 clearly did not meet these requirements, a stepwise approach based on Schumacker and Lomax (2016) was adopted for data analysis: First, structural equation modeling was used to assess whether there was a good fit of the data to the measurement part of the MIMIC model, that is, to define the latent variables based on their hypothesized indicators. Second, regression analyses were used to evaluate the structural part of the MIMIC model, that is, the power of the hypothesized predictor variables to determine the constructs.

6.2 Results

After working through the methodological aspects relevant to the empirical validation of Preckel et al.'s (2020) TAD framework in the last subchapter, the next subchapter turns to the results. In this context, the first section presents the results regarding the measurement part of the MIMIC model. Then, in the second section, the results for the structural part of the MIMIC model are reported. For reasons of consistency, both standardized and unstandardized SEM regression coefficients are reported in the two sections.

6.2.1 Indicators of Talent Development Stages

Based on the structural specifications of Preckel et al.'s (2020) TAD framework as well as on relevant insights from individual academic disciplines, such as Mathematics and Psychology, three hypotheses were formulated regarding potential indicators of the first three talent development stages in academic domains (see Research Issue 2: Talent Development in Academic Domains): First, it was hypothesized that in academic domains, the amount of individuals' prior knowledge, their perceived talent, and their motivation to engage with academic activities would be indicative of their level of aptitude in early adolescence. The second hypothesis stated that the study grades, scholarships, and study awards/prizes that individuals achieve in the course of their regular studies would indicate their level of competence. Finally, it was assumed that the preparation of a doctoral thesis, the number of scientific publications, and the receipt of scientific awards/prizes would be critical measures of young adults' level of expertise in academic domains.

Table 26 contains the means, standard deviations, and correlations for the assumed indicators across the first three talent development stages of Preckel et al.'s (2020) TAD framework. The data correspond to the software calculations under the unrestricted model, that is, to the statistics of the observed variables after the estimation of missing values. The table is informative in two respects: First, it shows that all indicators belonging to the same talent development level are significantly correlated with each other. Moreover, it suggests that the indicator *study grades* is significantly correlated with all other indicators except for *scientific publications*, which marginally missed the significance level, $r = .20$, $p = .071$.

Table 26

Descriptive Statistics and Correlations for the Hypothesized Indicators

Indicator	*M*	*SD*	1	2	3	4	5	6	7	8	9
1 Mentor prior knowledge	2.57	0.88	–								
2 Mentor talent	2.96	0.71	$.62^{***}$	–							
3 Mentor motivation	3.37	0.63	$.28^{**}$	$.35^{**}$	–						
4 Study grade [a]	2.53	0.43	$.38^{***}$	$.23^{*}$	$.22^{*}$	–					
5 Scholarships [b]	0.51	0.50	.20	.18	.09	$.33^{**}$	–				
6 Study awards/prizes [b]	0.27	0.45	.09	.02	.08	$.31^{**}$	.19	–			
7 Doctoral studies [b]	0.52	0.51	.04	.07	$.32^{*}$	$.35^{**}$	$.27^{*}$	$.25^{*}$	–		
8 Scientific publications	1.68	2.58	.18	.06	$.41^{***}$	.20	.15	.20	$.63^{***}$	–	
9 Scientific awards/prizes [b]	0.10	0.30	.19	.09	.12	$.26^{*}$	.12	$.36^{**}$	$.33^{**}$	$.46^{***}$	–

Note. $N = 84$. Significance of correlations was tested on Psychometrica (Lenhard & Lenhard, 2014).
[a] reflected. [b] 0 = no, 1 = yes.
$^{*} p < .05$. $^{**} p < .01$. $^{***} p < .001$ (two-tailed).

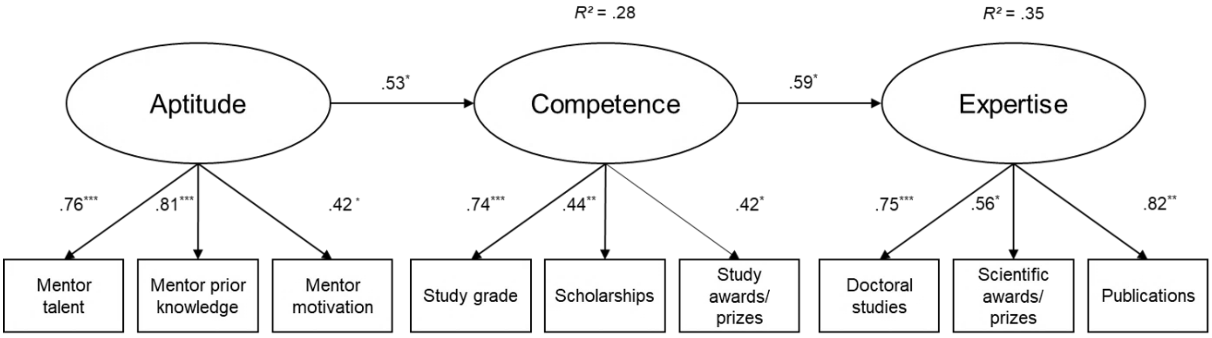
For estimating the measurement part of the MIMIC model, complete data were available from a total of 37 former junior students (44.0 %). The rest of the former junior students had missing values on almost all indicators, with the highest proportions of missing values occurring on the variables *mentor prior knowledge*, *mentor talent*, and *mentor motivation*. In more detail, 34 respondents were missing data on the variable *mentor prior knowledge* (40.5 %), 38 respondents were missing data on the variable *mentor talent* (45.2 %), and 35 respondents were missing data on the variable *mentor motivation* (41.7 %). As described above, the high proportions of missing values on these variables were due to the fact that the mentor ratings were only introduced as part of the selection interviews at JMU Würzburg in the winter semester of 2007/2008. Therefore, no mentor ratings were available for applicants up to the summer semester of 2007.

Model Estimation. Overall, the hypothesized model fit the data well, Yuan-Bentler χ^2 (25, N = 84) = 29.73, p = .234; fit indices were (robust) CFI = .96, (robust) TLI = .94, and (robust) RMSEA = .047 with 90 % CI [.000, .102]. No post-hoc modifications were made because of the good fit indices.

Standardized SEM results for the measurement part of the MIMIC model are shown in Figure 27. It is apparent from this figure that all indicators were significant. Hypothesis 1.2, Hypothesis 2.2, and Hypothesis 3.2 were thus completely confirmed.

Figure 27

Standardized SEM Results for the Talent Development Levels and Their Associated Indicators



Note. $N = 84$. Black lines indicate (bivariate) relations between variables of the same talent development level.

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

Direct and Indirect Effects. The latent construct *aptitude* significantly predicted the latent construct *competence* ($\beta = 0.53$, $p = .013$) which, in turn, significantly predicted the latent construct *expertise* ($\beta = 0.59$, $p = .023$). Accordingly, Hypothesis 4, which suggested that successive talent development stages in Preckel et al.'s (2020) TAD framework were predictive of each other, was confirmed for the first three stages. *Competence* served as an intervening variable between *aptitude* and *expertise*. The indirect effect of *aptitude* on *expertise* via *competence* was also significant ($\beta = 0.32$, $p = .031$). Overall, 28.2 % of the variance in *competence* was explained by *aptitude*. In turn, *competence* accounted for 35.2 % of the variance in *expertise*.

Table 27 lists the unstandardized coefficients of the indicators at their respective talent development stages. For each indicator, the table further includes standard errors, *z*-values, significance values (i.e., *p*-values; one-tailed), and confidence intervals (two-tailed).

Table 27

Unstandardized SEM Results for the Talent Development Levels and Their Associated Indicators

Indicator	*B*	*SE*	*z*	*p*	95 % CI
Aptitude					
Mentor prior knowledge	1.000				[1.000, 1.000]
Mentor talent	0.746	0.179	4.162	< .001	[0.395, 1.098]
Mentor motivation	0.372	0.209	1.781	.038	[-0.037, 0.782]
Competence					
Study grade [a]	1.000				[1.000, 1.000]
Scholarships [b]	0.705	0.254	2.781	.003	[0.208, 1.202]
Study awards/prizes [b]	0.590	0.261	2.260	.012	[0.078, 1.102]
Expertise					
Doctoral studies [b]	1.000				[1.000, 1.000]
Scientific publications	5.598	1.819	3.077	.001	[2.033, 9.163]
Scientific awards/prizes [b]	0.434	0.197	2.199	.014	[0.047, 0.821]

Note. $N = 84$. CI = confidence interval (two-tailed).
[a] reflected. [b] 0 = no, 1 = yes.

Finally, due to the high proportion of missing values in the sample, the robustness of the results was rechecked. For this purpose, the measurement part of the MIMIC model was estimated again, taking into account only cases with complete values for the indicators with the highest proportions of missing values (i.e., *mentor prior knowledge*, *mentor talent*, and *mentor motivation*). This was true for 46 cases. Unstandardized regression results can be looked up in Table D1 in Appendix D: SEM. Overall, the re-estimation results can be summarized as showing that the values obtained were broadly comparable to those of the full sample. Although most indicators were not significant – presumably due to the small number of cases – their coefficients were similar in magnitude. Moreover, the latent construct *aptitude* continued to significantly predict the latent construct *competence*. The variance accounted for in *competence* was 24.8 %. A difference compared to the full sample was that the effect of *competence* on *expertise* was no longer significant and that the variance accounted for in *expertise* was no more than 6.2 %.

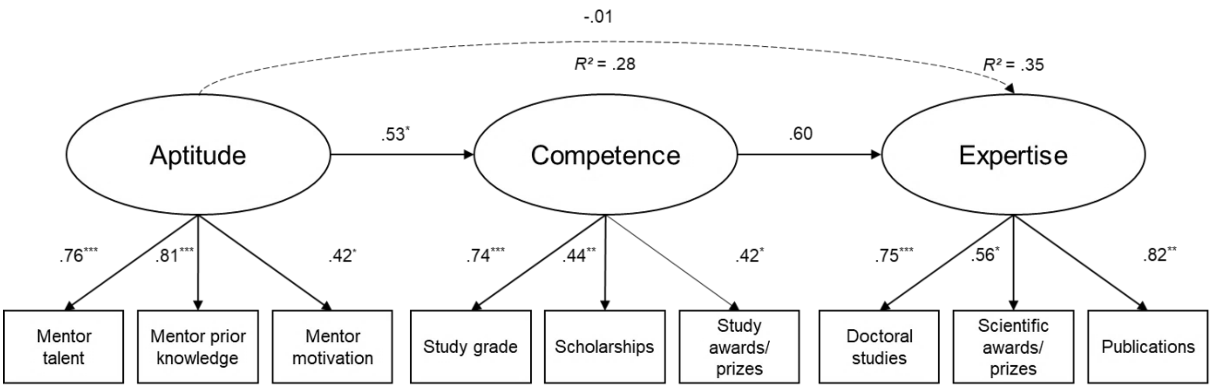
Excursus: Mediation Model of Talent Development Stages. In calculating the SEM for the measurement part of the MIMIC model, the question arose as to whether the construct *aptitude* would also have a direct effect on the construct *expertise* or whether there was only a significant indirect effect between these two constructs. This was especially interesting because a direct effect of *aptitude* on *expertise* would, in a broad sense, resemble the central assumption of the *gifted child paradigm* that early indicators of giftedness are predictive of later exceptional performance. A mediated relationship between *aptitude* and *expertise*, in contrast, would speak more to the validity of the *talent development paradigm*. To find an answer to this question, the measurement part of the MIMIC model was slightly modified and re-estimated in the form of a mediation model. As can be seen from Figure 28, the SEM diagram for the mediation model was essentially the same as for the original model, but with an additional direct effect from *aptitude* to *expertise* (see dashed line in Figure 28).

Model Estimation. Like the original model, the mediation model showed a good overall fit to the data, χ^2 (24, N = 84) = 29.98, p = .186, (robust) CFI = .95, (robust) TLI = .92, and (robust) RMSEA = .053 with 90 % CI [.000, .107].

Standardized SEM results are given in Figure 28. It is apparent from this figure that, as in the original model, all indicators of the first three talent development stages according to Preckel et al.’s (2020) TAD framework were significant.

Figure 28

Standardized SEM Results for the Talent Development Levels and Their Associated Indicators



Note. $N = 84$. Solid lines represent direct effects; dashed line represents indirect effect.
$^{*} p < .05$. $^{**} p < .01$. $^{***} p < .001$.

Direct and Indirect Effects. Also as in the original model, the latent construct *aptitude* significantly predicted the latent construct *competence* in the mediation model ($\beta = 0.53$, $p = .013$). Nevertheless, the direct effect of *competence* on *expertise* was no longer significant ($\beta = 0.60$, $p = .087$), and there was no longer a reliable indirect effect between *aptitude* and *expertise* ($\beta = 0.32$, $p = .098$). Moreover, there was no direct effect of *aptitude* on *expertise* ($\beta = -0.01$, $p = .488$). *Aptitude* accounted for 28.4 % of the variance in *competence*. In turn, *competence* explained 35.4 % of the variance in *expertise*.

Finally, to directly compare the two models, it was formally determined whether the original model or the mediation model would provide a better overall fit to the data. Since the two models are nested, a chi-square difference test could be calculated. This was done by subtracting the chi-square value for the larger model from the chi-square value for the smaller model and evaluating the difference with the degrees of freedom equal to the difference between the degrees of freedom in the two models (cf. Tabachnick & Fidell, 2014). The result of the chi-square difference test indicated that the original model and the mediation model did not significantly differ in their fit to the sample data, $\Delta \chi^2 = 0.242$, $p = .623$.

Table 28 additionally provides an overview of different fit indices for both talent development models. Again, the values of the original model and the mediation model seemed to be roughly comparable.

Table 28

Comparison of Fit Indices for the Original model and the Mediation Model

Model	χ^2			RMSEA			AIC	BIC	Δ AIC	Δ BIC
	Value	*df*	*p*	Value	90 % CI	*p*				
Original model	29.73	25	.234	.047	[.000, .102]	.487	1047.227	1117.710	–	–
Mediation model	29.98	24	.186	.053	[.000, .107]	.419	1049.226	1122.140	2.00	4.43

Note. AIC and BIC differences are relative to the original model. RMSEA = root-mean-square error of approximation; CI = confidence interval (two-tailed); AIC = Akaike information criterion; BIC = Bayesian information criterion.

6.2.2 Predictors of Talent Development Stages

Based on the results of the measurement part of the MIMIC model, the hypothetical scores of the former junior students on the latent constructs *aptitude*, *competence*, and *expertise* were calculated and saved as observed variables. Subsequently, regression models were used to examine the extent to which these observed variables could be determined from their hypothesized predictors. For a consistent presentation of the results, SEMs were also used in this process. Of note, for SEM regression models, the lavaan package (Rosseel et al., 2021) always indicates that the models are saturated or just-identified (i.e., $\chi^2 = 0$ and $df = 0$) because the number of distinct values in the sample variance-covariance matrix equals the number of parameters to be estimated (Schumacker & Lomax, 2016). On request, the lavaan package (Rosseel et al., 2021) also outputs the squared multiple correlation coefficient R^2, which indicates how much of the variance in the dependent variable of the regression model is accounted for by the independent predictor variables. R^2 is also interpreted as an effect size or model-fit criterion in multiple regression analysis (Schumacker & Lomax, 2016). The F-test for the significance of the R^2 value is $F = \frac{R^2/p}{(1 - R^2)/n - p - 1}$ (Schumacker & Lomax, 2016, p. 55). In the next section, the results of the regression models on the aptitude level, the competence level, and the expertise level of Preckel et al.'s (2020) TAD framework are successively reported.

Predictors on the Aptitude Level. Hypothesis 1.1 assumed that in academic domains, individuals' cognitive abilities, openness, and (self-)motivation would predict their level of aptitude in early adolescence. Table 29 presents the descriptive statistics and correlations for the hypothesized predictors on the aptitude level as computed by the software under the unrestricted model. A reliable positive correlation was found between the predictors *openness* and *self-motivation*, $r = .32$, $p = .001$. *Cognitive abilities* were neither related to *openness*, $r = -.17$, $p = .124$, nor to *self-motivation*, $r = .04$, $p = .752$.

Table 29

Descriptive Statistics and Correlations for the Hypothesized Predictors on the Aptitude Level

Predictor	*M*	*SD*	1	2	3
1 Cognitive abilities	60.75	9.66	–		
2 Openness	3.54	0.97	-.17	–	
3 Self-motivation	3.77	0.79	.04	.32**	–

Note. $N = 84$. Significance of correlations was tested on Psychometrica (Lenhard & Lenhard, 2014).
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$ (two-tailed).

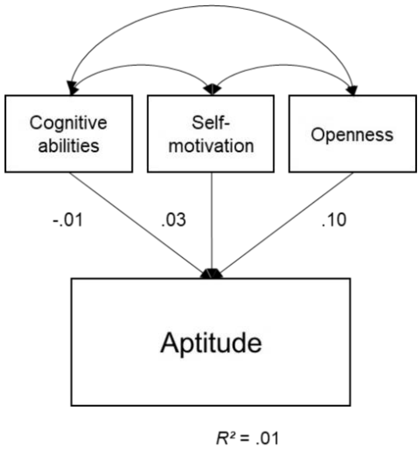
Complete data were available for 58 former junior students (69.0 %). Three former junior students had missing values on the predictor *openness* (3.6 %), and 25 former junior students had missing values on the predictor *self-motivation* (29.8 %). The high proportion of missing values on the predictor *self-motivation* can be attributed to the fact that, as reported above, the FB-SR-WÜ has only been used from the winter semester of 2006/2007 onward as part of the selection process for the junior study program at JMU Würzburg. Accordingly, no values on this variable were available for applicants up to the summer semester of 2006.

Model Estimation. As is usual for regression models in SEM format, the hypothesized model on the aptitude level was saturated. The predictor variables *cognitive abilities*, *self-motivation*, and *openness* together explained no more than 1.3 % of the variance in the dependent variable *aptitude*, F (3, 80) = 0.35, p = .789, and therefore did not form a statistically reliable set of predictors for the first talent development level of Preckel et al.'s (2020) TAD framework in academic domains.

Standardized regression coefficients and correlations on the aptitude level are provided in Figure 29, which shows that none of the predictors on the aptitude level were statistically significant, providing no support for Hypothesis 1.1.

Figure 29

Standardized Regression Results for the Hypothesized Predictors on the Aptitude Level



Note. $N = 84$. Black lines indicate (bivariate) relations between variables of the same talent development level.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 30 gives the regression constant and the unstandardized regression coefficients for the predictors on the aptitude level. In addition, standard errors, *z*-values, significance values (i.e., *p*-values; one-tailed), and confidence intervals (two-tailed) are included for each predictor.

Table 30

Unstandardized Regression Results for the Hypothesized Predictors on the Aptitude Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	-0.000	0.057	-0.007	.497	[-0.112, 0.112]
Cognitive abilities	-0.001	0.006	-0.081	.468	[-0.013, 0.012]
Openness	0.027	0.030	0.902	.184	[-0.031, 0.084]
Self-motivation	0.005	0.018	0.278	.391	[-0.030, 0.039]

Note. $N = 84$. CI = confidence interval (two-tailed).

Due to the high proportion of missing values on the predictor *self-motivation*, the regression model on the aptitude level was estimated again with a reduced sample that included only cases with complete values on this predictor. Unstandardized regression results for the predictors on the aptitude level can be looked up in Table D2 in Appendix D: SEM. The reduced sample contained 59 cases. As in the regression model with the full sample, none of the predictors were statistically significant. Overall, only 1.6 % of the variance in the dependent variable *aptitude* was explained by the predictors.

Predictors on the Competence Level. Hypothesis 2.1 posited that during regular studies, the variables *conscientiousness*, *study time*, and *investigative interests* would be predictive of individuals' level of competence in academic domains. Table 31 presents the descriptive statistics and correlations for the predictors of the competence level as computed by the software under the unrestricted model. Additionally, the table also includes the predictors of the aptitude level because Preckel et al.'s (2020) TAD framework presumes that there is considerable overlap between the predictors of successive talent development stages. There was a significant positive correlation between the predictors *cognitive abilities* and *investigative interests*, $r = .28$, $p = .011$. Moreover, *openness* was positively associated with *self-motivation*, $r = .28$, $p = .011$, and *conscientiousness*, $r = .24$, $p = .030$. Finally, *self-motivation* was found to be positively related to *conscientiousness*, $r = .52$, $p < .001$, and *study time*, $r = .27$, $p = .013$. Thus, in addition to the correlations between the predictor variables that belong to the same talent development level, there were also significant cross-correlations between the predictors of the aptitude and the competence level.

Table 31

Descriptive Statistics and Correlations for the Hypothesized Predictors on the Competence Level

Predictor	*M*	*SD*	1	2	3	4	5	6
1 Cognitive abilities	60.75	9.66	–					
2 Openness	3.54	0.97	-.17	–				
3 Self-motivation	3.71	0.78	-.04	.28*	–			
4 Conscientiousness	3.91	0.77	-.14	.24*	.52***	–		
5 Study time	37.10	11.99	-.01	.08	.27*	.20	–	
6 Investigative interests	3.72	0.96	.28*	-.02	.02	.06	.04	–

Note. $N = 84$. Significance of correlations was tested on Psychometrica (Lenhard & Lenhard, 2014).
* $p < .05$. ** $p < .01$. *** $p < .001$ (two-tailed).

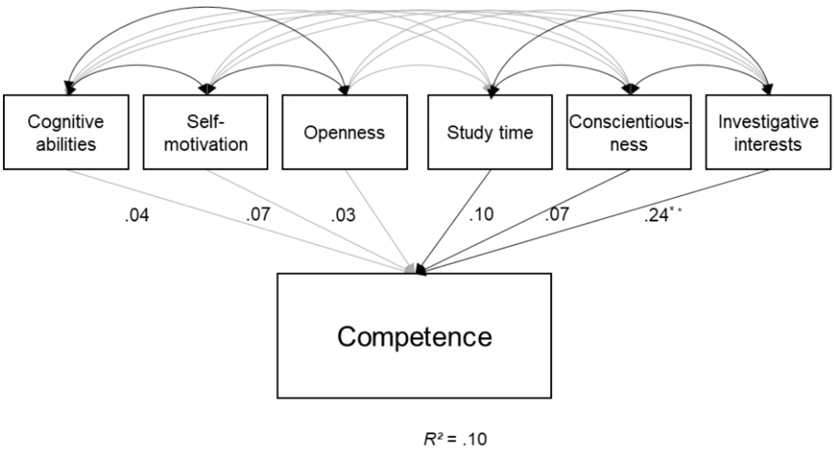
Complete data on all predictor variables were available for 57 former junior students (67.9 %). In addition to the missing values on the predictors of the aptitude level, five former junior students were also missing data on the predictor *study time* (6.0 %), and three former junior students were also missing data on the predictors *conscientiousness* (3.6 %) and *investigative interests* (3.6 %).

Model Estimation. As is usual for regression models in SEM format, the hypothesized model on the competence level was saturated. The predictor variables *cognitive abilities*, *self-motivation*, *openness*, *conscientiousness*, *study time*, and *investigative interests* in sum explained 10.2 % of the variance in the dependent variable *competence*, $F(3, 80) = 3.03$, $p = .034$, forming a statistically significant set of predictors for the second talent development level of Preckel et al.’s (2020) TAD framework in academic domains.

Standardized regression coefficients and correlations are provided in Figure 30. *Investigative interests* represented the only significant predictor on the competence level (β = 0.24, p = .007), supporting Hypothesis 2.1 at least partially.

Figure 30

Standardized Regression Results for the Hypothesized Predictors on the Competence Level



Note. N = 84. Black lines indicate (bivariate) relations between variables of the same talent development level. Gray lines indicate (bivariate) relations between variables of adjacent talent development levels.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 32 contains the regression constant and the unstandardized regression coefficients for the predictors on the competence level. Moreover, for each predictor, the table also includes standard errors, z-values, significance values (i.e., p-values; one-tailed), and confidence intervals (two-tailed).

Table 32

Unstandardized Regression Results for the Hypothesized Predictors on the Competence Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	0.001	0.027	0.038	.485	[-0.052, 0.054]
Cognitive abilities	0.001	0.003	0.422	.337	[-0.004, 0.006]
Openness	0.004	0.015	0.266	.395	[-0.025, 0.033]
Self-motivation	0.006	0.009	0.717	.237	[-0.011, 0.023]
Conscientiousness	0.011	0.019	0.572	.284	[-0.027, 0.049]
Study time	0.002	0.002	1.066	.143	[-0.002, 0.006]
Investigative interests	0.032	0.013	2.452	.007	[0.006, 0.058]

Note. *N* = 84. CI = confidence interval (two-tailed).

Due to the high proportion of missing values on the predictor *self-motivation*, the regression model was re-estimated with a reduced sample from which all cases with missing values on this predictor were excluded. The reduced sample contained 59 cases. Unstandardized regression results can be looked up in Table D3 in Appendix D: SEM. As in the regression model with the full sample, the predictor variable *investigative interests* was statistically significant ($\beta = 0.29$, $p = .005$). The remaining regression coefficients were also in a comparable range. The predictors explained a total of 13.1 % of the variance in the dependent variable *competence*.

Predictors on the Expertise Level. Hypothesis 3.1 suggested that in young adulthood, the variables *self-regulation*, *metacognition*, and *extraversion* would constitute critical determinants of individuals' level of expertise in academic domains. Table 33 presents the descriptive statistics and correlations for the predictors on the expertise level as calculated by the software under the unrestricted model. In addition, the table also includes the predictors that were postulated on the competence level. There were significant positive correlations between the predictor variables *conscientiousness* and *study time*, $r = .23$, $p = .035$, and between *conscientiousness* and *metacognition*, $r = .24$, $p = .028$. *Investigative interests* were positively associated with *self-regulation*, $r = .27$, $p = .013$, and negatively associated with *metacognition*, $r = -.28$, $p = .010$. A positive correlation was found for *self-regulation* and *metacognition*, $r = .38$, $p < .001$. *Metacognition* was positively associated with *extraversion*, $r = .25$, $p = .022$.

Table 33

Descriptive Statistics and Correlations for the Hypothesized Predictors on the Expertise Level

Predictor	*M*	*SD*	1	2	3	4	5	6
1 Conscientiousness	3.91	0.78	–					
2 Study time	36.90	12.08	.23*	–				
3 Investigative interests	3.74	0.97	.06	.03	–			
4 Self-regulation	3.71	0.64	.16	.21	.27*	–		
5 Metacognition	3.53	0.64	.24*	.20	-.28*	.38***	–	
6 Extraversion	3.16	1.08	.12	-.15	.09	.15	.25*	–

Note. $N = 84$. Significance of correlations was tested on Psychometrica (Lenhard & Lenhard, 2014).
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$ (two-tailed).

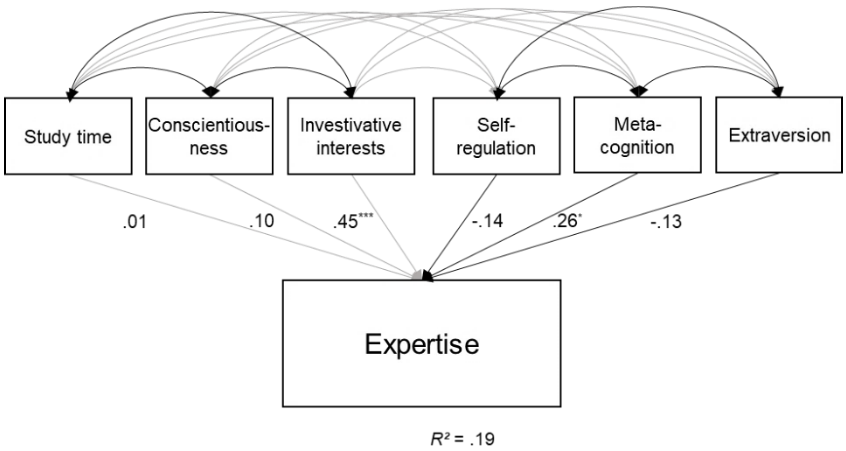
Complete data for the predictors on the competence and expertise level were available from 55 former junior students (65.5 %). In addition to the missing values regarding the predictors of the competence level, there were missing values on the predictor *self-regulation* for 27 former junior students (32.1 %), missing values on the predictor *metacognition* for 25 former junior students (29.8 %), and missing values on the predictor *extraversion* for three former junior students (3.6 %). The high proportions of missing values on the predictors *self-regulation* and *metacognition* could be attributed, as with the predictor *self-motivation* on the aptitude level, to the fact that the FB-SR-WÜ was not used as part of the selection process for the junior study program at JMU Würzburg until the winter semester of 2006/2007. As a consequence, no values on these variables were available for former junior students who had applied for the junior study program up to the summer semester of 2006.

Model Estimation. The hypothesized regression model on the expertise level was saturated. In total, the predictor variables *conscientiousness*, *study time*, *investigative interests*, *self-regulation*, *metacognition*, and *extraversion* explained 19.1 % of the variance in the dependent variable *expertise*, F (3, 80) = 6.30, p = .001, making up a statistically significant set of predictors for the third talent development stage of Preckel et al.'s (2020) TAD framework.

Standardized regression coefficients and correlations are provided in Figure 31. Partially confirming Hypothesis 3.1, the variable *metacognition* significantly predicted the dependent variable *expertise* (β = 0.26, p = .031). Moreover, as on the competence level, the variable *investigative interests* was a significant predictor (β = 0.45, p < .001). Contrary to expectations, the predictors *self-regulation* and *extraversion* did not reach significance.

Figure 31

Standardized Regression Results for the Hypothesized Predictors on the Expertise Level



Note. $N = 84$. Black lines indicate (bivariate) relations between variables of the same talent development level. Gray lines indicate (bivariate) relations between variables of adjacent talent development levels.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 34 contains the regression constant and the unstandardized regression coefficients for the predictors on the expertise level. In addition, standard errors, *z*-values, significance values (i.e., *p*-values; one-tailed), and confidence intervals (two-tailed) are reported for each predictor.

Table 34

Unstandardized Regression Results for the Hypothesized Predictors on the Expertise Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	0.006	0.034	0.187	.426	[-0.061, 0.074]
Conscientiousness	0.021	0.026	0.814	.208	[-0.029, 0.071]
Study time	0.000	0.003	0.071	.472	[-0.006, 0.006]
Investigative interests	0.077	0.021	3.607	< .001	[0.035, 0.118]
Self-regulation	-0.008	0.008	-1.002	.158	[-0.024, 0.008]
Metacognition	0.017	0.009	1.865	.031	[-0.001, 0.034]
Extraversion	-0.020	0.021	-0.954	.170	[-0.061, 0.021]

Note. $N = 84$. CI = confidence interval (two-tailed).

Finally, to check the robustness of the results on the expertise level, the regression model was estimated again with a reduced sample from which all cases with missing values on the predictors *self-regulation* and *metacognition* were excluded. The reduced sample contained 57 cases. Unstandardized regression results can be looked up in Table D4 in Appendix D: SEM. As in the regression model with the full sample, the predictor *investigative interests* reached statistical significance ($\beta = 0.50$, $p < .001$). In comparison, the predictor *metacognition* narrowly missed the significance level ($\beta = 0.20$, $p = .075$). The regression coefficients were in a comparable range. Overall, the predictors explained 21.6 % of the variance in *expertise*.

6.3 Discussion

The goal of Research Issue 2 was to empirically validate the structure of Preckel et al.'s (2020) TAD framework in academic domains. To this end, hypotheses regarding potential indicators and predictors of the talent development stages *aptitude*, *competence*, and *expertise* were formulated and tested using SEMs. The final talent development stage, *transformational* *achievement*, was not included in the hypotheses because it was assumed that the former junior students in the final sample for Research Issue 2 would not (yet) be advanced enough in their academic (and professional) careers to allow for its examination. In the next subchapter, the results of Research Issue 2 are discussed with regard to the theoretical assumptions of Preckel et al.'s (2020) TAD framework and examined in terms of their relevance for academic domains. Analogous to the previous subchapter, the focus is first on the indicators and then on the predictors of the first three talent development stages.

Indicators of Talent Development Stages. The results of Research Issue 2 provided consistent support for the hypotheses that had been proposed regarding the indicators of the first three talent development stages of Preckel et al.'s (2020) TAD framework in academic domains. In particular, it was confirmed that adolescents' academic aptitude could be modeled based on their subject-related prior knowledge, their perceived talent, and their motivation to engage with academic activities (Hypothesis 1.2). Also consistent with expectations, individuals' level of academic competence could be determined from their average study grades, their receipt of a scholarship, and their receipt of study awards/prizes (Hypothesis 2.2). Finally, young adults' academic expertise could be identified from their receipt of a doctoral degree, their number of scientific publications, and their receipt of scientific awards/prizes (Hypothesis 3.2).

In addition to the hypotheses regarding the indicators for the first three stages of Preckel et al.'s (2020) TAD framework, the results of Research Issue 2 also confirmed the hypothesis that the talent development stages *aptitude*, *competence*, and *expertise* were predictive of each other in their chronological order (Hypothesis 4). Concretely, individuals' academic aptitude in early adolescence predicted their academic competence in their regular studies, which, in turn, predicted their amount of academic expertise in their doctoral studies. Additionally, mediation analysis demonstrated that academic aptitude did not translate directly into academic expertise but was first transformed into academic competence. This finding clearly argues against the central assumption of the *gifted child paradigm*, according to which childhood precocity is causally linked to exceptional performance in adulthood (see Dai, 2018; Dai & Chen, 2013). Instead, it supports the notion of the *talent development paradigm*, which holds that high aptitude first needs to be cultivated in a domain-specific manner to eventually translate into high expertise or transformational achievement (see Subotnik et al., 2011, 2012, 2021).

In summary, the results regarding the measurement part of Research Issue 2 can be interpreted to suggest that the talent development process in academic domains, at least up to the stage of academic expertise, is well compatible with the structure of Preckel et al.'s (2020) TAD framework. Accordingly, academically gifted individuals typically pass through a sequence of (at least) three successive stages in their talent development process, spanning the period from early adolescence to young adulthood. In addition, the results show that each of these three stages can, in turn, be represented using a set of qualitatively different indicators that gradually become more specific over the course of the talent development process, evolving from general abilities to more specific skills and competencies.

Based on the results of Research Issue 2, the extent of adolescents' academic aptitude, for example, can be assessed by knowledgeable experts using broad psychological constructs, such as perceived talent, motivation to engage with academic activities, or subject-related prior knowledge. Although it is possible that differences in these constructs might appear quite early in life in some academic domains (e.g., Olszewski-Kubilius et al., 2019; Preckel et al., 2020; Worrell et al., 2019), drawing on the results of Research Issue 2, it nevertheless seems reasonable to generally identify academically gifted individuals between the ages of 15 and 18, that is, around the time when German adolescents typically enroll in junior study programs (see

Practical Background). This assumption also reconciles well with the fact that adolescents are not exposed to some academic fields until later in life (Worrell et al., 2019).

Then, at the second stage of academic talent development, more standardized, performance-related criteria, such as average study grades, scholarships, and study awards/prizes, appear to be appropriate indicators for capturing the level of competence that gifted individuals exhibit in their early adulthood. Before reaching this stage of talent development, academically gifted individuals typically go through a long period of education, over the course of which they must acquire profound declarative knowledge as well as highly sophisticated skills in a chosen subject. In academic domains, this is often accomplished through regular studies. The finding in Research Issue 2 that performance-related criteria collected during regular studies can serve as valid indicators of academic competence supports this view and suggests that talent development from late adolescence to early adulthood can possibly be conceptualized as successful advancement through the formal education system (i.e., from Gymnasium to doctoral studies; see also Chambers, 1964; Rodgers & Maranto, 1989; Wispé & Ritter, 1964). In line with this idea, the study grades of the former junior students, which can be seen as a clear indication of a successful academic career, showed significant correlations with virtually all other indicators in Research Issue 2, thus building a bridge between adolescents' talent and motivation at the first stage and their success at the third stage of academic talent development.

Finally, for the third stage of talent development according to Preckel et al.'s (2020) TAD framework, Research Issue 2 found that whether gifted individuals meet the requirements of academic expertise can be inferred from their receipt of a doctoral degree, their number of scientific publications, as well as their receipt of scientific awards/prizes. In contrast to the first two talent development stages, these indicators already demonstrate a high degree of specialization, which in academic domains often manifests itself in finding a special topic or niche. This finding is consistent with previous observations that academic expertise is associated, for example, with professional contributions to research teams or with scientific presentations on highly specific content (Olszewski-Kubilius et al., 2019).

Predictors of Talent Development Stages. Compared to the results of the measurement part of the MIMIC model, which showed that the talent development stages *aptitude*, *competence*, and *expertise* of Preckel et al.'s (2020) TAD framework could be fully represented in academic domains using framework-compliant indicators, there was little empirical support for the hypotheses made regarding the predictors of the structural part of the MIMIC model. Contrary to expectations, for example, junior students' cognitive abilities, their openness, and their motivation did not significantly predict the latent construct *aptitude* (Hypothesis 1.1). The same predictor variables were also not demonstrably related to the latent construct *competence* in academic domains. Moreover, on the level of competence, *investigative interests* constituted the only significant predictor; in contrast, the assumption that the variables *study time* and *conscientiousness* would also be relevant in the prediction of individuals' academic competence was not confirmed (Hypothesis 2.1). On the level of academic expertise, the influence of *investigative interests* remained, while the predictors *conscientiousness* and *study time* again turned out not to be significant. Finally, as expected, the predictor *metacognition* showed a reliable influence on the construct *expertise*; however, the predictors *self-regulation* and *extraversion* did not seem to be relevant (Hypothesis 3.1).

All in all, the results of the structural part of Research Issue 2 can be summarized as showing that most of the cross-domain predictors proposed in Preckel et al.'s (2020) TAD framework cannot be readily applied to academic domains. Exceptions to these results were the predictors *investigative interests* and *metacognition*, which significantly influenced the talent development process of academically gifted young adults at the stages of *competence* and *expertise*. The reason for this is not clear, but judging from the results of Research Issue 2, it might have to do with the fact that *investigative interests* and *metacognition* are more specific to academic domains than the rest of the predictors. There are several explanations for this fact: First, it is possible that the predictors *investigative interests* and *metacognition* genuinely have a high content-related fit to academic domains. For example, the conceptual description of *investigative interests* explicitly pertains to individuals who favor activities that entail the observational, symbolic, systematic, and creative examination of physical, biological, and cultural phenomena (Holland, 1997; Kabisch & Karpowski, 2016). All of these activities can clearly be classified as academic activities. Moreover, *metacognition* plays an important role in planned and self-regulated learning and problem-solving situations, which are also certainly central to knowledge acquisition and the generation of creative products in academic domains. The definition of *metacognition* further includes declarative knowledge of both learned information and control strategies as well as the ability to monitor and regulate cognitive processes (Wild & Schiefele, 1994).

Another possible explanation for the high specificity of the predictors *investigative interests* and *metacognition* for academic domains might stem from the fact that the largest proportion of the selected sample for Research Issue 2 came from a research-oriented background. As documented above, more than two thirds of those former junior students who had qualified for the sample of Research Issue 2 from the potential sample of Research Issue 1 had taken subjects from the field of Mathematics, Natural, & Engineering Sciences in both their junior and their regular studies. It is interesting to note at this point that subjects from this field in particular have traditionally high research and publication activities (Wanner et al., 1981), which can undoubtedly benefit from intense investigative interests and strong metacognitive abilities. It is possible that for this reason the two predictors were particularly relevant in the selected sample for Research Issue 2 and might not have become significant if a larger proportion of the sample had come from the field of Humanities or from the field of Law, Business, & Social Sciences, for example.

Finally, the high relevance of the predictors *investigative interests* and *metacognition* for talent development in academic domains might also have resulted from the concrete choice of indicators made in the measurement part of the MIMIC model to represent the first three talent development stages of Preckel et al.'s (2020) TAD framework. For instance, to represent the latent construct *expertise*, which was significantly influenced by both *investigative interests* and *metacognition* in Research Issue 2, the indicator variables *doctoral studies*, *scientific awards/prizes*, and *scientific publications* were used, which can be assumed to particularly presuppose skills such as research-related engagement or the ability to plan and monitor scientific activities. In this context, an interesting question would be whether the other two assumed predictors on the expertise level, *self-regulation* and *extraversion*, would have been more likely to become significant if indicators such as young adults' scientific reputation, their number of scientific presentations, or the size of their social research network would have been used to represent that level in the measurement part of the MIMIC model.

Limitations. Although having provided initial support for the validity of Preckel et al.'s (2020) TAD framework in academic domains, the results of Research Issue 2 must still be interpreted with caution for the following reasons: A first major limitation of Research Issue 2 is its small sample size. Only 84 former junior students from the potential sample of Research Issue 1 had chosen a subject from the same subject field in their regular as in their junior studies and had thus met the second selection criterion for Research Issue 2. At the same time, there were high numbers of missing values on some of the indicator and predictor variables. This was especially true for the scales of the FB-SR-WÜ and for the mentor ratings, which have only been used as standard instruments in the selection process for the junior study program at JMU Würzburg since the winter semester of 2006/2007 and the winter semester of 2007/2008, respectively, and therefore had up to 45.2 % missing values. Even though attempts were made to counteract the uncertainty in the data and to compensate for it using measures such as robust standard errors, scaled test statistics, and re-estimation of SEMs, all analyses should be repeated with larger samples to substantiate the results.

Second, some of the personality and interest measures used in the present thesis had low internal consistency, making it unclear whether the underlying constructs were adequately captured. Unfortunately, there were no comparative values available for the interest scales of the FES 16^{plus} R (Kabisch & Karpowski, 2016) or the scales of the BFI-10 (Rammstedt & John, 2007), which could have been used to put the internal consistency values of the present thesis into perspective. For instance, Kabisch and Karpowski (2016) had unfortunately excluded the 12 interest items of the FES 16^{plus} R from reliability measurement because, in their opinion, the number of items was too small to obtain meaningful values. Similarly, Rammstedt et al. (2013) had not considered internal consistency to be a suitable reliability measure for the BFI-10 scales because the number of items per scale was extremely small and the scales were apparently intended to have some heterogeneity. As explained in Rammstedt and John (2007), the items for the BFI-10 were selected from the BFI-44 with the intention to cover as broad a bandwidth as possible of the original dimensions by identifying two items per scale that both measured core aspects of the five prototypical factors of personality but were not highly redundant in content. Instead of internal consistencies, Rammstedt and John (2007) calculated part-whole correlations of the short scales with the full scales across all personality dimensions; the overall mean correlation was .83 (German sample). In addition, Rammstedt and John (2007) examined the retest reliabilities of the BFI-10 scales over an interval of 6 weeks and discovered a mean stability coefficient of .78 (German sample), indicating substantial reliability of the scales. All in all, then, it remains unclear how to judge the low internal consistencies of the scales in the present thesis. In future investigations, instruments with higher internal consistencies should be used to find out whether similar results are obtained.

Third, some of the predictors examined in Research Issue 2 were not measured precisely within those time frames of the talent development process in which Preckel et al. (2020) expect them to be most relevant for successful progression toward higher talent development stages. As mentioned above, Preckel et al.'s (2020) TAD framework does not rely on the assumption that individual psychological variables need to have strong predictive power across long-term development spans. Instead, it is assumed that indicators of a given talent development level can be predicted primarily by psychological variables assessed at the beginning of that level or the preceding level (Preckel et al., 2020). In the present thesis, however, predictors were only collected at two measurement points: either in the selection process for the junior study program or in the follow-up of former junior students at JMU Würzburg. As a consequence, in some cases, the actual point of measurement did not fall within the theoretical time frames specified by Preckel et al. (2020). For example, the predictor *openness* was used as a predictor of the first talent development stage, *aptitude*, but was not collected until the follow-up of former junior students, that is, not until the former junior students were in their early adulthood. Conversely, the predictors *self-regulation* and *metacognition* were already collected when the former junior students applied for the junior study program at JMU Würzburg, that is, when the former junior students were in their adolescent years, but were only used as predictors of the third talent development stage, *expertise*.

7 General Discussion

Due to theoretical contestations and inconsistent definitions of core concepts, the field of giftedness and gifted education has long been viewed as conceptually unstable and internally fragmented (e.g., Ambrose et al., 2010; Coleman, 2006; McBee et al., 2012). It was only in recent years that increased efforts have been made to organize extant research findings and to help the field of giftedness and gifted education regain greater uniformity. For instance, with the presentation of their TAD framework, Preckel et al. (2020) proposed an integrated model of giftedness and talent development that describes the talent development process using a sequence of four successive stages in which general abilities are assumed to gradually turn into more specific skills and competencies. Moreover, the TAD framework focuses on measurable person-related variables and outlines their relevance at different stages of the talent development process, making progression toward exceptional performance more suitable for empirical investigations and more usable for cross-domain applications than was the case in previous models (Preckel et al., 2020).

The present thesis has covered two related research issues: Research Issue 1 aimed to find out how the educational trajectories of former junior students unfold into their early adulthood. To this end, a comprehensive follow-up was conducted among former junior students at JMU Würzburg who had participated in the junior study program between the winter semester of 2004/2005 and the summer semester of 2011. Studies conducted up to this point had mainly focused on former junior students' transition from school to university and had thus neglected their long-term academic (and professional) development (e.g., Gabert, 2014; Kaden, 2016; Katzarow & Grönholdt, 2014; Stumpf & Gabert, 2016; Stumpf et al., 2011).

Research Issue 2 tried to determine the extent to which the structure of Preckel et al.'s (2020) TAD framework could be empirically validated in academic domains. As with Research Issue 1, no directly relevant findings had previously been available on this issue. As a longitudinal data basis for Research Issue 2, the data obtained from the follow-up of former junior students in Research Issue 1 were combined with the data from the selection process for the junior study program at JMU Würzburg. The aim was to identify indicators of the different talent development stages in academic domains and to establish them as practical guides for gifted education. In addition, an attempt was made to distinguish psychological variables that would predict whether individuals are meeting the expectations with regard to their age-appropriate talent development stages.

The final chapter serves to place the results of the present thesis into a broader context and to link them back to the starting point for their examination. To this effect, the first subchapter briefly summarizes and rediscusses Research Issue 1 and Research Issue 2. Subsequently, in the second subchapter, the main results of the two research issues are considered in terms of their theoretical and practical implications for the field of giftedness and gifted education. Finally, the last subchapter points out some general limitations of the present thesis and suggests directions for future research.

7.1 Research Issues

The following sections revisit the goals, methods, and results of the two central research issues of the present thesis. The aim is to summarize the content of all research questions in a compact manner and thus to create a basis for their general discussion. The first section focuses on Research Issue 1, while the second section provides a brief summary of Research Issue 2.

7.1.1 Research Issue 1: Follow-Up of Former Junior Students at JMU Würzburg

Research Issue 1 was fundamentally designed as a precursor to Research Issue 2. Its main purpose was to document in detail the long-term educational trajectories of former junior students at JMU Würzburg into their early adulthood. To this end, a comprehensive follow-up was conducted between October 2019 and February 2020 among 208 young adults who had participated in the junior study program at JMU Würzburg more than 8 years earlier. The design of the follow-up questionnaire was guided by a number of research questions that had emerged from the relevant literature on junior study programs in Germany. For example, given the abundant evidence of junior students' high academic performance both in school and in their junior studies, the question was formulated as to whether they would continue to be successful in their regular studies and what academic credentials they would achieve. Another question addressed the current job situation of former junior students; it had arisen from the fact that there had been no previous studies investigating what jobs former junior students commonly choose and what experiences they have in their professional careers. Likewise, potential long-term impacts of participation in junior study programs on the academic (and professional) development of the young adults had been understudied. To compensate for this shortcoming, the follow-up questionnaire included questions about how the former junior students at JMU Würzburg evaluated their participation in the gifted education measure in retrospect and whether they would attend the junior study program again from their current perspective.

For the most part, the data from the follow-up of former junior students at JMU Würzburg were analyzed descriptively and documented as a detailed report. Overall, the results showed that the former junior students continued to be academically (and later professionally) successful long after their school years. Of particular note was that at the time of the follow-up, the young adults had secured both bachelor's and master's degrees well beyond base-rate expectations (cf. Statistisches Bundesamt, 2020a). Likewise, their average grades in their regular studies were much better than the national reference values (cf. Statistisches Bundesamt, 2020d). Additionally, the former junior students had achieved special academic accomplishments, such as scholarships or awards/prizes, over the course of their regular studies. Among their places of study were traditional German higher education institutions as well as top international universities, such as the University of Oxford, the University of Cambridge, Stanford University, the Massachusetts Institute of Technology, and Harvard University (THE World Universities Insights Limited, 2019). Almost half of those who responded to the follow-up indicated that they had completed at least part of their regular studies at JMU Würzburg.

Compared to the number of bachelor’s and master’s degrees, the results of Research Issue 1 painted an even more impressive picture with regard to the number of doctoral degrees earned by the former junior students at JMU Würzburg; here, the proportion of doctoral students that was found in the respondent sample was more than 5 times higher than the nationwide proportion of doctoral students in a cohort (cf. Statistisches Bundesamt, 2020c, 2020d). In addition, more than one third of those former junior students who had already completed their doctoral studies at the time of the follow-up had received a “summa cum laude”. On top of that, the former junior students had also achieved special academic successes, such as scientific publications or scholarships, over the course of their doctoral studies.

While the former junior students had shown a clear preference for subjects from the field of Mathematics, Natural, & Engineering Sciences in their regular and their doctoral studies, the results on their professional situation revealed an almost identical concentration of jobs in the field of Mathematics, Natural, & Engineering Sciences and in the field of Law, Business, & Social Sciences. This shift in preference is probably due to the fact that, in addition to factors such as interests and talents, which are important in the context of subject choice for regular studies, factors such as income and professional advancement come into play when choosing a career.

Indicators of professional success were (still) quite heterogeneous among the former junior students at the time of the follow-up: On the one hand, the monthly gross income of the former junior students was most often in the range of “Up to 4,000 euros” to “Up to 5,000 euros” and was thus on average higher than the monthly gross income of the working population in Germany (cf. Statistisches Bundesamt, 2019). On the other hand, the professional status of the young adults was (still) most frequently associated with delegation powers (i.e., the authority to transfer work to apprentices, interns, or (student) assistants; Abele-Brehm & Hagmaier, 2011), indicating a not (yet) too advanced professional position. The contractual working hours of the former junior students averaged approximately 38 each week at the time of the follow-up, showing no gender-related differences. Contrastingly, a significant difference was found between females and males in their actual working hours, with the latter working about 5 more extra hours each week than the former.

The retrospective evaluation of the junior study program at JMU Würzburg by the former participants turned out to be overwhelmingly positive. In line with Stumpf et al. (2011), almost all of those young adults who responded to the follow-up asserted that, from their current perspective, they would attend the junior study program at JMU Würzburg again. Regarding their further academic development, the vast majority felt that the experience of having gained insight into their intended subject in the junior study program was important. Furthermore, most former junior students had benefited from getting to know everyday student life and gaining insight into university structures. However, there were mixed reactions to the statement that participation in the program had helped the former junior students avoid changing subjects in their regular studies. This was presumably due to the fact that some junior students had already made the right subject choice in their junior studies and had then simply continued their subjects in their regular studies, while other junior students had to change subjects (again) in their regular studies.

Taken together, the results of Research Issue 1 represent the first detailed report on the academic (and professional) development of former junior students well beyond their participation in the gifted education measure. As such, they contribute to a better understanding of how the high academic achievement potential of junior students unfolds and what the potential long-term impacts of junior study programs are on the educational trajectories of former participants.

7.1.2 Research Issue 2: Talent Development in Academic Domains

Research Issue 2 aimed to investigate the extent to which the structure of Preckel et al.'s (2020) TAD framework could be empirically validated in academic domains. As a longitudinal data basis, the data collected for Research Issue 1 in the follow-up of former junior students were combined with the data from the selection process for the junior study program at JMU Würzburg. Drawing on the structural assumptions of Preckel et al.'s (2020) TAD framework and on relevant insights into the specifics of the talent development process in individual academic disciplines, such as Mathematics and Psychology, hypotheses were derived regarding potential indicators and predictors of the talent development stages *aptitude*, *competence*, and *expertise* in academic domains.

Data analysis for Research Issue 2 was conducted in two steps using SEMs: First, it was examined to what extent the hypothesized indicators of the talent development stages *aptitude*, *competence*, and *expertise* could be used for modeling those stages and to what extent the modeled stages were predictive of each other in their chronological order. Second, it was tested whether the modeled talent development stages could be inferred from framework-compliant predictors.

The results of Research Issue 2 implied that the talent development stages *aptitude*, *competence*, and *expertise*, while being predictive of each other in their chronological order, could be modeled using framework-compliant indicators in academic domains. More specifically, adolescents' aptitude in academic domains could be determined from their prior knowledge, their subject-specific talent, and their motivation to engage in academic activities. In addition, it was possible to model young adults' academic competence in their regular studies from their average study grades, their receipt of a scholarship, and their receipt of study awards/prizes. Finally, young adults' expertise in academic domains could be identified from their receipt of a doctoral degree, their number of scientific publications, and their receipt of scientific awards/prizes during their doctoral studies. The talent development stage *transformational achievement* could not (yet) be modeled based on the longitudinal data.

Regarding the predictors of the first three talent development stages in academic domains, the results of Research Issue 2 revealed that former junior students' investigative interests reliably influenced the talent development stages *competence* and *expertise*. In addition, former junior students' metacognitive abilities seemed to predict the talent development stage *expertise*. The remaining predictors did not contribute significantly to the identification of the three talent development stages.

In sum, the findings in Research Issue 2 suggest that the structure of Preckel et al.'s (2020) TAD framework can only be empirically validated to some extent in academic domains. A possible explanation for this might be that the predictors in Preckel et al.'s (2020) TAD framework, unlike the postulated indicators, are highly specific with regard to the achievement domain under consideration and cannot be easily transferred to academic domains. Another possible explanation might lie in the composition of the selected sample for Research Issue 2 or in the concrete selection of indicators used to model the talent development stages.

7.2 Theoretical and Practical Implications

After the previous subchapter has rediscussed the goals, methods, and results of the two central research issues of the present thesis, the following subchapter builds on this and turns to possible theoretical and practical implications. The main focus of the subchapter is on implications resulting from Research Issue 2, although some conclusions can also be drawn from the results of Research Issue 1.

From a theoretical perspective, the results of the present thesis are useful in expanding the current state of giftedness research on how talent development manifests in academic domains and what conditions contribute to successful progression toward exceptional academic performance. Based on the structure of Preckel et al.'s (2020) TAD framework, the results of Research Issue 2 indicate, first, that talent development in academic domains proceeds in (at least) three distinct stages, each of which can be modeled using qualitatively different indicators that gradually move from general abilities to more specific skills and competencies over the course of the talent development process. All aspects considered, this makes the *talent development paradigm* (cf. Subotnik et al., 2011, 2012, 2021) a suitable model to theoretically represent the progress of academically gifted individuals on their path toward excellence. In contrast, Research Issue 2 found no indications of the validity of the *gifted child paradigm* (cf. Dai, 2018; Dai & Chen, 2013) in academic domains.

Second, the results of Research Issue 2 allow for the theoretical conclusion that, unlike the framework-compliant indicators, the predictors proposed in Preckel et al.'s (2020) TAD framework cannot be readily applied to academic domains but might need to be tailored more specifically to the subject field or discipline under consideration. For example, in Research Issue 2, where the selected sample was predominantly from the field of Mathematics, Natural, & Engineering Sciences, former junior students' investigative interests emerged as the only significant predictor of the latent construct *competence*. Furthermore, young adults' metacognitive abilities turned out to be a significant predictor of the latent construct *expertise*. In this context, an interesting question would be whether, for example, the other two hypothesized predictors on the competence level, *conscientiousness* and *study time*, would have played a more important role in a sample composed primarily of junior students from the field of Law, Business, & Social Sciences, since success in subjects from this subject field might depend more on individuals' work attitudes involving characteristics such as diligence, perseverance, or effort than is presumably the case in the field of Mathematics, Natural, & Engineering Sciences.

From a practical perspective, the results of the present thesis make useful suggestions on how to identify academically gifted individuals and how to reasonably design curricula aimed at promoting giftedness in academic domains. First, the outcome of Research Issue 2 – that the talent development process in academic domains can be viewed as a sequence of (at least) three successive stages, each with qualitatively different talent manifestations – leads to the conclusion that identification procedures in academic domains need to be specifically adapted and validated for each stage of talent development. In this regard, some practical ideas can be directly derived from the indicators used to model the first three talent development stages of Preckel et al.'s (2020) TAD framework in Research Issue 2. For example, at the time individuals are first exposed to academic achievement domains, assessments by knowledgeable experts can provide valid indications of their academic aptitude. Potential measures that might be used in this process include global rating scales or short, cursory tests such as those used by the mentors in the selection process for the junior study program at JMU Würzburg. Then, as individuals progress toward higher talent development stages, the importance of demonstrated achievement as an indication of high academic giftedness increases (cf. Olszewski-Kubilius & Thomson, 2015). For instance, the results of Research Issue 2 indicate that performance-related measures, such as study grades, the receipt of a scholarship, or the receipt of study awards/prizes, can be used to identify high levels of competence in academic domains. Finally, at the third stage of talent development, demonstrated achievement becomes even more prominent; at this stage, for example, concrete, independent works such as the successful preparation of a doctoral thesis can be considered valid evidence of academic expertise.

In their comments on the practical implications arising from the *talent development paradigm*, Olszewski-Kubilius and Thomson (2015) even go a step further and advocate for a more comprehensive assessment of giftedness that includes a variety of different measures such as test scores, portfolios, or actual achievements, regardless of the stage of individual talent development. A positive example of such a multidimensional approach can be found in the selection process for the junior study program at JMU Würzburg. Here, a wide range of psychological, performance-related, motivational, and socio-demographic variables is used to gain a comprehensive picture of applicants' abilities and characteristics. Furthermore, both the coordinator for the junior study program at the BYB and the mentors who oversee applicants' intended subjects are actively involved in the selection process (Stumpf et al., 2011; Stumpf & Schneider, 2010). For example, in the actual decision for or against applicants' acceptance, particular weight is given to the mentors' assessments of the young people's talent, their prior knowledge, and their study-related motivation. It might well be seen as a success of the extensive selection process at JMU Würzburg that, as the results of Research Issue 1 have shown, more than half of those former junior students who responded to the follow-up had started or already completed a doctoral degree.

Second, from a practical perspective, the results of the present thesis imply that curricula for gifted education measures in academic domains should be matched to the stage of talent development of the targeted individuals. For instance, children and adolescents who are at the first stage of talent development in academic domains might especially profit from enriched environments that expose them to a variety of disciplines and that broadly stimulate their interests and motivation. Examples of such environments include enrichment seminars, after-school clubs, or student competitions (see Olszewski-Kubilius & Thomson, 2015). For adolescents who are about to proceed to the stage of academic competence, more systematic gifted education programs, such as advanced courses that focus on teaching content and technical knowledge as well as on deepening understanding of a certain subject (field), are needed. In contrast, young adults at the expertise level are best served by gifted education measures that continue skill development through advanced courses while also offering opportunities to pursue special interests through independent projects and more authentic work in an academic discipline. Possible options at this level include mentorships that focus on conducting research in a domain or on finding solutions to real-world problems (see Olszewski-Kubilius & Thomson, 2015).

Although regular schooling plays a key role in promoting talent, Subotnik et al. (2017) point out that academic talent cannot be fully developed in school. Rather, high-level academic talent development requires that schools collaborate with out-of-school settings, such as public organizations or universities, to provide their pupils with intensive exposure to a variety of topics, authentic experiences, and opportunities to creatively explore different disciplines (Subotnik et al., 2018b). As described in the practical background of the present thesis, collaboration between schools and universities in Germany is possible, among others, in the context of junior study programs. Through these programs, academically gifted adolescents are offered enriched environments that allow them to acquire knowledge and skills that go well beyond what is normally taught in school (Solzbacher, 2008a; Stumpf, 2011; Stumpf & Schneider, 2008). In addition, adolescents can take exams as part of their junior studies and earn credits that can later be counted toward their regular studies, giving them the chance to considerably shorten their future study time (Deutsche Telekom Stiftung, 2008, 2011; Solzbacher, 2006–2007, 2008a, 2011; Stumpf & Schneider, 2008).

7.3 General Limitations and Directions for Future Research

In addition to those limitations that have already been discussed in the context of Research Issue 1 and Research Issue 2, there are also more general aspects that narrow the findings of the present thesis. At the same time, these limitations equally highlight areas for improvement and provide directions for future research. The following sections are finally intended to provide some ideas that might be taken up in subsequent studies.

First, in subsequent studies, it would be advisable to cover a larger time frame than was the case in the present thesis, that is, a larger interval separating the follow-up of former junior students from their participation in the gifted education measure. As detailed in the methodological sections of Research Issue 1, an interval of 8 years was deliberately chosen as the time frame in the present thesis, since, on this basis, it could be assumed that, given a standard period of study of 6 semesters (i.e., 3 years) for a bachelor's degree and another 4 semesters (i.e., 2 years) for a master's degree, most former junior students at JMU Würzburg would have completed their regular studies at the time of the follow-up. As it turned out, this was indeed the case for almost all respondents. However, a considerable number of those who completed the follow-up had started working on their doctoral thesis directly after their regular studies and were thus still in (extended) academic education. Documentation of the current professional situation of former junior students was therefore only possible to a limited extent. What is more, at the time of the follow-up, former junior students were not (yet) sufficiently advanced in their professional careers to allow for an examination of the final talent development stage of Preckel et al.'s (2020) TAD framework, *transformational achievement*. According to Olszewski-Kubilius et al. (2015), the transition from expertise to exceptional achievement typically occurs in adulthood and, depending on the academic discipline, might occur in early adulthood (e.g., in Mathematics or Music) or in later adulthood (e.g., in Psychology or Diplomacy). Correspondingly, it would be advisable to choose a time frame of at least 20 years for subsequent studies in order to be able to fully capture both the professional careers of former junior students and their potential for transformational achievement.

Second, a natural progression of the present thesis would be to examine the structure of Preckel et al.'s (2020) TAD framework at the subordinate level of subject fields or even at the level of individual academic disciplines. As described above, the results of Research Issue 2 have provided little empirical support for the generalizability of the predictors of Preckel et al.'s (2020) TAD framework to academic domains, whereas, in contrast, all framework-compliant indicators could be used to model the first three talent development stages. Therefore, an interesting question would be whether the importance of predictors varies across academic subject fields or disciplines. To find out, for example, SEM multiple group analysis might be performed in R (R Core Team, 2020) using Rosseel et al.'s (2021) lavaan package. In the present thesis, this was unfortunately not possible due to the small sample size of Research Issue 2 as well as the resulting lack of variance in the groups. It would therefore also be advisable for subsequent studies to use larger sample sizes.

Finally, it would be of great interest to the field of giftedness and gifted education if subsequent studies empirically tested the validity of Preckel et al.'s (2020) TAD framework in domains other than academic achievement. In the present thesis, talent development was examined exclusively in academic domains, allowing no conclusions to be drawn about the determinants and manifestations of exceptional performance in other domains of human endeavor such as Sports or Music. However, as Preckel et al. (2020) explain, their TAD framework was developed with the intention of enabling a systematic comparison of domains, particularly with respect to psychological predictor variables. More precisely, Preckel et al. (2020) hypothesize that, while some psychological variables might be domain-specific, others might have strong predictive power in more than one domain. Thus, it remains an empirical question to identify significant predictors shared across multiple domains (Preckel et al., 2020).

In academic domains, the present thesis has taken a first step in this direction. It is now up to subsequent studies to take this step as a model and to empirically investigate talent development in other achievement domains as well.

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List of Abbreviations

AIC	Akaike Information Criterion
AP	Advanced Placement
BFI-10	Big Five Inventory 10 (Rammstedt & John, 2007)
BFI-44	Big Five Inventory 44 (John et al., 1991)
BIC	Bayesian Information Criterion
BYB	Begabungspsychologische Beratungsstelle [Psychological Counseling Center for Giftedness]
CFI	Comparative Fit Index
(C)MAR	(Completely) Missing at Random
DMGT	Differentiating Model of Giftedness and Talent (Gagné, 1985)
DMNA	Developmental Model for Natural Abilities (Gagné, 2018)
EHEA	European Higher Education Area
FAU	Friedrich-Alexander-Universität
FB-SR-WÜ	Würzburger Fragebogen zur Selbstregulation [Würzburg Self-Regulation Questionnaire]
FES 16^{plus} R	Fragebogen zum Erkenntnisstreben 16+, Revision [Quest for Knowledge Questionnaire 16+, Revision] (Kabisch & Karpowski, 2016)
FIML	Full Information Maximum Likelihood
G8	8-year (Bavarian) Gymnasium
G9	9-year (Bavarian) Gymnasium
IMTD	Integrative Model of Talent Development (Gagné, 2018)
JMU	Julius-Maximilians-Universität
KFT 4–12+ R	Kognitiver Fähigkeitstest für 4. bis 12 Klassen, Revision [Cognitive Abilities Test for Grades 4 to 12, Revision] (Heller & Perleth, 2000)

KMK	Kultusministerkonferenz [Standing Conference of the Ministers of Education and Cultural Affairs of the German states]
LMU	Ludwig-Maximilians-Universität
MDAAM	Munich Dynamic Ability-Achievement Model (Perleth, 2001)
MIMIC	Multiple Indicators Multiple Causes (Model)
MMG	Munich Model of Giftedness (Heller, 1992, 2001)
MPMG	Munich Process Model of Giftedness (Perleth & Ziegler, 1997)
NNFI	Non-Normed Fit Index
ÖZBF	Österreichisches Zentrum für Begabtenförderung und Begabungsforschung [Austrian Research and Support Center for the Gifted and Talented]
RMSEA	Root-Mean-Square Error of Approximation
SEM	Structural Equation Model
TAD	Talent Development in Achievement Domains (Framework; Preckel et al., 2020)
TDMM	Talent Development Megamodel (Subotnik et al., 2011, 2018b)
TLI	Tucker-Lewis Index

Appendices

Appendix A: Subject Classification

Table A1

Junior Students' (Intended) Subjects for the Junior Study Program (N = 208)

Subject	Frequency	
	n	%
Humanities		
Archeology	4	1.9
Chinese Studies	3	1.4
English Studies	10	4.8
Greek Studies	2	1.0
History	3	1.4
Latin Studies	2	1.0
Philosophy	11	5.3
Romance Studies	1	0.5
Mathematics, Natural, & Engineering Sciences		
Biology	3	1.4
Business Information Systems	1	0.5
Chemistry	13	6.3
Computer Science	23	11.1
Geography	3	1.4
Mathematics	63	30.3
Physics, Nanostructure Technology	27	13.0
Law, Business, & Social Sciences		
Economics	4	1.9
Law	4	1.9
Political Science	13	6.3
Psychology	6	2.9
Others		
Art History	1	0.5
(Human) Medicine	11	5.3

Table A2

Former Junior Students' Subject Choices in their Bachelor's (n = 104), Master's (n = 93), and Doctoral Studies (n = 53)

Subject	Bachelor's Degree		Master's Degree		Doctoral Degree	
	n	%	n	%	n	%
Humanities						
Chinese Studies			1	1.1		
Classical Philology	1	1.0				
English Studies, English (Teaching Degree)	2	1.9	2	2.2		
Ethnology	1	1.0				
German Studies, German (Teaching Degree)	2	1.9				
Greek Studies	1	1.0	1	1.1	1	1.9
History	1	1.0	1	1.1		
Islamic (Religious) Studies	1	1.0			1	1.9
Latin Studies, Latin (Teaching Degree)	1	1.0	1	1.1	1	1.9
Philosophy (of Science)	2	1.9	3	3.2	1	1.9
Philosophy and Religion	1	1.0				
Romance Studies, French (Teaching Degree)			1	1.1		
Mathematics, Natural, & Engineering Sciences						
Architecture	1	1.0				
Biology	2	1.9	2	2.2	1	1.9
Biotechnology	1	1.0				
Business Information Systems	3	2.9	2	2.2		
Business Mathematics	1	1.0	1	1.1		
Chemical Engineering	1	1.0	1	1.1		
Chemistry	4	3.8	3	3.2	2	3.8
Civil Engineering	1	1.0				
Cognitive Science			1	1.1		
Computational Mathematics	1	1.0				
Computer Science	11	10.6	8	8.6	6	11.3

Engineering Economics	3	2.9	2	2.2		
Electrical Engineering					1	1.9
Engineering Informatics	1	1.0	1	1.1		
Engineering Science	1	1.0				
Functional Materials	1	1.0	1	1.1		
Geography, Geography (Teaching Degree)	1	1.0	1	1.1	1	1.9
Mathematics	12	11.5	15	16.1	9	17.0
Mechanical Engineering	3	2.9	3	3.2	1	1.9
Mechatronics	3	2.9				
Neuroscience					1	1.9
Pharmacy	1	1.0	1	1.1	1	1.9
Physics	7	6.7	6	6.5	6	11.3
Space Science and Technology	1	1.0	1	1.1		
Technomathematics	1	1.0				
Law, Business, & Social Sciences						
Business Administration	5	4.8	5	5.4	2	3.8
China Business and Economics					1	1.9
Economics	1	1.0	1	1.1	1	1.9
Finance and Information Management			1	1.1		
Law	2	1.9	4	4.3	1	1.9
Political Science	1	1.0	3	3.2	1	1.9
Psychology	5	4.8	4	4.3	3	5.7
Sociology	1	1.0				
System Theory	1	1.0	1	1.1		
Others						
(Human) Medicine	13	12.5	12	12.9	10	18.9
Digital Humanities			2	2.2		
Media Communication	1	1.0	1	1.1	1	1.9

Table A3

Former Junior Students' Jobs (n = 73)

Job	Frequency	
	n	%

Humanities		
Teacher of English and Latin	1	1.4
Mathematics, Natural, & Engineering Sciences		
Assistant Professor for Imaging Physics	1	1.4
Chief Digital Officer	1	1.4
(Senior) Data Scientist	4	5.5
(Design) Engineer	5	6.8
Hardware Designer	1	1.4
(Postdoctoral) Research Associate, Physics	5	6.8
(Postdoctoral) Research Associate, Mathematics	3	4.1
Research Associate, Biology		
Research Associate, Chemistry	1	1.4
Research Associate, Computer Science	1	1.4
Research Associate, Pharmacy	2	2.7
Research Associate, Geography	1	1.4
Software Developer/Architect	1	1.4
Teacher of Mathematics and Physics	5	6.8
	1	1.4
Law, Business, & Social Sciences		
Branch Office Manager	1	1.4
Business Development Manager	1	1.4
Business Development Retailer	1	1.4
Customer Service Representative	1	1.4
Lawyer	1	1.4
Logistics Planner	1	1.4
Management/Business Consultant	5	6.8
Policy Associate	1	1.4
Research Associate, Economics	1	1.4
Research Associate, Law	1	1.4
(Postdoctoral) Research Associate, Psychology	2	2.7
Product Owner/Business Analyst		
Product Manager	1	1.4
Project/Systems Manager	1	1.4
Risk Management Representative/Consultant	4	5.5
Senior Psychologist	2	2.7

Scrum Master	1	1.4
University Assistant	2	2.7
	1	1.4
Others		
(Assistant) Physician	9	12.3
Dramatic Advisor	1	1.4
Research Associate, Communication	1	1.4
Research Associate, Digital Humanities	1	1.4

Appendix B: Follow-Up Material

E-Mail Invitation to the Follow-Up (1st Week of Data Collection)

Sehr #u_anredeform1# #u_anrede1# #u_nachname#,

das Frühstudium an der Julius-Maximilians-Universität Würzburg blickt mittlerweile auf 15 erfolgreiche Jahre zurück. Als Instrument der Begabtenförderung wurde es zum Wintersemester 2004/2005 auf Initiative von Herrn Prof. Dr. Wolfgang Schneider, dem ehemaligen Direktor der Begabungspsychologischen Beratungsstelle, und Herrn Dr. Richard Greiner, dem Geschäftsführer des Instituts für Mathematik, eingerichtet. Seitdem haben etwa 700 Schülerinnen und Schüler neben ihrem Schulunterricht als Frühstudierende reguläre Lehrveranstaltungen an der Julius-Maximilians-Universität Würzburg besucht.

Die Auswahl und Betreuung der Frühstudierenden wird von der Begabungspsychologischen Beratungsstelle, einer zentralen wissenschaftlichen Einrichtung der Julius-Maximilians-Universität Würzburg, koordiniert. Daneben ist die Begabungspsychologische Beratungsstelle auch mit der kontinuierlichen Evaluation und Erforschung des Frühstudiums betraut. Aus aktuellem Anlass besteht ein Forschungsziel beispielsweise darin, die weitere akademische und berufliche Entwicklung der Frühstudierenden, die in der Anfangszeit an der Fördermaßnahme teilgenommen haben, zu untersuchen.

Bei unserer Evaluation und Forschung sind wir auf Ihre Unterstützung als #u_anredeform2# #u_anrede2# angewiesen. Wir bitten Sie deshalb, an unserer **Nachbefragung** zum Frühstudium teilzunehmen; Da wir Sie unter Ihrer E-Mail-Adresse #adresse# nicht mehr erreichen konnten

Ihren personalisierten Fragebogen können Sie unter folgendem Link aufrufen:

#code_complete#

Die Bearbeitung der Nachbefragung wird **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Ihre Angaben unterliegen den Bestimmungen der **europäischen Datenschutz-Grundverordnung (DSGVO)** und werden ausschließlich für Forschungszwecke bzw. zur kontinuierlichen Evaluation des Frühstudiums erhoben. Die Verarbeitung Ihrer Daten erfolgt anonym.

Als kleines Dankeschön verlosen wir unter allen Teilnehmerinnen und Teilnehmern **Gutscheine der CTS EVENTIM AG & Co. KGaA im Gesamtwert von 100 Euro**.

Bei Fragen können Sie uns gerne kontaktieren.

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter
Direktor der Begabungspsychologischen Beratungsstelle

Lorena Fleischmann, M.Sc.
Wissenschaftliche Mitarbeiterin

Sehr geehrte Frau Brückner,

das Frühstudium an der Julius-Maximilians-Universität Würzburg blickt mittlerweile auf **15 erfolgreiche Jahre** zurück. Als Instrument der Begabtenförderung wurde es zum Wintersemester 2004/2005 auf Initiative von Herrn Prof. Dr. Wolfgang Schneider, dem ehemaligen Direktor der Begabungspsychologischen Beratungsstelle, und Herrn Dr. Richard Greiner, dem Geschäftsführer des Instituts für Mathematik, eingerichtet. Seitdem haben etwa 700 Schülerinnen und Schüler neben ihrem Schulunterricht als Frühstudierende reguläre Lehrveranstaltungen an der Julius-Maximilians-Universität Würzburg besucht.

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Bei unserer Evaluation und Forschung sind wir auf Ihre Unterstützung als ehemalige Frühstudierende angewiesen. Wir bitten Sie deshalb, an unserer **Nachbefragung zum Frühstudium** teilzunehmen; Ihren personalisierten Fragebogen können Sie unter folgendem Link aufrufen:

https://ww2.unipark.de/uc/Nachbefragung/a76b/?code=6523fb6f24914757

Die Bearbeitung der Nachbefragung wird **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Ihre Angaben unterliegen den Bestimmungen der **europäischen Datenschutz-Grundverordnung (DSGVO)** und werden ausschließlich für Forschungszwecke bzw. zur kontinuierlichen Evaluation des Frühstudiums erhoben. Die Verarbeitung Ihrer Daten erfolgt anonym.

Als kleines Dankeschön verlosen wir unter allen Teilnehmerinnen und Teilnehmern **Gutscheine der CTS EVENTIM AG & Co. KGaA im Gesamtwert von 100 Euro**.

Bei Fragen können Sie uns gerne kontaktieren.

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter Direktor der Begabungspsychologischen Beratungsstelle	Lorena Fleischmann, M.Sc. Wissenschaftliche Mitarbeiterin

E-Mail Reminder of the Follow-Up (3rd and 5th Week of Data Collection)

Sehr #u_anredeform1# #u_anrede1# #u_nachname#,

wir möchten Sie an unsere Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg erinnern. Als Instrument der Begabtenförderung wurde das Frühstudium an der Julius-Maximilians-Universität Würzburg zum Wintersemester 2004/2005, d.h. **vor mittlerweile 15 Jahren**, eingerichtet. Mit unserer Nachbefragung verfolgen wir das Ziel, die weitere akademische und berufliche Entwicklung der Frühstudierenden, die in der Anfangszeit an der Fördermaßnahme teilgenommen haben, zu erforschen.

Bei unserer Forschung sind wir auf Ihre Unterstützung als #u_anredeform2# #u_anrede2# angewiesen. Wir bitten Sie deshalb, an unserer **Nachbefragung zum Frühstudium** teilzunehmen; Ihren personalisierten Fragebogen können Sie unter folgendem Link aufrufen:

#code_complete#

Die Bearbeitung der Nachbefragung wird **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Ihre Angaben unterliegen den Bestimmungen der **europäischen Datenschutz-Grundverordnung (DSGVO)** und werden ausschließlich für Forschungszwecke bzw. zur kontinuierlichen Evaluation des Frühstudiums erhoben. Die Verarbeitung Ihrer Daten erfolgt anonym.

Als kleines Dankeschön verlosen wir unter allen Teilnehmerinnen und Teilnehmern **Gutscheine der CTS EVENTIM AG & Co. KGaA im Gesamtwert von 100 Euro**.

Bei Fragen können Sie uns gerne kontaktieren.

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter
Direktor der Begabungspsychologischen Beratungsstelle

Lorena Fleischmann, M.Sc.
Wissenschaftliche Mitarbeiterin

Postal Invitation to the Follow-Up (5th Week of Data Collection)

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Begabungspsychologische
Beratungsstelle
Direktor: Prof. Dr. Tobias Richter

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Begabungspsychologische Beratungsstelle
Röntgenring 10
97070 Würzburg
Telefon: 0931/31-86023
E-Mail: begabungsberatungsstelle@uni-wuerzburg.de

«Adresse»

Würzburg, 18. November 2019

Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg

«Anrede»

das Frühstudium an der Julius-Maximilians-Universität Würzburg blickt mittlerweile auf **15 erfolgreiche Jahre** zurück. Als Instrument der Begabtenförderung wurde es zum Wintersemester 2004/2005 auf Initiative von Herrn Prof. Dr. Wolfgang Schneider, dem ehemaligen Direktor der Begabungspsychologischen Beratungsstelle, und Herrn Dr. Richard Greiner, dem Geschäftsführer des Instituts für Mathematik, eingerichtet. Seitdem haben etwa 700 Schülerinnen und Schüler neben ihrem Schulunterricht als Frühstudierende reguläre Lehrveranstaltungen an der Julius-Maximilians-Universität Würzburg besucht.

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Bei unserer Evaluation und Forschung sind wir auf Ihre Unterstützung als «u_anredeform2» «u_anrede2» angewiesen. Wir bitten Sie deshalb, an unserer **Nachbefragung zum Frühstudium** teilzunehmen; Ihren personalisierten Fragebogen können Sie unter folgendem Link aufrufen:

«code»

Hinweis: Leider konnten wir Sie unter der E-Mail-Adresse «u_email» nicht mehr erreichen. Bitte geben Sie deshalb den Link von Hand in die Adressleiste Ihres Browsers ein. Alternativ können Sie Ihren personalisierten Fragebogen auch über folgenden QR-Code aufrufen:

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Die Bearbeitung der Nachbefragung wird **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Ihre Angaben unterliegen den Bestimmungen der **europäischen Datenschutz-Grundverordnung (DSGVO)** und werden ausschließlich für Forschungszwecke bzw. zur kontinuierlichen Evaluation des Frühstudiums erhoben. Die Verarbeitung Ihrer Daten erfolgt anonym.

Als kleines Dankeschön verlosen wir unter allen Teilnehmerinnen und Teilnehmern **Gutscheine der CTS EVENTIM AG & Co. KGaA im Gesamtwert von 100 Euro**.

Bei Fragen können Sie uns gerne kontaktieren.

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter
Direktor der Begabungspsychologischen Beratungsstelle

Lorena Fleischmann, M.Sc.
Wissenschaftliche Mitarbeiterin

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Postal Invitation/Reminder to the Follow-Up (7th Week of Data Collection)

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Begabungspsychologische Beratungsstelle
Direktor: Prof. Dr. Tobias Richter

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Begabungspsychologische Beratungsstelle
Röntgenring 10
97070 Würzburg
Telefon: 0931/31-86023
E-Mail: begabungsberatungsstelle@uni-wuerzburg.de

«Adresse»

Würzburg, 02. Dezember 2019

Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg

«Anrede»

das Frühstudium an der Julius-Maximilians-Universität Würzburg blickt mittlerweile auf **15 erfolgreiche Jahre** zurück. Als Instrument der Begabtenförderung wurde es zum Wintersemester 2004/2005 auf Initiative von Herrn Prof. Dr. Wolfgang Schneider, dem ehemaligen Direktor der Begabungspsychologischen Beratungsstelle, und Herrn Dr. Richard Greiner, dem Geschäftsführer des Instituts für Mathematik, eingerichtet. Seitdem haben etwa 700 Schülerinnen und Schüler neben ihrem Schulunterricht als Frühstudierende reguläre Lehrveranstaltungen an der Julius-Maximilians-Universität Würzburg besucht.

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Bei unserer Evaluation und Forschung sind wir auf Ihre Unterstützung als «u_anredeform2» «u_anrede2» angewiesen. Wir bitten Sie deshalb, an unserer **Nachbefragung zum Frühstudium** teilzunehmen; Ihren personalisierten Fragebogen können Sie unter folgendem Link aufrufen:

«code»

Hinweis: Leider konnten wir Sie unter der E-Mail-Adresse «u_email» nicht mehr erreichen. Bitte geben Sie deshalb den Link von Hand in die Adressleiste Ihres Browsers ein. Alternativ können Sie Ihren personalisierten Fragebogen auch über folgenden QR-Code aufrufen:

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Die Bearbeitung der Nachbefragung wird **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Ihre Angaben unterliegen den Bestimmungen der **europäischen Datenschutz-Grundverordnung (DSGVO)** und werden ausschließlich für Forschungszwecke bzw. zur kontinuierlichen Evaluation des Frühstudiums erhoben. Die Verarbeitung Ihrer Daten erfolgt anonym.

Als kleines Dankeschön verlosen wir unter allen Teilnehmerinnen und Teilnehmern **Gutscheine der CTS EVENTIM AG & Co. KGaA im Gesamtwert von 100 Euro**.

Bei Fragen können Sie uns gerne kontaktieren.

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter
Direktor der Begabungspsychologischen Beratungsstelle

Lorena Fleischmann, M.Sc.
Wissenschaftliche Mitarbeiterin

Follow-Up Questionnaire

Julius-Maximilians-
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WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Liebe ehemalige Frühstudierende, lieber ehemaliger Frühstudierender,

vielen Dank, dass Sie sich Zeit nehmen, um an unserer Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg teilzunehmen.

Die Nachbefragung stellt Ihre **akademische und berufliche Entwicklung** in den Mittelpunkt. Ihnen werden zunächst einige Fragen zu Ihren Tätigkeiten seit Ihrem Abitur gestellt (z.B. Berufsausbildung, Studium, Promotion, Habilitation, Berufstätigkeit). Anschließend möchten wir Sie bitten, auf Ihr Frühstudium zurückzublicken und vor dem Hintergrund Ihrer Tätigkeiten zu beurteilen. Beispielsweise möchten wir von Ihnen wissen, welche Erfahrungen aus dem Frühstudium aus Ihrer heutigen Sicht für Ihre weitere akademische und berufliche Entwicklung am wichtigsten waren. Das Ende der Nachbefragung beschäftigt sich schließlich mit Ihrer Persönlichkeit. Dabei werden Sie aufgefordert, Ihre Person in Bezug auf eine Reihe von Aussagen einzuschätzen.

Die Bearbeitung der Nachbefragung wird insgesamt **ca. 10 bis 15 Minuten** in Anspruch nehmen.

Nochmals vielen Dank für Ihre Unterstützung!

Mit freundlichen Grüßen

Prof. Dr. Tobias Richter	Lorena Fleischmann, M.Sc.
Direktor der Begabungspsychologischen Beratungsstelle	Wissenschaftliche Mitarbeiterin

---

Ihre Angaben unterliegen den Bestimmungen der europäischen Datenschutz-Grundverordnung (DSGVO). Gemäß Art. 13 Abs. 1 erhalten Sie folgende datenschutzrechtliche Hinweise:

Verantwortlich für die Datenerhebung ist die Universität Würzburg, Sanderring 2, 97070 Würzburg (E-Mail: info@uni-wuerzburg.de). Bei datenschutzrechtlichen Fragen können Sie sich an den behördlichen Datenschutzbeauftragten der Universität Würzburg, Sanderring 2, 97070 Würzburg (E-Mail: datenschutz@uni-wuerzburg.de) wenden.

Die Datenerhebung erfolgt zu Forschungszwecken bzw. zur kontinuierlichen Evaluation des Frühstudiums. Die Datenverarbeitung erfolgt anonym.

Ihre Daten werden längstens für einen Zeitraum von 10 Jahren gespeichert. Eine Übermittlung Ihrer Daten an Dritte findet nicht statt.

Ihre weiteren Rechte gemäß DSGVO, insbesondere Ihr Recht auf Auskunft, Berechtigung und Löschung gemäß Art. 5 bis 21, können Sie unter folgendem Link einsehen:

htttps://www.uni-wuerzburg.de/universitaet/datenschutzbeauftragter

2% WEITER

Julius-Maximilians-
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WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Bevor Sie mit der Nachbefragung starten, möchten wir Sie um eine Einschätzung Ihrer **allgemeinen Lebenszufriedenheit** bitten.

Wie zufrieden sind Sie derzeit mit Ihrem Leben?

Bitte geben Sie an, inwieweit Sie derzeit alles in allem mit Ihrem Leben zufrieden sind.

überhaupt nicht zufrieden	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

4% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Nun können Sie mit der Nachbefragung starten. Bitte machen Sie zu Beginn Angaben zu Ihrem **Abitur**.

In welchem Jahr haben Sie Ihr Abitur absolviert?

Bitte geben Sie das Kalenderjahr an, in dem Sie Ihre Abiturprüfung abgelegt haben.

Bitte wählen

Mit welcher Durchschnittsnote haben Sie Ihr Abitur absolviert?

Bitte geben Sie die Durchschnittsnote an, die auf Ihrem Abiturzeugnis vermerkt ist.

Bitte wählen

7% WEITER

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WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

In welchen Fächern haben Sie Ihre Abiturprüfung abgelegt?

Bitte geben Sie alle Fächer an, in denen Sie Ihre Abiturprüfung abgelegt haben.

- ☐ Biologie
- ☐ Chemie
- ☐ Deutsch
- ☐ Englisch
- ☐ Erdkunde
- ☐ Französisch
- ☐ Geschichte
- ☐ Kunst/Bildende Kunst
- ☐ Latein
- ☐ Mathematik
- ☐ Musik
- ☐ Physik
- ☐ Religionslehre/Ethik
- ☐ Sozialkunde/Gemeinschaftskunde
- ☐ Sport
- ☐ Wirtschaft/Wirtschaft und Recht
- ☐ Sonstiges

9% WEITER

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Mit welchen Punktzahlen haben Sie Ihre Abiturprüfung abgelegt?

Bitte geben Sie für jedes Fach an, welche Punktzahl Sie in der Abiturprüfung erreicht haben.

Falls Ihre Abiturprüfung nicht mit Punktzahlen sondern mit Noten bewertet wurde, rechnen Sie Ihre Noten bitte folgendermaßen um: 1,0 - 1,1 = 15 Punkte; 1,2 - 1,5 = 14 Punkte; 1,6 - 1,8 = 13 Punkte; 1,9 - 2,1 = 12 Punkte; 2,2 - 2,5 = 11 Punkte; 2,6 - 2,8 = 10 Punkte; 2,9 - 3,1 = 9 Punkte; 3,2 - 3,5 = 8 Punkte; 3,6 - 3,8 = 7 Punkte; 3,9 - 4,1 = 6 Punkte; 4,2 - 4,5 = 5 Punkte; 4,6 - 4,8 = 4 Punkte; 4,9 - 5,1 = 3 Punkte; 5,2 - 5,5 = 2 Punkte; 5,6 - 6,0 = 1 Punkt.

	Punktzahl in Abiturprüfung
Englisch	Bitte wählen
Erdkunde	Bitte wählen
Latein	Bitte wählen
Mathematik	Bitte wählen

Wie zufrieden waren Sie mit Ihren Abiturleistungen?

Bitte geben Sie an, inwieweit Sie alles in allem mit Ihren Abiturleistungen zufrieden waren.

überhaupt nicht zufrieden	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

11% WEITER

Julius-Maximilians-
UNIVERSITÄT
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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Im Folgenden würden wir Sie gerne zu Ihren Tätigkeiten seit Ihrem Abitur befragen. Dazu präsentieren wir Ihnen einen Zeitstrahl, der alle Kalenderjahre seit Ihrem Abitur umfasst. Sie sollen für jedes Kalenderjahr angeben, welcher Tätigkeit Sie **überwiegend** nachgegangen sind.

Falls Sie beispielsweise Ihr **Abitur** im Kalenderjahr **2010** absolviert haben, anschließend für ein Jahr einen **Freiwilligendienst** geleistet haben und dann ins **Studium** eingestiegen sind, könnte Ihr Zeitstrahl folgendermaßen aussehen:

	überwiegende Tätigkeit
2011	Freiwilligendienst
2012	Studium
2013	Studium
2014	Studium
2015	Studium
2016	Studium
2017	Berufstätigkeit
2018	Berufstätigkeit
heute	Berufstätigkeit

Welchen Tätigkeiten sind Sie seit Ihrem Abitur überwiegend nachgegangen?

Bitte geben Sie für jedes Kalenderjahr die Tätigkeit an, der Sie überwiegend nachgegangen sind.

	überwiegende Tätigkeit
2012	Bitte wählen
2013	Bitte wählen
2014	Bitte wählen
2015	Bitte wählen
2016	Bitte wählen
2017	Bitte wählen
2018	Bitte wählen
heute	Bitte wählen

Möchten Sie Ihren Zeitstrahl noch ergänzen?

Falls Ihnen Ihr Zeitstrahl unvollständig erscheint, geben Sie bitte in wenigen Worten Ihre weiteren Tätigkeiten an (z.B. umfangreiche Berufstätigkeit während des Studiums).

13% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Sie haben auf Ihrem Zeitstrahl angegeben, dass Sie einen Ausbildungsberuf erlernt haben. Wir möchten Sie deshalb bitten, einige Fragen zu Ihrer **Berufsausbildung** zu beantworten. Unsere Fragen beziehen sich dabei auf Ihre gesamte Ausbildungszeit, d.h. auf alle Kalenderjahre, für die Sie die entsprechende Tätigkeit angegeben haben.

Welchen Ausbildungsberuf/welche Ausbildungsberufe haben Sie erlernt?

Bitte geben Sie die vollständige Bezeichnung Ihres Ausbildungsberufs/Ihrer Ausbildungsberufe an.

- ☐ Bankkaufmann/Bankkauffrau
- ☐ Fachinformatiker/Fachinformatikerin
- ☐ Industriekaufmann/Industriekauffrau
- ☐ Kaufmann/Kauffrau für Büromanagement
- ☐ Kaufmann/Kauffrau für Spedition und Logistikdienstleistung
- ☐ Kaufmann/Kauffrau für Versicherungen und Finanzen
- ☐ Kaufmann/Kauffrau im Einzelhandel
- ☐ Kaufmann/Kauffrau im Groß- und Außenhandel
- ☐ Mechatroniker/Mechatronikerin
- ☐ Steuerfachangestellter/Steuerfachangestellte
- ☐ Sonstiges

18% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Haben Sie Ihre Berufsausbildung/Ihre Berufsausbildungen abgeschlossen?

Bitte geben Sie für jede Berufsausbildung an, ob Sie diese abgeschlossen haben, und nennen Sie ggf. die Durchschnittsnote Ihrer Abschlussprüfung.

	Abschluss	Durchschnittsnote in Abschlussprüfung
Bankkaufmann/Bankkauffrau	Bitte wählen	Bitte wählen

Wie zufrieden waren Sie mit Ihren Ausbildungsleistungen?

Bitte geben Sie an, inwieweit Sie alles in allem mit Ihren Ausbildungsleistungen zufrieden waren.

überhaupt nicht zufried en	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

20%

WEITER

Julius-Maximilians-
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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Sie haben auf Ihrem Zeitstrahl angegeben, dass Sie studiert haben. Wir möchten Sie deshalb bitten, einige Fragen zu Ihrem **Studium** zu beantworten. Unsere Fragen beziehen sich dabei auf Ihre gesamte Studienzeit, d.h. auf alle Kalenderjahre, für die Sie die entsprechende Tätigkeit angegeben haben.

Welches Fach/welche Fächer haben Sie studiert?

Bitte geben Sie alle Fächer an, für die Sie regulär als Student/Studentin eingeschrieben waren.

- ☐ (Human-)Medizin
- ☐ Anglistik/Englisch
- ☐ Archäologie
- ☐ Betriebswirtschaftslehre
- ☐ Biologie
- ☐ Chemie
- ☐ Evangelische Theologie/Religionslehre
- ☐ Geografie/Erdkunde
- ☐ Germanistik/Deutsch
- ☐ Geschichte
- ☐ Informatik
- ☐ Katholische Theologie/Religionslehre
- ☐ Kunstgeschichte, Kunstwissenschaft
- ☐ Mathematik
- ☐ Philosophie
- ☐ Physik
- ☐ Politikwissenschaft/Politologie
- ☐ Psychologie
- ☐ Wirtschaftsinformatik
- ☐ Wirtschaftswissenschaften
- ☐ Sonstiges

22% WEITER

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Haben Sie Ihr Studium abgeschlossen?

Bitte geben Sie für jedes Fach an, ob Sie Ihr Studium abgeschlossen haben, und nennen Sie ggf. Ihren höchsten Abschluss und Ihre Abschlussnote.

Falls Sie Rechtswissenschaft studiert haben und Ihre Studienleistungen nicht mit Noten sondern mit Punktzahlen bewertet wurden, rechnen Sie Ihre Punktzahlen bitte folgendermaßen um: 18 Punkte - 16 Punkte = 1,0; 15 Punkte - 14 Punkte = 1,3; 13 Punkte - 12 Punkte = 1,7; 11 Punkte - 10 Punkte = 2,0; 9 Punkte = 2,3; 8 Punkte = 2,7; 7 Punkte = 3,0; 6 Punkte = 3,3; 5 Punkte = 3,7; 4 Punkte = 4,0.

	Abschluss	Abschlussnote
Psychologie	Bitte wählen	Bitte wählen

Wie zufrieden waren Sie mit Ihren Studienleistungen?

Bitte geben Sie an, inwieweit Sie alles in allem mit Ihren Studienleistungen zufrieden waren.

überhaupt nicht zufried en	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

24%

WEITER

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Wie viele Semester haben Sie studiert?

Bitte geben Sie für jedes Fach die Gesamtzahl der Semester an, für die Sie regulär als Student/Studentin eingeschrieben waren.

	Gesamtzahl Semester
Psychologie	Bitte wählen

Wo haben Sie studiert?

Bitte geben Sie die vollständigen Namen aller Hochschulen/Universitäten an, an denen Sie regulär als Student/Studentin eingeschrieben waren.

Haben Sie im Rahmen Ihres Studiums einen Auslandsaufenthalt absolviert?

Bitte geben Sie an, ob Sie im Rahmen Ihres Studiums einen Auslandsaufenthalt absolviert haben, und nennen Sie ggf. das Land/die Länder Ihres Aufenthalts.

○ Ja, ich habe einen Auslandsaufenthalt in folgendem Land/folgenden Ländern absolviert:

○ Nein, ich habe keinen Auslandsaufenthalt absolviert.

27% WEITER

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Haben Sie während Ihres Studiums ein Stipendium erhalten?

Bitte geben Sie an, ob Sie während Ihres Studiums eine finanzielle/ideelle Förderung erhalten haben, und nennen Sie ggf. den Namen Ihres Förderprogramms.

◯ Ja, ich habe während meines Studiums folgendes Stipendium erhalten:

◯ Nein, ich habe während meines Studiums kein Stipendium erhalten.

Haben Sie während Ihres Studiums sonstige Auszeichnungen/Preise erhalten?

Bitte geben Sie an, ob Sie während Ihres Studiums sonstige Auszeichnungen/Preise (z.B. Preise für Abschlussarbeiten) erhalten haben.

◯ Ja, ich habe während meines Studiums folgende Auszeichnungen/Preise erhalten:

◯ Nein, ich habe während meines Studiums keine weiteren Auszeichnungen/Preise erhalten.

Haben Sie während Ihres Studiums wissenschaftliche Publikationen veröffentlicht?

Bitte geben Sie an, ob Sie während Ihres Studiums wissenschaftliche Publikationen veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Publikationen.

◯ Ja, ich habe während meines Studiums folgende Anzahl wissenschaftlicher Publikationen veröffentlicht:

◯ Nein, ich habe während meines Studiums keine wissenschaftlichen Publikationen veröffentlicht.

Haben Sie während Ihres Studiums wissenschaftliche Patente veröffentlicht?

Bitte geben Sie an, ob Sie während Ihres Studiums wissenschaftliche Patente veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Patente.

◯ Ja, ich habe während meines Studiums folgende Anzahl wissenschaftlicher Patente veröffentlicht:

◯ Nein, ich habe während meines Studiums keine wissenschaftlichen Patente veröffentlicht.

Wie viel Zeit haben Sie wöchentlich in Ihr Studium investiert?

Bitte schätzen Sie ein, wie viel Zeit (in Stunden/Woche) Sie während der Vorlesungszeit durchschnittlich in Ihr Studium investiert haben.

29% WEITER

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BERATUNGSSTELLE WÜRZBURG

Sie haben auf Ihrem Zeitstrahl angegeben, dass Sie promoviert haben. Wir möchten Sie deshalb bitten, einige Fragen zu Ihrer **Promotion** zu beantworten. Unsere Fragen beziehen sich dabei auf Ihre gesamte Promotionszeit, d.h. auf alle Kalenderjahre, für die Sie die entsprechende Tätigkeit angegeben haben.

In welchem Fach/welchen Fächern haben Sie promoviert?

Bitte geben Sie alle Fächer an, in denen Sie eine Promotion angestrebt haben.

- ☐ (Human-)Medizin
- ☐ Anglistik/Englisch
- ☐ Archäologie
- ☐ Betriebswirtschaftslehre
- ☐ Biologie
- ☐ Chemie
- ☐ Evangelische Theologie/Religionslehre
- ☐ Geografie/Erdkunde
- ☐ Germanistik/Deutsch
- ☐ Geschichte
- ☐ Informatik
- ☐ Katholische Theologie/Religionslehre
- ☐ Kunstgeschichte, Kunstwissenschaft
- ☐ Mathematik
- ☐ Philosophie
- ☐ Physik
- ☐ Politikwissenschaft/Politologie
- ☐ Psychologie
- ☐ Wirtschaftsinformatik
- ☐ Wirtschaftswissenschaften
- ☐ Sonstiges

31% WEITER

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BERATUNGSSTELLE WÜRZBURG

Haben Sie Ihre Promotion abgeschlossen?

Bitte geben Sie für jedes Fach an, ob Sie Ihre Promotion abgeschlossen haben, und nennen Sie ggf. Ihre Abschlussnote.

	Abschluss	Abschlussnote
Psychologie	Bitte wählen	Bitte wählen

Wie zufrieden waren Sie mit Ihren Promotionsleistungen?

Bitte geben Sie an, inwieweit Sie <u>alles in allem</u> mit Ihren Promotionsleistungen zufrieden waren.

überhaupt nicht zufried en	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

33%

WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Wie viele Semester haben Sie promoviert?

Bitte geben Sie für jedes Fach die Gesamtzahl der Semester an, die Sie an Ihrer Promotion gearbeitet haben.

	Gesamtzahl Semester
Psychologie	Bitte wählen

Wo haben Sie promoviert?

Bitte geben Sie die vollständigen Namen aller Hochschulen/Universitäten an, an denen Sie promoviert haben.

Sind Sie neben Ihrer Promotion einer beruflichen Tätigkeit nachgegangen?

Bitte geben Sie an, ob Sie neben Ihrer Promotion beruflich tätig waren, und nennen Sie ggf. die vollständige Bezeichnung Ihrer Berufstätigkeit (z.B. wissenschaftlicher Mitarbeiter/wissenschaftliche Mitarbeiterin).

- ○ Ja, ich bin neben meiner Promotion folgender Berufstätigkeit nachgegangen:
- ○ Nein, ich bin neben meiner Promotion keiner beruflichen Tätigkeit nachgegangen.

36% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Haben Sie während Ihrer Promotion ein Stipendium erhalten?

Bitte geben Sie an, ob Sie während Ihrer Promotion eine finanzielle/ideelle Förderung erhalten haben, und nennen Sie ggf. den Namen Ihres Förderprogramms.

○ Ja, ich habe während meiner Promotion folgendes Stipendium erhalten:

○ Nein, ich habe während meiner Promotion kein Stipendium erhalten.

Haben Sie während Ihrer Promotion sonstige Auszeichnungen/Preise erhalten?

Bitte geben Sie an, ob Sie während Ihrer Promotion sonstige Auszeichnungen/Preise (z.B. Nachwuchspreise) erhalten haben.

○ Ja, ich habe während meiner Promotion folgende Auszeichnungen/Preise erhalten:

○ Nein, ich habe während meiner Promotion keine weiteren Auszeichnungen/Preise erhalten.

Haben Sie während Ihrer Promotion wissenschaftliche Publikationen veröffentlicht?

Bitte geben Sie an, ob Sie während Ihrer Promotion wissenschaftliche Publikationen veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Publikationen.

○ Ja, ich habe während meiner Promotion folgende Anzahl wissenschaftlicher Publikationen veröffentlicht:

○ Nein, ich habe während meiner Promotion keine wissenschaftlichen Publikationen veröffentlicht.

Haben Sie während Ihrer Promotion wissenschaftliche Patente veröffentlicht?

Bitte geben Sie an, ob Sie während Ihrer Promotion wissenschaftliche Patente veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Patente.

○ Ja, ich habe während meiner Promotion folgende Anzahl wissenschaftlicher Patente veröffentlicht:

○ Nein, ich habe während meiner Promotion keine wissenschaftlichen Patente veröffentlicht.

Wie viel Zeit haben Sie wöchentlich in Ihre Promotion investiert?

Bitte schätzen Sie ein, wie viel Zeit (in Stunden/Woche) Sie durchschnittlich in Ihre Promotion investiert haben.

38% WEITER

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Sie haben auf Ihrem Zeitstrahl angegeben, dass Sie habilitiert haben. Wir möchten Sie deshalb bitten, einige Fragen zu Ihrer **Habilitation** zu beantworten. Unsere Fragen beziehen sich dabei auf Ihre gesamte Habilitationszeit, d.h. auf alle Kalenderjahre, für die Sie die entsprechende Tätigkeit angegeben haben.

Über welches Thema haben Sie habilitiert?

Bitte beschreiben Sie das Thema, über das Sie habilitiert haben, in wenigen Worten.

40% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Haben Sie Ihre Habilitation abgeschlossen?

- ◯ Ja, ich habe meine Habilitation abgeschlossen.
- ◯ Nein, ich habe meine Habilitation nicht abgeschlossen.

Wie zufrieden waren Sie mit Ihren Habilitationsleistungen?

Bitte geben Sie an, inwieweit Sie alles in allem mit Ihren Habilitationsleistungen zufrieden waren.

überhaupt nicht zufrieden	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
◯	◯	◯	◯	◯

42% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Wie viele Semester haben Sie habilitiert?

Bitte geben Sie die Gesamtzahl der Semester an, die Sie an Ihrer Habilitation gearbeitet haben.

Bitte wählen

Wo haben Sie habilitiert?

Bitte geben Sie die vollständigen Namen aller Hochschulen/Universitäten an, an denen Sie habilitiert haben.

Sind Sie neben Ihrer Habilitation einer beruflichen Tätigkeit nachgegangen?

Bitte geben Sie an, ob Sie neben Ihrer Habilitation beruflich tätig waren, und nennen Sie ggf. die vollständige Bezeichnung Ihrer Berufstätigkeit (z.B. wissenschaftlicher Mitarbeiter/wissenschaftliche Mitarbeiterin).

○ Ja, ich bin neben meiner Habilitation folgender Berufstätigkeit nachgegangen:

○ Nein, ich bin neben meiner Habilitation keiner beruflichen Tätigkeit nachgegangen.

44%

WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Haben Sie während Ihrer Habilitation eigenständig Drittmittel eingeworben?

Bitte geben Sie an, ob Sie während Ihrer Habilitation eigenständig Drittmittel eingeworben haben, und nennen Sie ggf. die Höhe Ihrer eingeworbenen Drittmittel.

◯ Ja, ich habe während meiner Habilitation eigenständig Drittmittel in folgender Höhe eingeworben:

◯ Nein, ich habe während meiner Habilitation eigenständig keine Drittmittel eingeworben.

Haben Sie während Ihrer Habilitation sonstige Auszeichnungen/Preise erhalten?

Bitte geben Sie an, ob Sie während Ihrer Habilitation sonstige Auszeichnungen/Preise (z.B. Forschungspreise) erhalten haben.

◯ Ja, ich habe während meiner Habilitation folgende Auszeichnungen/Preise erhalten:

◯ Nein, ich habe während meiner Habilitation keine weiteren Auszeichnungen/Preise erhalten.

Haben Sie während Ihrer Habilitation wissenschaftliche Publikationen veröffentlicht?

Bitte geben Sie an, ob Sie während Ihrer Habilitation wissenschaftliche Publikationen veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Publikationen.

◯ Ja, ich habe während meiner Habilitation folgende Anzahl wissenschaftlicher Publikationen veröffentlicht:

◯ Nein, ich habe während meiner Habilitation keine wissenschaftlichen Publikationen veröffentlicht.

Haben Sie während Ihrer Habilitation wissenschaftliche Patente veröffentlicht?

Bitte geben Sie an, ob Sie während Ihrer Habilitation wissenschaftliche Patente veröffentlicht haben, und nennen Sie ggf. die Anzahl Ihrer Patente.

◯ Ja, ich habe während meiner Habilitation folgende Anzahl wissenschaftlicher Patente veröffentlicht:

◯ Nein, ich habe während meiner Habilitation keine wissenschaftlichen Patente veröffentlicht.

Wie viel Zeit haben Sie wöchentlich in Ihre Habilitation investiert?

Bitte schätzen Sie ein, wie viel Zeit (in Stunden/Woche) Sie durchschnittlich in Ihre Habilitation investiert haben.

47% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Sie haben auf Ihrem Zeitstrahl angegeben, dass Sie derzeit beruflich tätig sind. Wir möchten Sie deshalb bitten, einige Fragen zu Ihrer **Berufstätigkeit** zu beantworten.

Welcher Berufstätigkeit gehen Sie derzeit nach?

Bitte geben Sie die vollständige Bezeichnung der beruflichen Tätigkeit an, der Sie derzeit nachgehen.

Welche Aussage trifft/Aussagen treffen derzeit auf Ihre Berufstätigkeit zu?

Falls derzeit keine Aussage auf Ihre Berufstätigkeit zutrifft, lassen Sie die Frage bitte unbeantwortet.

☐ Ich bin im Rahmen meiner Berufstätigkeit berechtigt, Aufgaben (z.B. an Auszubildende, Praktikanten/Praktikantinnen oder studentische/wissenschaftliche Hilfskräfte) zu delegieren.

☐ Ich habe im Rahmen meiner Berufstätigkeit eine dauerhafte Leitungsfunktion (z.B. gegenüber einer Arbeitsgruppe oder Ar beitseinheit) inne.

☐ Ich bin im Rahmen meiner Berufstätigkeit offizielle Vorgesetzte/offizieller Vorgesetzter für andere Personen (z.B. Personen mit abgeschlossener Berufsausbildung oder Personen mit (Fach-)Hochschulabschluss).

Wie hoch ist derzeit Ihr monatliches Bruttoeinkommen?

Bitte geben Sie näherungsweise an, wie hoch derzeit Ihr monatliches Bruttoeinkommen ist.

Bitte wählen

Wie viel Zeit investieren Sie derzeit wöchentlich in Ihre Berufstätigkeit?

Bitte geben Sie Ihre vertragliche Arbeitszeit und eine Einschätzung Ihrer tatsächlichen Arbeitszeit in Stunden/Woche an.

vertragliche Arbeitszeit

tatsächliche Arbeitszeit

Promovieren Sie derzeit neben Ihrer Berufstätigkeit?

Bitte geben Sie an, ob Sie derzeit neben Ihrer Berufstätigkeit promovieren, und nennen Sie ggf. das Fach/die Fächer, in dem/denen Sie eine Promotion anstreben.

○ Ja, ich promoviere derzeit neben meiner Berufstätigkeit in folgendem Fach/folgenden Fächern:

○ Nein, ich promoviere derzeit nicht neben meiner Berufstätigkeit.

Habilitieren Sie derzeit neben Ihrer Berufstätigkeit?

Bitte geben Sie an, ob Sie derzeit neben Ihrer Berufstätigkeit habilitieren, und nennen Sie ggf. das Thema, über das Sie Ihre Habilitation verfassen.

○ Ja, habilitiere derzeit neben meiner Berufstätigkeit über folgendes Thema:

○ Nein, ich habilitiere derzeit nicht neben meiner Berufstätigkeit.

Wie zufrieden sind Sie derzeit mit Ihrer Berufstätigkeit?

Bitte geben Sie an, inwieweit Sie derzeit alles in allem mit Ihrer beruflichen Tätigkeit zufrieden sind.

überhaupt nicht zufrieden	eher nicht zufrieden	weder noch	eher zufrieden	voll und ganz zufrieden
○	○	○	○	○

Welche Ziele haben Sie für Ihre berufliche Zukunft?

Bitte beschreiben Sie in wenigen Worten, welche Ziele Sie sich für Ihre berufliche Zukunft gesetzt haben (z.B. in Bezug auf Berufstätigkeit, Einkommen oder Position).

78% WEITER

Vor dem Hintergrund Ihrer akademischen und beruflichen Entwicklung möchten wir Sie nun bitten, auf Ihr **Frühstudium** zurückzublicken und einige Fragen zu beantworten.

Würden Sie aus Ihrer heutigen Sicht wieder am Frühstudium teilnehmen?

Bitte geben Sie an, ob Sie aus Ihrer heutigen Sicht wieder am Frühstudium der Julius-Maximilians-Universität Würzburg teilnehmen würden.

nein, auf keinen Fall	eher nein	weder noch	eher ja	ja, auf jeden Fall
○	○	○	○	○

80% WEITER

Julius-Maximilians-
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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Welche Erfahrungen aus Ihrem Frühstudium waren für Ihre weitere akademische Entwicklung am wichtigsten?

Bitte geben Sie alle Erfahrungen an, die für Ihre weitere akademische Entwicklung besonders wichtig waren.

- ☐ Kennenlernen des Studienalltags
- ☐ Einblick in universitäre Strukturen
- ☐ Übernahme von Eigenverantwortung
- ☐ Aneignung von Wissen
- ☐ Aneignung allgemeiner Lernstrategien
- ☐ Einblick in gewähltes Studienfach
- ☐ Kennenlernen eigener Belastbarkeitsgrenzen
- ☐ Sonstiges ______

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Aufgrund meiner Erfahrungen im Frühstudium habe ich mir einen späteren Studienfachwechsel erspart.	○	○	○	○	○
Mit meinem Frühstudium habe ich wichtige Weichen für meine weitere akademische Entwicklung gestellt.	○	○	○	○	○

82% WEITER

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BERATUNGSSTELLE WÜRZBURG

Welche Erfahrungen aus Ihrem Frühstudium waren für Ihre weitere beruﬂiche Entwicklung am wichtigsten?

Bitte beschreiben Sie in wenigen Worten alle Erfahrungen, die für Ihre weitere beruﬂiche Entwicklung besonders wichtig waren.

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Aufgrund meines Frühstudiums bin ich heute weiter in meiner beruflichen Entwicklung als meine ehemaligen Mitschülerinnen und Mitschüler.	○	○	○	○	○
Mit meinem Frühstudium habe ich wichtige Weichen für meine spätere berufliche Entwicklung gestellt.	○	○	○	○	○

84%

WEITER

Neben Ihrer heutigen Sicht auf Ihr Frühstudium interessieren uns im Folgenden auch **allgemeine Angaben zu Ihrer Person.**

Welchen Familienstand haben Sie derzeit?

Bitte geben Sie an, welchen Familienstand Sie derzeit haben.

- ○ ledig
- ○ verheiratet
- ○ eingetragene Lebenspartnerschaft
- ○ geschieden
- ○ getrennt lebend
- ○ verwitwet

Wie viele Kinder haben Sie derzeit?

Bitte geben Sie an, wie viele Kinder Sie haben.

- ○ Ich habe keine Kinder.
- ○ Ich habe ein Kind.
- ○ Ich habe zwei Kinder.
- ○ Ich habe drei Kinder.
- ○ Ich habe mehr als drei Kinder.

Wie empfinden Sie derzeit die Gewichtung von Privatem und Beruflichem in Ihrem Leben?

Bitte geben Sie an, wie Sie derzeit in Ihrem Leben die Gewichtung von Privatem und Beruflichem empfinden, indem Sie den Regler in die Nähe des entsprechenden Pols auf der Skala verschieben.

Privates Berufliches

87% WEITER

Am Ende der Nachbefragung möchten wir Sie noch um eine **Einschätzung Ihrer Person** in Bezug auf eine Reihe von Aussagen bitten; sie sollen für jede Aussage entscheiden, inwieweit diese auf Sie zutrifft. Zur Einschätzung der Aussagen steht Ihnen eine 5-stufige Skala von "trifft überhaupt nicht zu" bis "trifft voll und ganz zu" zur Verfügung.

Bitte lesen Sie alle Aussagen aufmerksam durch und antworten Sie spontan.

89% WEITER

Julius-Maximilians-
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WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Bevor ich reagiere, denke ich ausführlich über ein Problem nach.	○	○	○	○	○
Bevor ich eine Entscheidung treffe, wäge ich die Vor- und Nachteile von Situationen explizit ab.	○	○	○	○	○
Bevor ich zu einer Schlussfolgerung komme, suche ich nach verschiedenen Standpunkten.	○	○	○	○	○
Ich stimme den Grad meiner Überzeugung auf die Stichhaltigkeit der verfügbaren Evidenz ab.	○	○	○	○	○
Bevor ich Maßnahmen ergreife, denke ich über zukünftige Folgen nach.	○	○	○	○	○
Ich suche nach kleinsten Unterschieden und vermeide verabsolutierende Sichtweisen.	○	○	○	○	○
Bevor ich mich entscheide, sammle ich Informationen.	○	○	○	○	○

96% WEITER

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Ich kann komplexe Probleme bewältigen.	○	○	○	○	○
Ich habe ausgezeichnete Ideen.	○	○	○	○	○
Ich gehe wenige Dinge von selbst an.	○	○	○	○	○
Ich lasse andere Entscheidungen für mich treffen.	○	○	○	○	○
Ich denke schnell.	○	○	○	○	○
Ich habe kein gutes Vorstellungsvermögen.	○	○	○	○	○
Ich hinterfrage Dinge nie.	○	○	○	○	○
Ich drücke Gedanken klar aus.	○	○	○	○	○
Ich verstehe Dinge schnell.	○	○	○	○	○
Ich lasse mir von anderen Vorschriften machen.	○	○	○	○	○

96% WEITER

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Ich bin eher zurückhaltend, reserviert.	○	○	○	○	○
Ich schenke anderen leicht Vertrauen, glaube an das Gute im Menschen.	○	○	○	○	○
Ich bin bequem, neige zur Faulheit.	○	○	○	○	○
Ich bin entspannt, lasse mich durch Stress nicht aus der Ruhe bringen.	○	○	○	○	○
Ich habe nur wenig künstlerisches Interesse.	○	○	○	○	○
Ich gehe aus mir heraus, bin gesellig.	○	○	○	○	○
Ich neige dazu, andere zu kritisieren.	○	○	○	○	○
Ich erledige Aufgaben gründlich.	○	○	○	○	○
Ich werde leicht nervös und unsicher.	○	○	○	○	○
Ich habe eine aktive Vorstellungskraft, bin fantasievoll.	○	○	○	○	○

96% WEITER

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BEGABUNGSPSYCHOLOGISCHE
BERATUNGSSTELLE WÜRZBURG

Inwieweit treffen folgende Aussagen auf Sie zu?

Bitte entscheiden Sie für jede Aussage, inwieweit diese auf Sie zutrifft.

	trifft überhaupt nicht zu	trifft eher nicht zu	weder noch	trifft eher zu	trifft voll und ganz zu
Ich überprüfe gerne Texte oder Rechnungen auf Fehler.	○	○	○	○	○
Es bereitet mir Freude, die psychologische Entwicklung des Menschen zu verstehen.	○	○	○	○	○
Es macht mir Spaß, mich mit technischen Entwicklungen auseinanderzusetzen.	○	○	○	○	○
Ich übernehme gerne die Verantwortung für eine Arbeitsgruppe.	○	○	○	○	○
Es macht mir Spaß, meine künstlerischen Fähigkeiten zu perfektionieren.	○	○	○	○	○
Es bereitet mir Freude, Menschen mit Problemen nachhaltig zu helfen.	○	○	○	○	○
Wenn ein Gerät kaputtgeht, suche ich gerne nach der Ursache, um es zu reparieren.	○	○	○	○	○
Es macht mir Spaß, einen mathematischen Beweis zu führen.	○	○	○	○	○
Es bereitet mir Freude, selbstständig zu experimentieren.	○	○	○	○	○
Ich setze mich gerne mit der Wirkungsweise von Musik/Kunst/Theater auseinander.	○	○	○	○	○
Ich entwickle gerne erfolgreiche geschäftliche Strategien.	○	○	○	○	○
Es macht mir Spaß, Informationen in logische und systematische Abfolgen zu ordnen.	○	○	○	○	○

96% WEITER

Julius-Maximilians-UNIVERSITÄT WÜRZBURG

BEGABUNGSPSYCHOLOGISCHE BERATUNGSSTELLE WÜRZBURG

Die Nachbefragung ist nun beendet. Vielen Dank, dass Sie sich Zeit zur Bearbeitung genommen haben!

Falls Sie an den Ergebnissen der Nachbefragung interessiert sind, kontaktieren Sie uns gerne unter:
begabungsberatungsstelle@uni-wuerzburg.de

Wir wünschen Ihnen alles Gute und weiterhin viel Erfolg für Ihre Zukunft!

FENSTER SCHLIESSEN

100%

Cover Letter to the Winners/Recipients of the Vouchers

Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Begabungspsychologische Beratungsstelle
Direktor: Prof. Dr. Tobias Richter

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Begabungspsychologische Beratungsstelle
Röntgenring 10
97070 Würzburg
Telefon: 0931/31-86023
E-Mail: begabungsberatungsstelle@uni-wuerzburg.de

«Adresse»

Würzburg, 14. Juli 2020

Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg

«Anrede»

anbei erhalten Sie als kleines Dankeschön für Ihre Teilnahme an unserer Nachbefragung zum Frühstudium an der Julius-Maximilians-Universität Würzburg einen Gutschein der **CTS EVENTIM AG & Co. KGaA im Wert von 10 Euro.**

Aus verwaltungsrechtlichen Gründen möchten wir Sie bitten, uns den Erhalt des Gutscheins kurz zu bestätigen. Bitte schicken Sie dazu die beigelegte **Postkarte unterschrieben an uns zurück**.

Vielen Dank und freundliche Grüße

Prof. Dr. Tobias Richter
Direktor der Begabungspsychologischen Beratungsstelle

Lorena Fleischmann, M.Sc.
Wissenschaftliche Mitarbeiterin

Begabungspsychologische Beratungsstelle, Röntgenring 10, 97070 Würzburg

Voucher

GUTSCHEIN

WERT: 10 €

GUTSCHEINCODE:

Gültig bis 31.12.2023

Postcard

© Foto: Universität Würzburg

Hiermit bestätige ich, dass ich für meine Teilnahme an der **Nachbefragung zum Frühstudium** an der Julius-Maximilians-Universität Würzburg (Zeitraum: Oktober 2019 bis Februar 2020) einen **Gutschein der CTS EVENTIM AG & Co. KGaA im Wert von 10 Euro** erhalten habe.

ORT, DATUM

UNTERSCHRIFT

Begabungspsychologische Beratungsstelle

Röntgenring 10

97070 Würzburg

Appendix C: Selection Process Material

Protocol Sheet

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Begabungspsychologische Beratungsstelle – Auswahlverfahren Frühstudium

Protokollbogen Mentorengespräch

Datum des Gesprächs: ____________ Fachmentor: ____________ Fach: ____________

Name des Bewerbers: ______________________ Klasse: ________

Bitte geben Sie zusammenfassend nachfolgende Einschätzungen ab:

Ausmaß des fachspezifischen Vorwissens für Studienbeginn:

☐ sehr gering ☐ gering ☐ mittel ☐ hoch ☐ sehr hoch

☐ keine Einschätzung möglich weil: ______________________

Fachspezifische Begabung:

☐ sehr gering ☐ gering ☐ mittel ☐ hoch ☐ sehr hoch

☐ keine Einschätzung möglich

Motivation zum Frühstudium

☐ sehr gering ☐ gering ☐ mittel ☐ hoch ☐ sehr hoch

☐ keine Einschätzung möglich weil: ______________________

Vorstellungen/Erwartungen zu Studienfach:

☐ sehr diffus ☐ eher diffus ☐ mittel ☐ eher konkret ☐ sehr konkret

☐ sehr unrealistisch ☐ eher unrealistisch ☐ mittel ☐ eher realistisch ☐ sehr realistisch

☐ keine Einschätzung möglich weil: ______________________

Befürworten Sie die Aufnahme zum Frühstudium?

☐ ja ☐ nein ☐ mit Einschränkung: ______________________

Besonderheiten/Ergänzungen:

____
Unterschrift des Fachmentors

Appendix D: SEM

Table D1

Unstandardized SEM Results for Talent Development Levels and Their Associated Indicators

Indicator	*B*	*SE*	*z*	*p*	95 % CI
Aptitude					
Mentor prior knowledge	1.000				[1.000, 1.000]
Mentor talent	0.731	0.211	3.459	< .001	[0.317, 1.145]
Mentor motivation	0.353	0.247	1.427	.077	[-0.132, 0.837]
Competence					
Study grade [a]	1.000				[1.000, 1.000]
Scholarships [b]	0.391	0.558	0.701	.242	[-0.702, 1.484]
Study awards/prizes [b]	0.304	0.321	0.948	.172	[-0.324, 0.932]
Expertise					
Doctoral studies [b]	1.000				[1.000, 1.000]
Scientific publications	6.130	5.099	1.202	.115	[-3.863, 16.123]
Scientific awards/prizes [b]	0.224	0.201	1.114	.133	[-0.170, 0.618]

Note. n = 46. CI = confidence interval (two-tailed).

[a] reflected. [b] 0 = no, 1 = yes.

Table D2

Unstandardized Regression Results for Hypothesized Predictors on the Aptitude Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	0.008	0.076	0.101	.460	[-0.141, 0.157]
Cognitive abilities	-0.001	0.008	-0.105	.458	[-0.018, 0.016]
Openness	0.032	0.036	0.882	.189	[-0.039, 0.102]
Self-motivation	0.006	0.023	0.278	.391	[-0.039, 0.052]

Note. n = 59. CI = confidence interval (two-tailed).

Table D3

Unstandardized Regression Results for Hypothesized Predictors on the Competence Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	0.014	0.035	0.393	.347	[-0.055, 0.083]
Cognitive abilities	0.002	0.003	0.588	.278	[-0.004, 0.008]
Openness	0.010	0.018	0.537	.296	[-0.026, 0.046]
Self-motivation	0.007	0.009	0.705	.241	[-0.012, 0.025]
Conscientiousness	0.010	0.024	0.408	.342	[-0.037, 0.057]
Study time	0.001	0.003	0.552	.291	[-0.004, 0.006]
Investigative interests	0.041	0.016	2.584	.005	[0.010, 0.073]

Note. n = 59. CI = confidence interval (two-tailed).

Table D4

Unstandardized Regression Results for Hypothesized Predictors on the Expertise Level

Predictor	*B*	*SE*	*z*	*p*	95 % CI
(Constant)	0.036	0.043	0.836	.202	[-0.049, 0.122]
Conscientiousness	0.025	0.032	0.762	.223	[-0.039, 0.088]
Study time	-0.005	0.003	-1.309	.096	[-0.011, 0.002]
Investigative interests	0.087	0.024	3.661	< .001	[0.040, 0.134]
Self-regulation	-0.008	0.008	-0.963	.168	[-0.025, 0.008]
Metacognition	0.014	0.010	1.439	.075	[-0.005, 0.033]
Extraversion	-0.037	0.026	-1.430	.077	[-0.089, 0.014]

Note. n = 57. CI = confidence interval (two-tailed).